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RFID Facilitates Grain Storage in India

Topics/Verticals: Inventory/Warehouse Management, Transport, Logistics

Adani Grain Logistics deployed radio frequency identification to automate steps for receiving, testing and tracking food grain at its two main depots.

By Mary Catherine O'Connor

Apr. 19, 2010—Three years ago, the government of India instituted regulations for the storage of grain harvested and sold in that country. The rules are designed to ensure that only safe, clean grain is sold for food. The Food Corporation of India (FCI), an agency that oversees food grain procurement, storage and distribution operations, enforces the regulations. To comply with the rules, businesses that operate grain storage silos have established systems for testing grain samples, which are then stored in secure, climate-controlled silos until needed.

Adani Grain Logistics, which operates several grain storage facilities in India, has implemented an automated, RFID-based system for receiving, testing and tracking food grain harvested in the states of Haryana and Punjab. The system was tested in April 2007, and was deployed permanently three months later at two grain depots, located in the cities of Kaithal and Moga. Both depots are new, and are owned by FCI, which outsources their operation to Adani.

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A truck at the weighbridge

Large agricultural corporations and small local farmers bring grain products to the depots. When a truck driver delivering grain enters one of the facilities, he is directed to a testing station, where a sample of the grain is tested for several quality factors, such as humidity level, to determine for how long it can be stored safely. If the grain sample passes the quality tests, the driver is directed to a bay, where he dumps the load into a large receptacle that holds the grain until it is loaded into a silo. The driver is then directed to another area of the facility, to be paid before leaving.

The regulations require that food grain be stored in climate-controlled silos for no more than three years. The company can maintain the grain's quality once it is placed within the silos, through automated systems that periodically stir the grain and maintain optimal humidity levels. But Adani also wanted to automate the depot operations, to better control the type and quality of the grain placed into

the silos, as well as to quickly and accurately track the incoming loads of grain, linking the shipment information with its accounting system. "Adani wanted as much automation as possible," says Malay Nandy, who heads the IT department for Adani Agri-Vertical, part of the Adani Group corporate conglomerate.

Truck lanes with silos

Adani considered different technologies to help it track and test each load of grain brought to the facilities. "We thought about using GPS, bar codes, RFID and other signaling technologies," Nandy says, "but we decided that RFID was the best." A bar-code system, for instance, would have required too many manual steps, he says, because a driver would have had to carry shipping documents to each station and interact with a bar-code scanner numerous times. And GPS would not have provided sufficient granularity in tracking the trucks throughout the yard.

With the RFID system, Adani was able to meet all of its objectives for the tracking system, including tracking each truck at each station within the facility, automatically linking the unique ID number encoded to the tag given to each driver with the corresponding order information in Adani's billing software, and preventing vehicles from dumping grain into the wrong bays.

How It Works

Each depot has a large parking area in which drivers await their turn to enter the facility. At the main security gate, the driver provides an Adani employee with paperwork. The worker enters information from that paperwork—including the order number, the type of grain being delivered, and the truck and driver identifiers—into the Terminal Operations and Management System (TOMS) software. Before each driver is given an RFID tag, the Adani employee uses an RFID interrogator, located inside the security gatehouse, to read the tag's unique ID number. RFID middleware from Bar Code India, the systems integrator for the RFID solution, forwards the tag ID to the TOMS software, where it is then associated with the order information in the TOMS database.

The tag is attached to the truck, and the driver proceeds to a weigh station. An RFID reader is mounted alongside the weighbridge at which the driver stops. The scale calculates the weight of the vehicle loaded with grain, while the interrogator reads the tag ID. The RFID middleware controlling the reader transmits the tag ID and the truck's weight to the TOMS database, where this information is associated with the vehicle and driver information. A lane number is then displayed on an electronic board, located above the reader, directing the driver to the sample testing area.

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A closer look at the lanes

Upon arriving at the testing area, the driver stops at an electronic display containing three lights—red, yellow and green. An interrogator located next to the vehicle reads the tag ID number, and the middleware checks with the TOMS software to verify that the driver has entered the proper lane for testing. If he is not in the correct lane, a red light appears and an employee directs him to the proper spot. If he is in the correct lane, the light turns yellow while a sample is removed from the load and taken to a testing facility in the depot. The testing generally takes approximately 15 minutes.

Once the test is complete, an Adani employee calls up the order information and enters the results in the TOMS software. If the sample passes the quality test, the green light is displayed on the lane sign, along with the number of the unloading bay in which the driver is directed to dump the load. There are different types of grain, and it is critical that each type is taken to the designated bay and, eventually, to

the proper silo. A boom is also raised so that the truck can proceed.

Reader enclosure

If the test shows that the grain sample fails to meet quality benchmarks, the red light is displayed and the boom remains in place while an Adani employee directs the driver away from the unloading area and out of the facility. The driver returns the tag before exiting. If he fails to do so, Adani levees a fee against his company, or against the farmer himself.

If the load is approved and the driver proceeds from the testing lane to the unloading bay, he must stop once more in front of a boom and an interrogator, which reads the tag ID number. The middleware checks to see if the truck is about to enter the correct unloading bay, and a green light tells the driver to proceed as the boom lifts. If the middleware determines he is in the wrong spot, the light turns red and

he is directed to the proper lane.

Once the load is dumped, the driver proceeds to a second scale, where the tare (or unladen) weight of the truck is determined. An interrogator mounted by the weighbridge reads the RFID tag a final time, and then sends the tag's ID and weight to the TOMS software, where the amount due for the grain is determined, based on the tare weight and the grain-quality testing results. Before the vehicle exits the depot, the driver is paid and an Adani employee removes the tag so it can be reused for another truck.

System Design

The RFID tags are passive, and comply with the EPC Gen 2 (ISO 18000-6) air-interface standard. Adani and Bar Code India worked with Omnia Technologies, an Indian RFID tag manufacturer, to develop a custom tag for this application. The tag is encased in a rugged housing and attached to a lanyard. Once a tag is commissioned to a truck, the Adani employee uses the lanyard to hang the tag on a part of the vehicle protruding from the frame, such as the side-view mirror.

The tag design satisfied Adani's requirement that the tag be easy to attach and remove from the truck, as well as able to withstand extreme temperatures and dust. By hanging the tag from the truck's frame, an air buffer is produced around the tag, which decreases RF interference from the vehicle.

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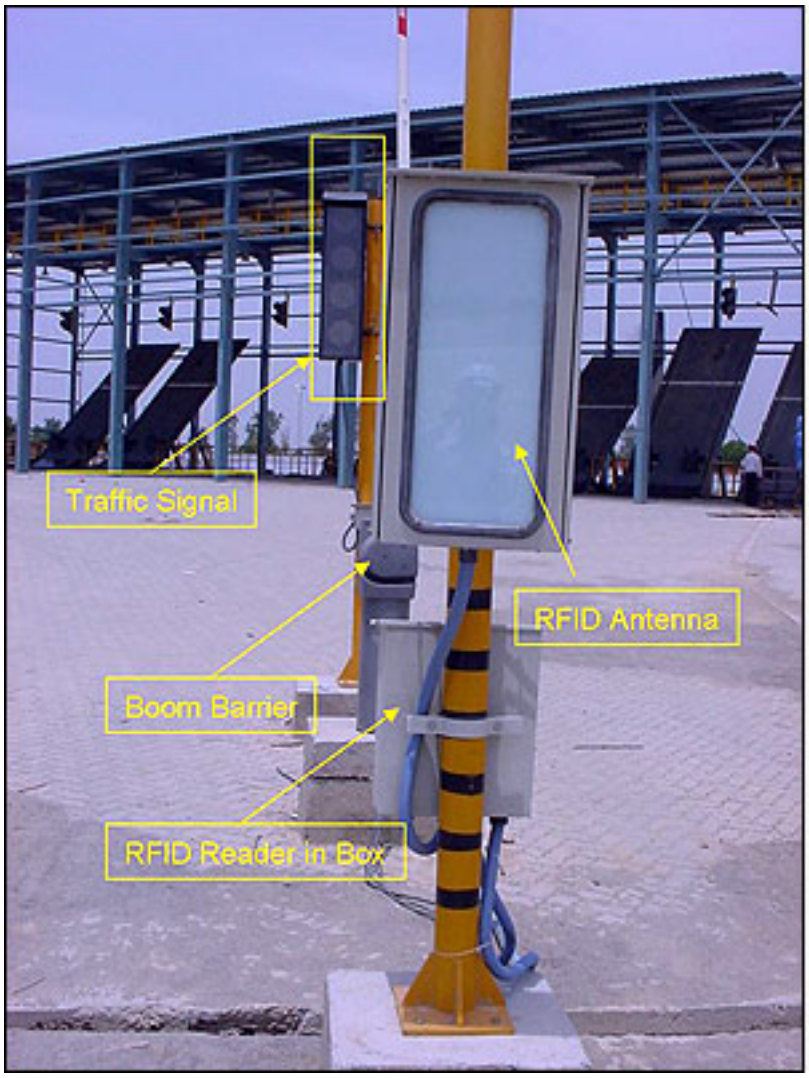

Reader with traffic light

Bar Code India selected passive EPC tags to keep costs low, since the tags do not require batteries and cost less than US$2 apiece. Each depot has a pool of 1,000 tags, which is an ample number even during the busiest time of the year—namely, the harvest that extends from mid-April until the end of May, when up to 1,000 trucks can be processed at each depot over the course of a single day.

The tags also provided the greatest read range and ease of use for Adani employees and truck drivers. "We could have used high-frequency (13.56 MHz) smart cards," says Rajat Ratra, Bar Code India's principal RFID consultant, "but this would have meant that the cards would have to be held out, right in front of the readers, and this would have been more work for the drivers."

The system uses 13 Motorola XR480 fixed readers. Each interrogator is encased in a weatherproof cabinet designed by Bar Code India. The total cost of the system—including the hardware and middleware, as well as the integration and testing work—was around US$125,000, says Vikas Wadhwa, the company's head of business.

Because the RFID system was integrated into the original design and construction of both grain depots, Ratra says, Bar Code India did not need to retrofit any existing infrastructure at the facilities, which made the project relatively straightforward. "We marked all the strategic locations where the readers should be mounted," he states. Before the construction of the buildings, ramps and weighbridges was complete, Bar Code India's staff then ran simulation scenarios, and tested the tags and readers to make sure the hardware would work as expected.

One important issue the firm's engineers had to address was that not all trucks entering the facility would be the same size. That meant they needed to determine at what height and angle the reader

antennas were most likely to capture the ID number from a tag attached to any truck arriving at the depot.

The system works in waterlogged conditions.

"On the good side, the trucks would be coming into the facility [and each read station] at a controlled, slow pace, so the readers were able to read the tags as they were moving," Ratra says. "We also used Motorola's dual patch antennas, which gave us good height coverage." Most of the testing work involved positioning the antennas so they would create a read zone that could capture tags attached to trucks of varying widths.

Another important element of the system design, according to Wadhwa, was ensuring the interrogators would be safe from inclement weather. "There is a lot of rain [during the rainy season], so we had to

design the reader enclosures to withstand downpours that drop up to 50 centimeters of rain," he states. The system, he adds, has thus far operated without any failures due to rain or heat.

The RFID system has also helped facilitate one final, but vital, element of the process: speed. "We have an agreement [with the Food Corporation of India] to spend no more than 65 minutes to receive the trucks, verify the quality of the grain, unload the trucks and collect the tare weight," says Adani's Nandy. "So how can we calculate the service time? That's another reason we are using RFID." The TOMS system tracks the entrance and exit times of each delivery truck, based on the tag reads, thereby enabling Adani to verify to the Food Corporation of India that it meets its specified turnaround time for each truck.