

# BULK

---

## MATERIALS

---

## MANAGEMENT



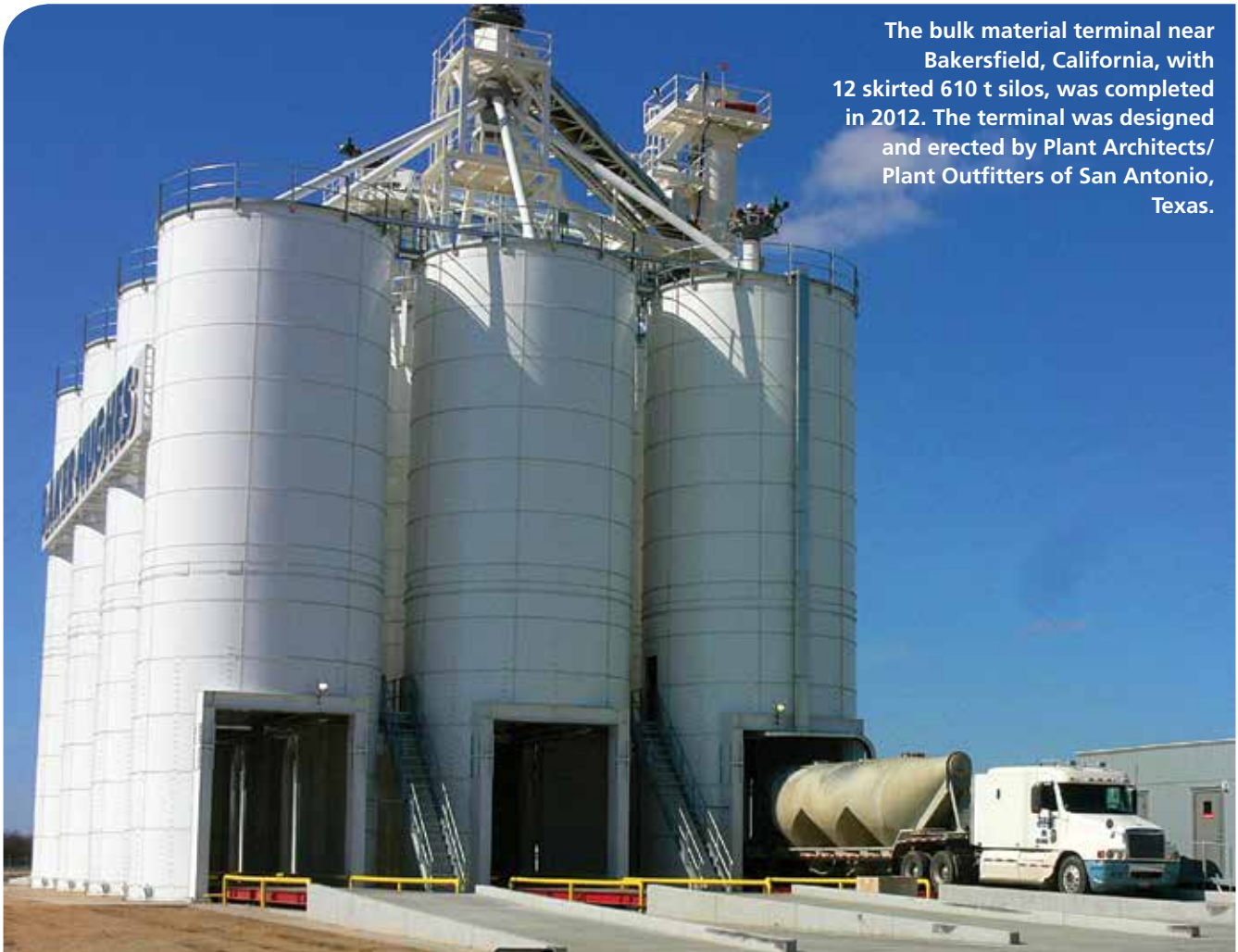
ROBIN SHEPHERDSON,  
SCALE-TRON, CANADA,  
TALKS THROUGH THE  
MEASUREMENT AND  
CONTROL SYSTEMS USED  
AT BAKER HUGHES' BULK  
MATERIALS TERMINAL  
NEAR BAKERSFIELD,  
CALIFORNIA.

### **Introduction**

Bulk material terminals generally hold incoming material delivered by truck, rail or sea transport and dispatch it to nearby destinations by truck or rail cars. The following case study is based on a terminal for sand used in the gas and oil fracking industry, although it is equally applicable to cement, grain and other bulk powdered and granular materials with small differences in dust control and explosion-proofing.

### **Case study: Baker Hughes terminal, Bakersfield**

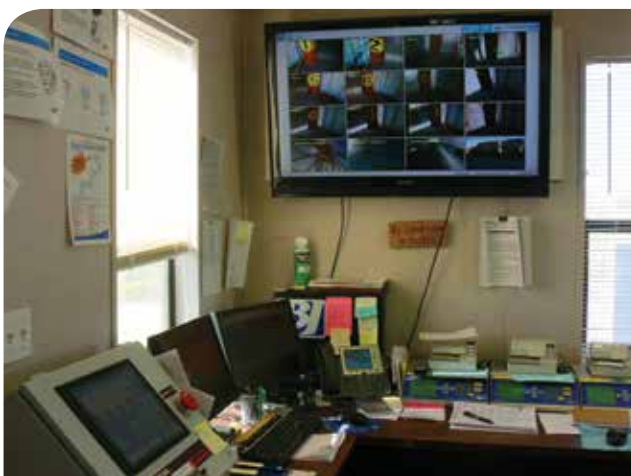
Incoming material, whether from the hold of a ship, a train of rail cars or fleet of trucks, is discharged into a receiving hopper



The bulk material terminal near Bakersfield, California, with 12 skirted 610 t silos, was completed in 2012. The terminal was designed and erected by Plant Architects/Plant Outfitters of San Antonio, Texas.

and from there must be conveyed to holding silos. At the Baker Hughes terminal near Bakersfield, California, a horizontal underground belt conveyor feeds from incoming trucks or rail cars onto a bucket elevator, which discharges through a flop gate to one of two

belt conveyors, each feeding a turnhead. Each turnhead can select one of six 600 t silos. The level in each silo is monitored and feed is directed to another silo when one becomes full. From a daily schedule, trucks are filled from the silos while being weighed. Once loaded they are dispatched to various destinations in the surrounding area.



View of control room showing touchscreen plant control system (left), two computer monitors for inventory (corner), large monitor for the cameras (above) and the three truck scale indicators and ticket printers (right).

### Control and measurement

All this machinery needs controlling, and there are three interrelated control and measurement areas: plant control, which includes all the conveying operations; silo inventory monitoring, which is carried out by measurement of stress in the silo walls; and batching by weight into the trucks, which uses three extra-long truck scales for weight measurement. In addition, a camera system provides security and allows the plant operator to position the trucks for filling using a radio system.

The plant is controlled by a system supplied by Scale-Tron, which utilises a touchscreen and PLC to combine the ultimate in reliability with ease of use and the flexibility to modify the system, even when it is running (if this is necessary). The motors and valves that control the machinery are all powered from a centrally located motor control centre, which houses motor starters, their overload protection devices and two

variable speed drives (inverters) to optimise the operation of the bucket elevator and its feed conveyor. The cabinet for the control PLC is located directly next to it to minimise wiring for the many interconnections, while the touchscreen is housed in the control room, 100 ft away, connected by an Ethernet cable – it could alternatively be connected by radio link if necessary. The control system receives weight information from the three truck scales via serial digital connection and uses this data to dispense pre-set weights to the two compartments in each truck. A recipe database allows the operator to select weights to suit different trucks and compartments, while the filling data for the trucks is saved for use in inventory. All operations can be viewed on the many pages of the touchscreen and onscreen buttons allow automatic, semi-automatic or manual operation of all functions. The truck scale indicators each have a ticket printer for printing shipping slips.

An interconnected PC computer stores all the records of incoming shipments and outgoing truck loads, creating an inventory database based on this information. It can store customer information such as addresses, orders placed, pricing and discounts as well as product and truck information. Accounting systems can be interconnected to the inventory system via file transfer software when necessary. Although truck loading weights are transferred from the legal-for-trade weight indicators to the PLC system automatically, the operator has to enter incoming shipments from the weight tickets. Alternatively, a conveyor scale can enter these amounts too and the operator can check them against the weight tickets.

The three truck scales in this installation each span four 25 ft dia. silos, making a 120 ft platform necessary. Fairbanks Scales provided two 60 ft above-ground platforms mounted end to end for each of these, with digital summing boxes to combine their outputs.

A Scale-Tron SiloWeigh.Net silo weighing system monitors the weight of material in all the silos, displaying this information on the same computer screen as the inventory database to give a cross-check between the on-hand amounts reported by the two systems. Although the control system database is theoretically more accurate, it is based on shipping slips for incoming material and does not account for any material lost during shipment. The silo weighing system uses sensors that measure the stress in the silo's legs or walls, and with correct placement they give typical accuracy between 1 and 2% of full scale. During a short filling cycle of an hour or two, however, the accuracy can be much higher and can be used to verify the shipment weights to identify losses. The sensors are connected to a digital weight transmitter in each silo and these transmitters are interconnected to communicate over a single digital cable to a dedicated data acquisition unit, which stores the data if communication is broken and passes it on to the local viewing database in the local operator's computer. The software acts as a web server, allowing other computers on the same local network to view this data



Clicking on any vessel drills down to a historical trend graph showing the current reading as well as levels over a selectable period of hours, days or weeks. The display also shows an alarm log plus useful statistics. Records for any selected interval can be downloaded to an Excel spreadsheet to determine filling or usage amounts.



The motor control centre controls all the motors in the bulk material terminal. The two variable frequency drives for the incoming feed conveyor and bucket elevator are seen at the bottom left. The control PLC is housed in a separate cabinet to the left of this one.

as a series of bar graphs for all silos or a historical trend graph of a selected silo. Local alarms can be generated if necessary, to sound horns when the levels become too low or too high. If the computer is connected to the internet through either the local network, a dedicated connection or a cellular modem, the data can also be stored in the central SiloWeigh.Net server

for password protected viewing and download from the website. In this way, data from many sites of the same company can be viewed from head office or any location, allowing inventory to be monitored and shipments to be scheduled in a more efficient manner than is normally possible by use of email or telephone communication. The database can also trigger warning alarms and send e-mail or text alerts to other computers and mobile phones. Additionally, the system can interconnect with the supplier's database to provide automatic orders for shipments, improving the efficiency of the dispatching process and cutting costs.

A camera system provided by Axis Communications monitors the external area around the silos, the rail terminal and all the filling positions for the trucks. These cameras are connected by a separate Ethernet network with digital communication to a dedicated computer, which stores video records and displays the live video feeds on a large monitor. This system has the capability to enlarge the view from any camera as well as replaying past history. The plant operator uses this, together with his VHF radio, to instruct drivers during positioning of trucks to receive their loads.

### **Terminal design**

The bulk material terminal was designed by San Antonio-based Plant Architects and erected by its associated company, Plant Outfitters. The silos, supplied by Tank Connection, are erected from ground level; when a ring has been assembled it is jacked high enough to assemble the next ring and so on until the whole silo is completed. All the control equipment, designed and assembled by Scale-Tron's engineering and production team, was installed by Plant Outfitters under Scale-Tron's supervision. The Plant Architects, Plant Outfitters and Scale-Tron team have completed many successful projects in concrete and bulk material handling. 🌐



The touchscreen controller handles all plant functions, including selection of silos to be filled and batching into the waiting trucks. PLC and touchscreen technology is free from Windows issues and operates reliably with minimal maintenance for many years.