

CHILTON'S SEPTEMBER 1995

FOOD

ENGINEERING

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THE DENNIS GROUP, INC.

*Project Design, Engineering and Construction
Management for 1995 FOOD PLANT of the YEAR*

**NEW PLANT
OF THE YEAR**

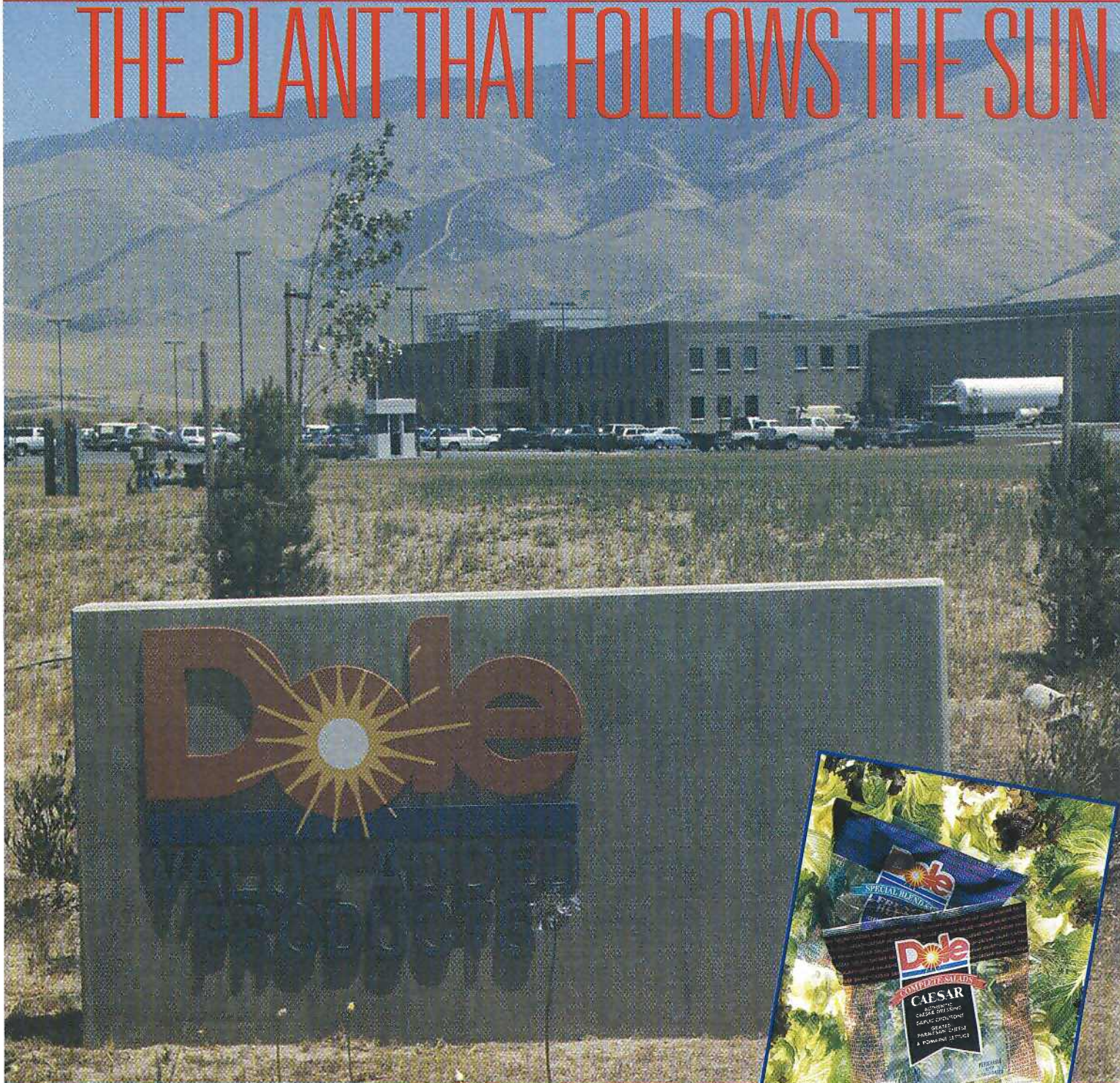
**DOLE
VALUE ADDED
PRODUCTS**

THE PLANT THAT FOLLOWS THE SUN

PLANT OF THE YEAR

DOLE VALUE ADDED

THE PLANT THAT FOLLOWS THE SUN



PRODUCTS

THE NEW \$28 MILLION DOLE VALUE ADDED PRODUCTS PLANT AT SOLEDAD, CA, LEAPFROGS CONVENTIONAL PLANT DESIGN TO SET A NEW STANDARD IN THE FRESH VEGETABLE INDUSTRY. • CHARLES E. MORRIS, MIDWEST EDITOR

Most fresh vegetables in the United States come from two growing areas 600 miles apart: California's Salinas Valley with growing season April through October, and the Yuma, AZ/Imperial Valley, CA, area with growing season November through March.

Because highly-perishable raw materials are a major cost, manufacturing economics in the fresh-vegetable industry dictate that plants be located near their source of supply. Major processors actually relocate their plants seasonally between these two areas.

The largest of these firms, Dole Fresh Vegetables, Inc. (a unit of Dole Food, Inc.), formerly operated one plant at Marina, CA, April through early November, and a "mirror" plant at Yuma, November through March. Dole shifted major equipment back and forth to minimize capital idled during the off season.

In the autumn of 1992, Dole Fresh Vegetables was expanding its manufacturing strategy for a new product cate-

gory: refrigerated, retail-packaged pre-cut fresh vegetables and salads. The company had extended its food-service line of pre-cut vegetables into the retail market in April '91, and the new "Refrigerated Salad" category was an instant success with consumers.

Double disaster

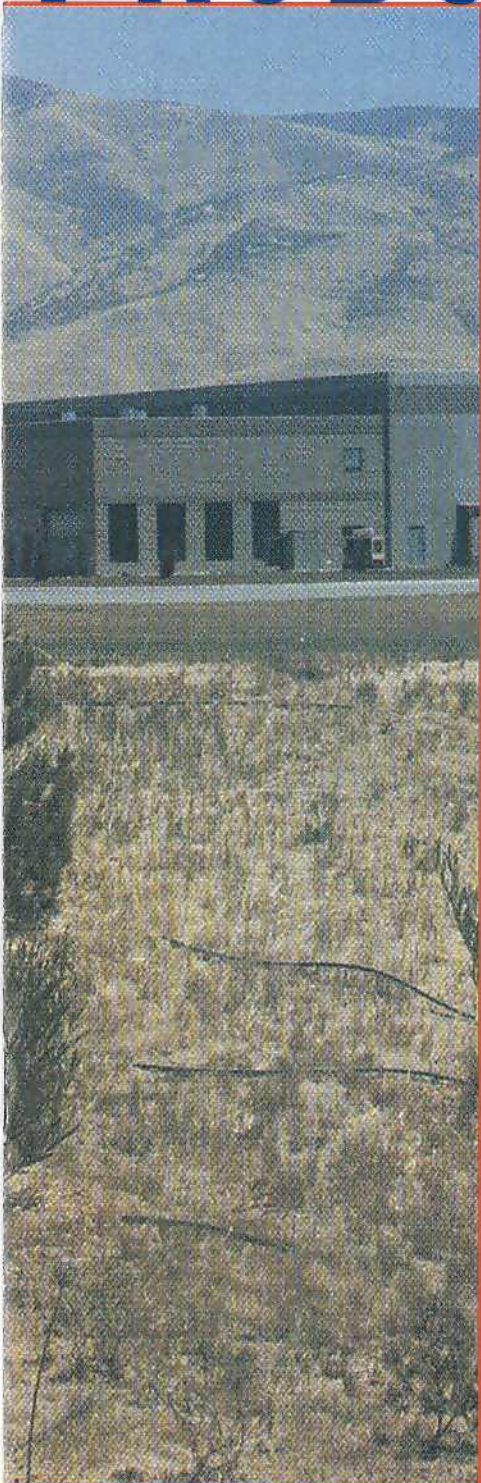
By November '92, Dole had completed the first phase of a two-phase off-season expansion plan at Yuma and was planning to expand its older, site-constrained plant at Marina. Dole retained the Dennis Group, Inc. (DGI), a design, engineering and construction-management firm based in Springfield, MA, to critique its manufacturing strategy and design plans.

Then Dole was hit with a double whammy:

- On November 11, Dole voluntarily recalled cole slaw produced at the Marina plant. Product contamination had been detected in a one-pound bag of Coleslaw Mix by the Canadian Health Ministry. Although no illness resulted, Dole shut Marina down, started disassembling and sanitizing the plant, and modifying several processes.

- On November 13—one week prior to startup—the Yuma plant was totally destroyed by fire. Nothing could be sal-

*Plant Photography: Marvin White
Grensted Photography
Salinas, CA.*





executing three concurrent projects:

1.) Double the capacity of the Marina plant while in full operation.

Huge forklifts move 20 600 to 900-pound harvest bins at a time from flatbed trucks to conveyors feeding either a vacuum cooler or hydroshower for cooling incoming vegetables.

vaged. Fortunately there were no injuries.

Dole was left with no manufacturing facilities to supply a growing market, or to produce new products scheduled for rollout in January and April '93.

Threefold plan

First priority: Bring Marina back on-line with an improved manufacturing environment. The Dole/DGI team accomplished this in five days, and Dole regained pre-disaster sales levels within two months.



Vegetables are visually inspected, manually trimmed and defects removed on stainless-steel trim lines. The "megacutter" at lower left, adapted and enlarged from the meat industry, cuts lettuce at throughputs of 18,000 pounds per hour. Shredded carrots and red cabbage are added to salad blends at right center.

Next challenge: Develop an expansion plan which would allow Dole to maintain its aggressive expansion/new-product rollout schedule within the original capital budget.

The Dole/DGI engineering team developed a plan for

2.) Rebuild and double the size of the Yuma plant in time for seasonal production starting November '93. (The value of the destroyed plant was covered by insurance.)

3.) Build a new plant to replace site-constrained Marina in time for seasonal production starting April '94. Startup date was mandated by perishable crops. This meant building a much larger "greenfield" plant within a budget (excluding site purchase) originally projected for expanding Marina.

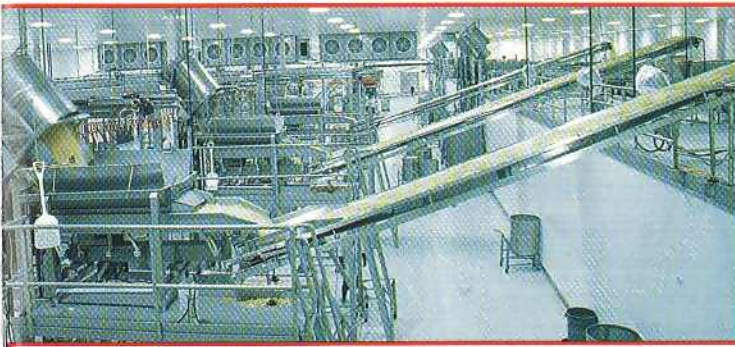
DGI was awarded design, engineering and construction-management responsibilities, and DGI engineers were integrated with Dole's eight-person engineering staff. Marina was expanded within its site limitations by 30,000 sq.-ft. and started-up in May '93. A new 220,000 sq.-ft. replacement plant started-up at Yuma in time for seasonal production in November '93.

Meanwhile, after evaluating 53 sites throughout a 65-mile radius over a two-month period, the Dole/DGI team, in June '93, selected a 361-acre site at Soledad, CA, as the location for its new plant to replace Marina. Ground was broken in late July—allowing only eight months until mandatory startup.

Sets new standard

Started-up in April '94—on time and within budget—the new \$28 million, 258,800 sq.-ft. Dole Value Added Products plant at Soledad leapfrogs conventional plant design to set a new standard for the fresh-vegetable industry. Design innovations include:

- USDA-equivalent sanitary standards, applied for the first time to the largely unregulated fresh-vegetable industry. All process equipment is made of stainless steel with continuous welds and open construction.
- Hazard Analysis at Critical Control Points (HACCP). A hazard-analysis approach was a key priority in plant design and construction to eliminate safety concerns.
- Process innovations, including new and redesigned equipment plus technology transfer from other food-processing industries.
- Improved mobility, allowing more efficient seasonal relocation of more equipment. Most equipment is of mod-

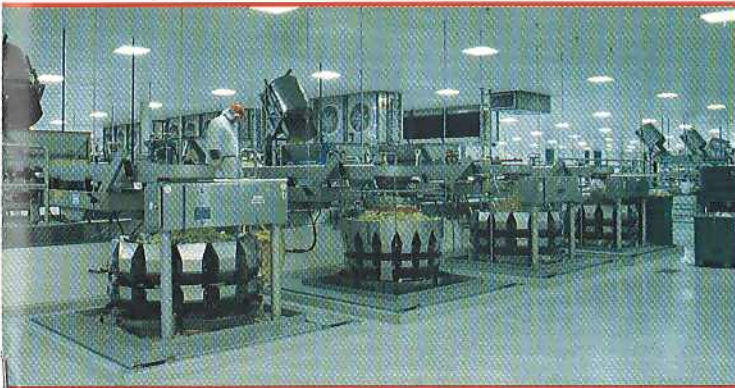


Elevated baskets gently dump blended vegetables onto vibratory metering conveyors and belt conveyors feeding combination scales and packaging machines.

ular construction and pedestaled for easy removal by overhead monorails or forklift. About 76 flatbed trailers are now required to move the plant to Yuma, for example, as opposed to the 20-25 needed to relocate from Marina, yet the April '95 move—from shutdown at Yuma to startup at Soledad—was accomplished in only 81 hours. Transport time was 18 hours. “We’re like an organized caravan that follows the lettuce,” says Manufacturing Director Eric Schwartz.

Flexible manufacturing

The plant is designed to convert 360 million pounds of raw vegetables into 190 million pounds of finished products per year. Dole salads and pre-cut vegetables offer



Vibratory metering conveyors in-line with single combination scales feed VFFS machines producing larger packages.

100-percent usable product to the consumer, so more than 40 percent of raw-vegetable weight—about 400,000 pounds per day—is removed as waste. The fresh-vegetable industry “has evolved from a chop-shop culture to a ready-to-eat culture,” Schwartz observes.

About 900 mostly seasonal employees working three shifts (two production, one cleanup) process some 25 dif-

ferent vegetables into 70 “active” SKUs ranging from Broccoli and Cauliflower Florets to Caesar, California Blend and European Blend Salads. Vegetables are typically harvested, transported, processed, packaged and shipped within 36 hours. No raw materials are inventoried; once in-plant, vegetables can move “from bin to bag in 12 to 15 minutes,” Schwartz adds. About 50 percent of all production is made to order; no finished goods are warehoused on-site. Most orders are shipped the same day the customer’s order is placed.

“We can make every SKU every day, which can mean up to 70 changeovers per day,” Schwartz points out. “We average about 58 changeovers per day.” About 85 percent of plant production is packaged for retail, 15 percent for food service markets. Refrigerated shelf life of finished products: 14 to 19 days, depending on variety.

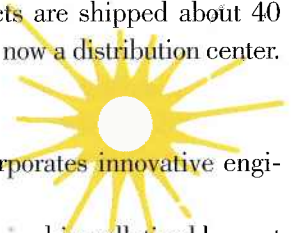
The plant typically ships about 60,000 cases of finished products per day but has shipped as many as 80,000, Schwartz adds. Finished products are shipped about 40 miles to the former Marina plant, now a distribution center.

Creative engineering

Each step of the process incorporates innovative engineering by the Dole/DGI team:

Receiving: Vegetables are received in palletized harvest bins weighing 600 to 900 pounds each, 20 bins per flatbed trailer. After weigh-in and physical inspection, vegetables are cooled to 35-40°F in a conveyORIZED vacuum cooler or hydroshower to remove field heat. Huge forklifts designed to handle 20 bins at a time (10 pallets stacked two high) move entire flatbed loads from trucks to cooler, then after cooling into the raw-material warehouse, where smaller forklifts continuously supply trim-line hoppers with two bins at a time. This rapid-handling system minimizes outside staging time for cooled product. Redesigned bin dumpers roll rather than drop product into hoppers, reducing product damage and extending shelf life.

Trimming & cutting: Vegetables are conveyed down trim lines for visual inspection, manual trim, and removal of defects and field debris. Trim lines are of 30-ft. modular stainless steel construction for improved sanitation and minimum breakdown during plant relocation. Power supply is electric rather than hydraulic to further ease reinstallation. Trim-line waste is removed at rates up to 120,000 pounds per hour via Reyco pneumatic conveyors (rather than typical belt conveyors) and blown directly to





Cartons descend from case formers on mezzanine to cartoning lines below.

the waste press for composting. The pneumatic system better handles wet, leafy waste, minimizes capital costs and is easily cleaned with a chlorine/water purge.

Trimmed lettuce varieties are conveyed to Carruthers cutting machines, originally developed for cutting frozen meat blocks and oversized for vegetable applications, to minimize product damage while making square, consistent, accurate cuts. On one line, a “megacutter” boosts throughput tenfold to 18,000 pounds per hour, eliminating a former bottleneck.

On other lines, vegetables such as broccoli and cauliflower are trimmed into florets; carrots are peeled in a Magnuson peeler and shredded in an Urschel cutter; spinach is rotated in a DGI-designed tumbler to remove sand and soil before washing. One line incorporates a “vegetable combination project” which automates blending, washing and continuous (rather than batch) drying of complex vegetable combinations.

Washing (the most critical control point): HACCP integration includes a triple-wash system designed by the Dole/DGI team to tightly control temperature, chlorination and product dwell while conserving as much energy as possible.

Cutting traumatizes vegetables; their respiration rates increase, speeding degradation. Cut and blended vegetables are therefore conveyed immediately into chilled chlorinated water for a controlled dwell. This reduces respiration rates and reduces bacteria while thoroughly cooling the product.

According to DGI, engineering the wash process was formerly considered an exercise in energy conservation. It centered on calculating the amount of energy required to lower the temperature of a given quantity of water, then filtering and recirculating the water while continuously controlling chlorine with each screening.

But vegetable particulates in recirculated wash water create high BOD, which binds free chlorine and negates its benefit. DGI therefore designed a triple-wash system consisting of:

1.) An initial chilled, chlorinated wash to remove gross debris. This system is completely isolated and allows four screened reuses of water before complete,

automatic replenishment.

2.) A secondary, isolated chilled-water system in which chlorine can be controlled, as a sanitizing step.

3.) A spray of single-pass, chlorinated chilled water serves as a final “kill” step.

Cut vegetables are pumped into tubular, 8-inch diameter washing flumes by Cornell hydropumps, originally designed for pumping live fish without damage in the seafood industry. Screening and chilling systems allow all process water to be recycled.

The plant uses 650,000 gallons of water per day, derived from an aquifer and cooled through an APV plate heat exchanger before use. Wastewater is applied with a linear sprinkler system to crops such as kale and alfalfa grown on-site.

Drying: Leafy products move across dewatering conveyors; more delicate products such as broccoli and cauliflower are dried by air knife. Vegetables then move via vibratory conveyors into stainless steel baskets, which are maneuvered by chain hoists into centrifugal dryers redesigned by Dole engineers to minimize the time vegetables spend unpackaged. The new PLC-controlled dryers reduce total spin time by 50 percent. Baskets are then staged on a stainless steel roller deck



Manufacturing Director Eric Schwartz (left) and Production Manager Tom Gallardo confer on a mezzanine overlooking the vegetable processing lines.

and moved to elevators supplying the packaging systems. This was formerly a labor-intensive, accident-prone area where employees pushed loaded baskets across wet surfaces, adding risk of cross-contamination and causing idling downstream.

DGI collaborated with Stokes Material Handling Co. to design a more highly automated handling system combining free roller conveyors with proximity switches and PLC-con-



More than 40 percent of raw vegetable weight, about 400,000 pounds per day, is pneumatically conveyed as waste to a press to remove excess water weight. Pressed waste is hauled away for composting on-site as humus for cover crops.

trolled chain conveyors to keep packaging lines continuously supplied. The new system minimizes injuries and contamination.

Packaging: Baskets of dried vegetables elevate to vibratory metering conveyors feeding 19 packaging lines, each consisting of Hayssen/Yamato computerized combination scales atop Hayssen vertical form/fill/seal (VFFS) bagging machines. (Designed with expansion in mind, the plant can accommodate 17 more packaging lines.) Packaging lines were formerly sized to the 5-pound food-service package, which required a feed rate to the scales of about 200 pounds per minute. For retail packages, however, the plant now uses eight different bag sizes ranging from 6 ounces to 5 pounds. Since smaller bags require a feed rate of only 60 pounds per minute to the scales, many upstream and downstream line components were oversized.

For smaller packages, the Dole/DGI team designed a "double stack" system with six Key Iso-Flow vibratory metering conveyors stacked in tandem to supply a combination of twin-tube and single-tube VFFSs for a combined operating speed of about 300 packages per minute. This system reduces required upstream/downstream equipment, better utilizes plant space, and allowed design of a smaller plant than originally envisioned—important to keeping the project within budget.

For mixed-vegetable salads such as Caesar, Italian Blend, California Blend and Herb Ranch, pouches of seasonings, croutons and dressings (supplied by other packers) are manually added at the scales. Products are bagged in films of varying oxygen-transmission rates



Project Engineer Bill Vith monitors engine-room and wash-loop operations from the central control room at a PC integrated with PLCs throughout the plant.

(OTRs) designed by Dole to match vegetable respiration rates and mass.

Finished packages travel via belt conveyors through metal detectors and are manually cartoned on lines supplied by mezzanine case formers. Cartoned products are manually palletized and moved to a staging area for immediate shipping.

Process control is based on Texas Instruments PLCs integrated with a single PC in a central control room via Opto 22 Cyrano man-machine interface (MMI) and Wonderware software. Cyrano, a flow-chart programming language, interfaces Wonderware with the PLC control language, explains Project Engineer Bill Vith. PLCs control process variables such as refrigeration temperatures, pump speeds and scale-feed rates, and equipment such as the basket-handling decks and elevators. The system monitors equipment such as dryers, packaging machines and motor controls in real time; alarms process variations when out of spec; monitors and histograms use of resources such as water and chlorine; and incorporates a statistical process control (SPC) capability used to tighten process specifications and improve equipment utilization.

Quality assurance incorporates HACCP, with three shift supervisors and 22 technicians monitoring critical control points such as water temperatures, chlorine levels, plant temperatures and metal detectors. The plant's QA lab inspects incoming raw materials, and samples finished products for specifications such as cut, size, package weight, shelf life, and mix ratio. QA technicians and production teams apply SPC to tightening package fill-weight variances. Microbiological testing is conducted by an independent lab, and plant technicians use 3M Petrifilms for quick quantitative indications of bacterial growth on equipment surfaces.

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