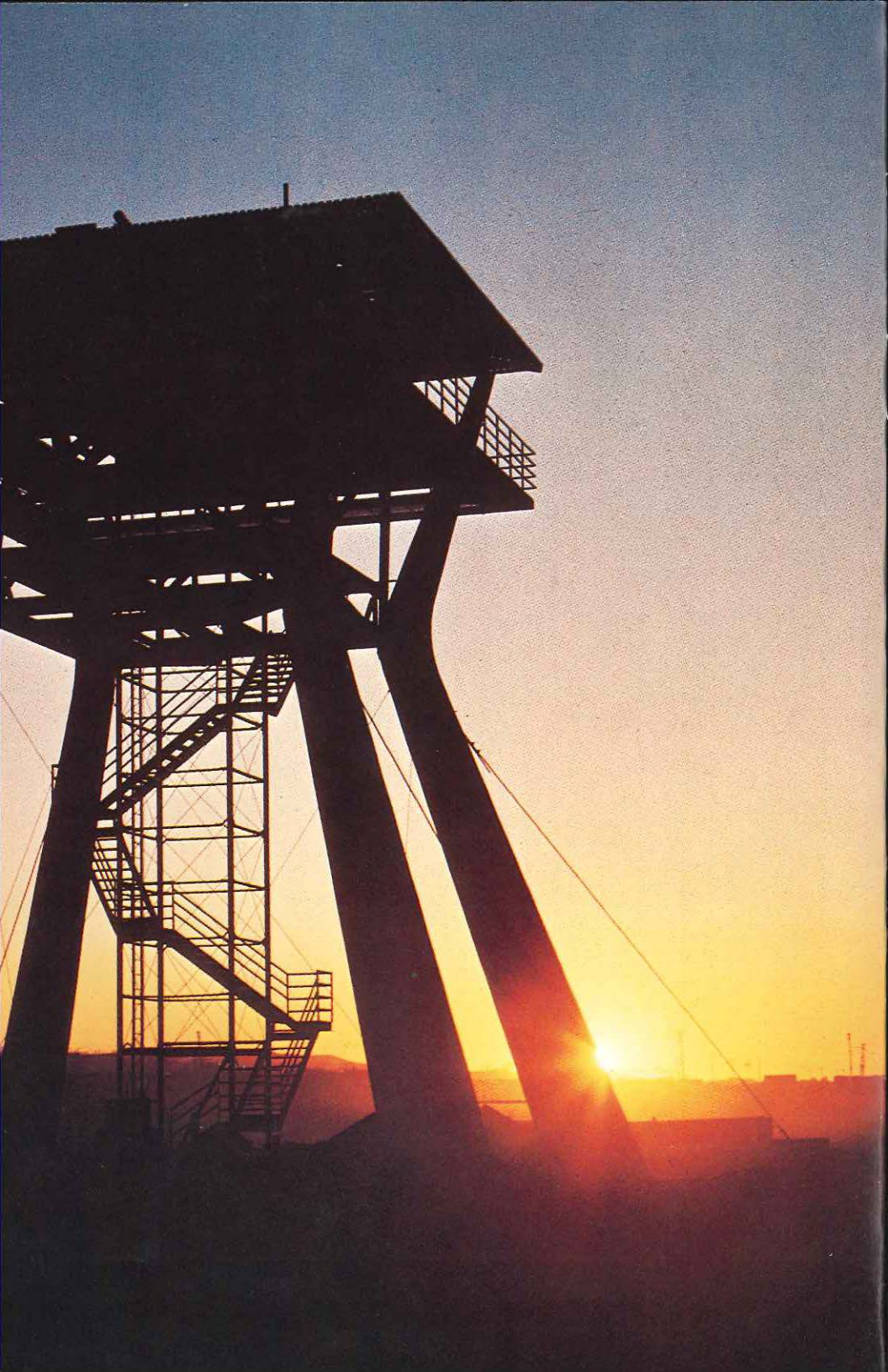
Barstow

Santa Fe's Modern Oasis



Santa Fe Railway has had considerable experience with electronic classification yards, with such installations in service at Chicago, Ill., Kansas City, Kans., and Pueblo, Colo. In our ongoing program of upgrading our railroad operations, it was decided that the next new yard should be built in a location that would produce the most favorable results for our West Coast operations.

At Barstow, Calif., our railroad branches off to Northern and Southern California, forming a huge "Y" with the main stem to the east. Barstow was the logical location for a facility that could combine and classify traffic for each of the three directions, and Santa Fe has invested more than $50 million to provide it.

Our new ability to quickly classify both eastbound and westbound cars at Barstow into many groups of cars for specific destinations, aided by the new "mini-hump" concept, will prove beneficial to Santa Fe shippers and receivers throughout California. In fact, what we do now at Barstow improves service between California points and virtually every point on the Santa Fe, as well as service to connecting railroads serving other parts of the country.

There is much more to Barstow than a modern, computerized freight classification yard. There are diesel servicing facilities, freight car maintenance and repair facilities, a vast array of communications and data processing equipment, and more—virtually everything needed to run a complete railroad.

Building such a facility on a river bank, in the heart of the high desert, brings with it special problems—problems that have been met in ways that protect the environment and beautify the area beyond its original state. We have been privileged to work with the people of Barstow, San Bernardino County, and the State of California to ensure that we have respected the rights of our neighbors as we improved our own plant.

In short, we are proud of our new Barstow facility. It represents the most advanced technology available within the railroad industry. Along with the technology, we are proud of the Santa Fe men and women who designed it, built it and make it work. We know this combination has produced a more efficient rail operation for us, and improved service to our customers.

John S. Reed
Chairman and Chief Executive Officer

(Cover)
Dusk at Barstow Yard

(Inside front cover)
The setting sun highlights the supervisor's high tower during construction.

Barstow Changes Operating Procedure

The advent of Barstow Yard brought a major change in the way Santa Fe moves freight to and from California. While those changes are internal and our customers may not be aware of them, they should be aware of the result. That result is improved service.

Prior to completion of the Barstow facilities, traffic originating at Santa Fe points in California was held for the departure of trains from those individual points headed toward the shipment's destination. While there will continue to be through trains made up at Los Angeles and at Richmond which will go directly to Chicago without intermediate handling, cars for other destinations are simply placed in trains in random order as they accumulate and move directly to Barstow for classification. This results in faster handling from California points.

Similarly, all California-bound traffic originating west or south of Kansas City moves to Barstow in random order as fast as it becomes available, then is classified into station order for delivery.

Periodically a conference call is made by the operations planner at Barstow Yard which includes dispatchers at San Bernardino, Fresno and Winslow plus the trainmaster at Los Angeles to discuss anticipated traffic within the following 12 hour period, so that each can make appropriate plans. In addition, regional car distributors are located at Barstow to assure that empty cars in good condition are assigned promptly to meet the needs of Santa Fe shippers.

All of these factors have combined to relieve local yards in California and points east of Barstow from congestion and enable them to serve Santa Fe customers faster and more efficiently.

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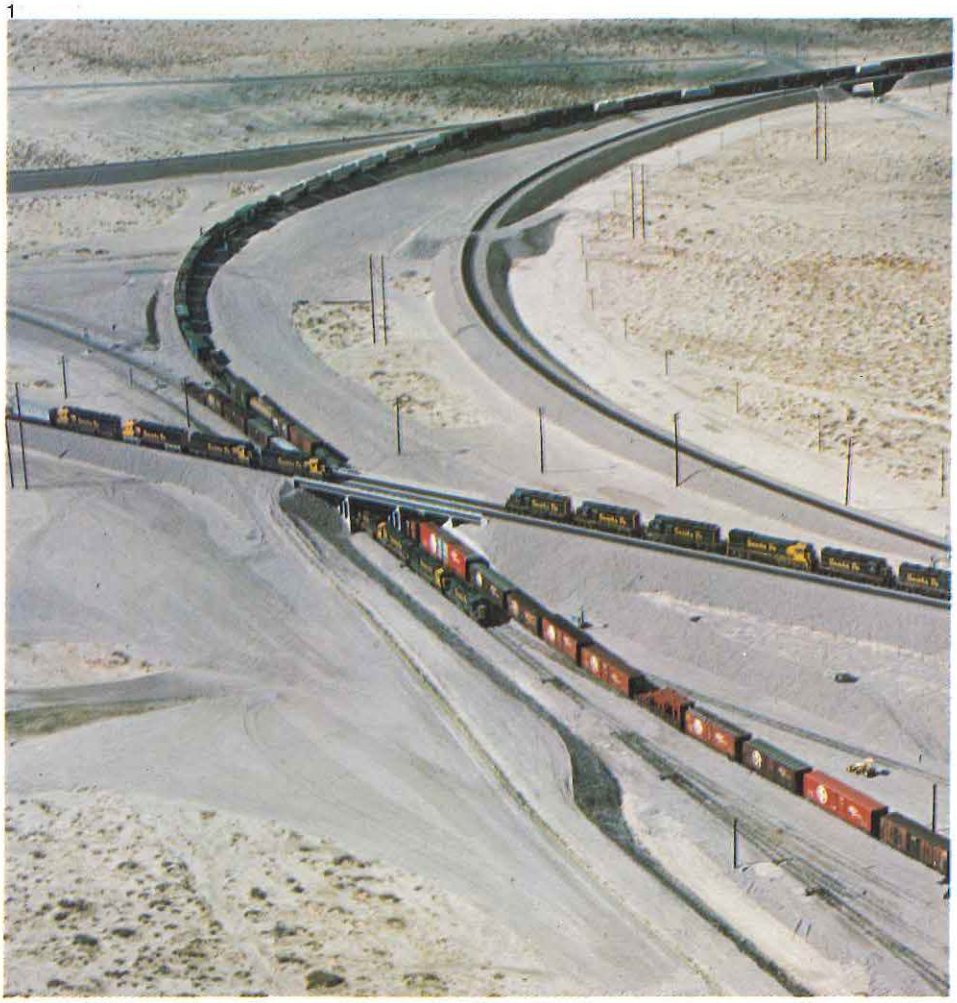


1
Configuration of tracks at the west end of Barstow yard allow simultaneous arrivals and departures without interference.
2
Nearly 20,000 trees were planted in the sandy soil.
3
An extensive irrigation system brings green to the desert.
4
Flowers bloom with the humpmaster's tower in the background.
5
Each locomotive and caboose is washed at Barstow, with the water being recycled through a reclamation system.

Environmental Concerns

In designing the new Barstow facilities, Santa Fe engineers paid special attention to environmental concerns relating to air, water and sound. The first two of these involved unique situations because of the yard's location in a desert area, yet next to a normally-dry river bed that at times carries a raging torrent.

If the yard has any effect on the blowing sand problem in the Barstow area, it should be a favorable one. The entire area was covered with crushed rock prior to installation of tracks. Nearly 20,000 trees of several varieties were planted, along with hundreds of shrubs and two miles of ground cover along a 10-foot high wind dike. There are six miles of water lines throughout the facility, much of which is used for irrigation purposes.

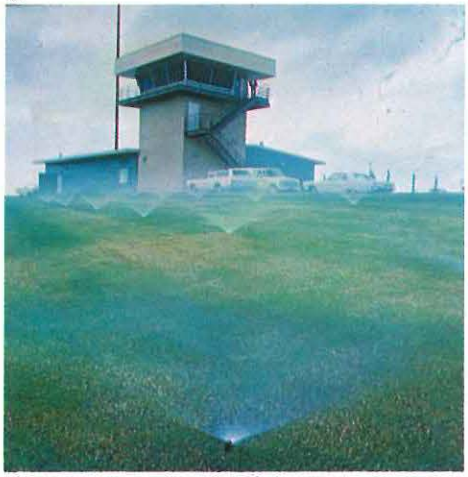
Since the surrounding hills to the south drain toward the Mojave River, during rain storms large volumes of water flow through the area now comprising the yard. Two large flood retention ponds have been constructed to impound the water and release it to the river at a more steady pace. Under normal non-flood conditions, the bottom of the retention ponds is planted with alfalfa, which also guards against blowing dust.

A half-million dollar waste water treatment facility, complete with three waste evaporation ponds, protects underground water sources from contamination. Much of the water used for washing locomotives, cars and other equipment is purified and reused for rinsing. Any output from the treatment facility will meet all state and city requirements before entering the city sewer system.

In addition to the many trees and shrubs, earthen embankments between the yard area and surrounding development will muffle sounds generated by car handling.

2

3



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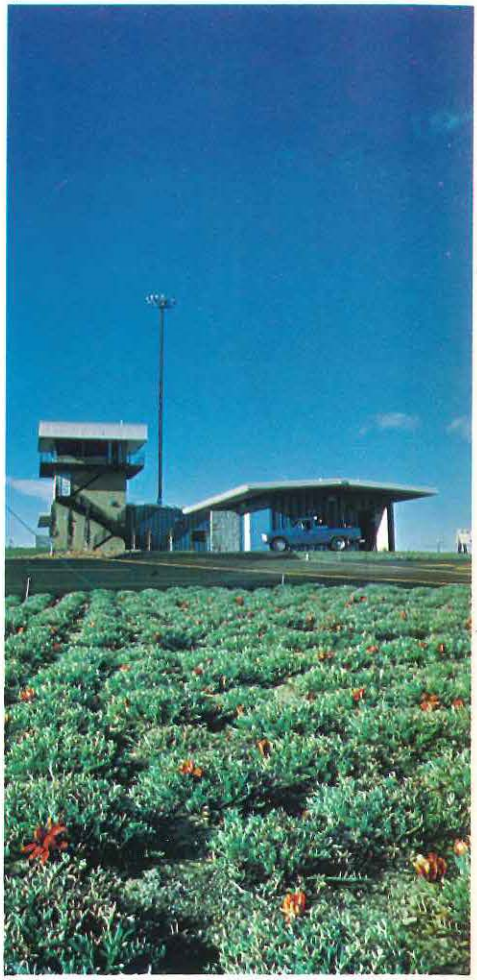

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Supervisor's High Tower

1

In addition to being a unique and attractive building the supervisor's high tower is the key to all activities at Barstow Yard.

An operations planner is on duty at all times in the high tower to supervise the general operations and direct the arrival, classification and departure of trains. An assistant general car foreman is also located there to assist the operations planner and supervise all maintenance and repair functions. As a management tool, each has available a large variety of information from the computer through displays on a Cathode Ray Tube (CRT). They also have the capability of issuing instructions through input to the computer, and have instant communication via radio, intercom and telephone to every key point throughout the yard.

Displays available to them on the CRT include an "inbound train lineup" which contains details and status on all trains currently in the receiving yard and due to arrive within the next 12 hours. This is a progressive report that is updated automatically by the computer or manual input as work progresses, and is used by various supervisors to determine priority of trains to be worked. Similarly, there are displays relating to total cars due or on hand in the various areas of the yard, data relating to numbers of cars for the different blocks or destinations, a "puller lineup" which shows moves necessary by switch engines at the east end of the yard to assemble an outbound train in proper block order, and displays showing status of outbound trains which are planned or under way.

By calling up these displays on the CRT, the operations planner and assistant general car foreman have instantaneous access to current data relating to any portion of the entire yard operation to aid them in planning and management functions.

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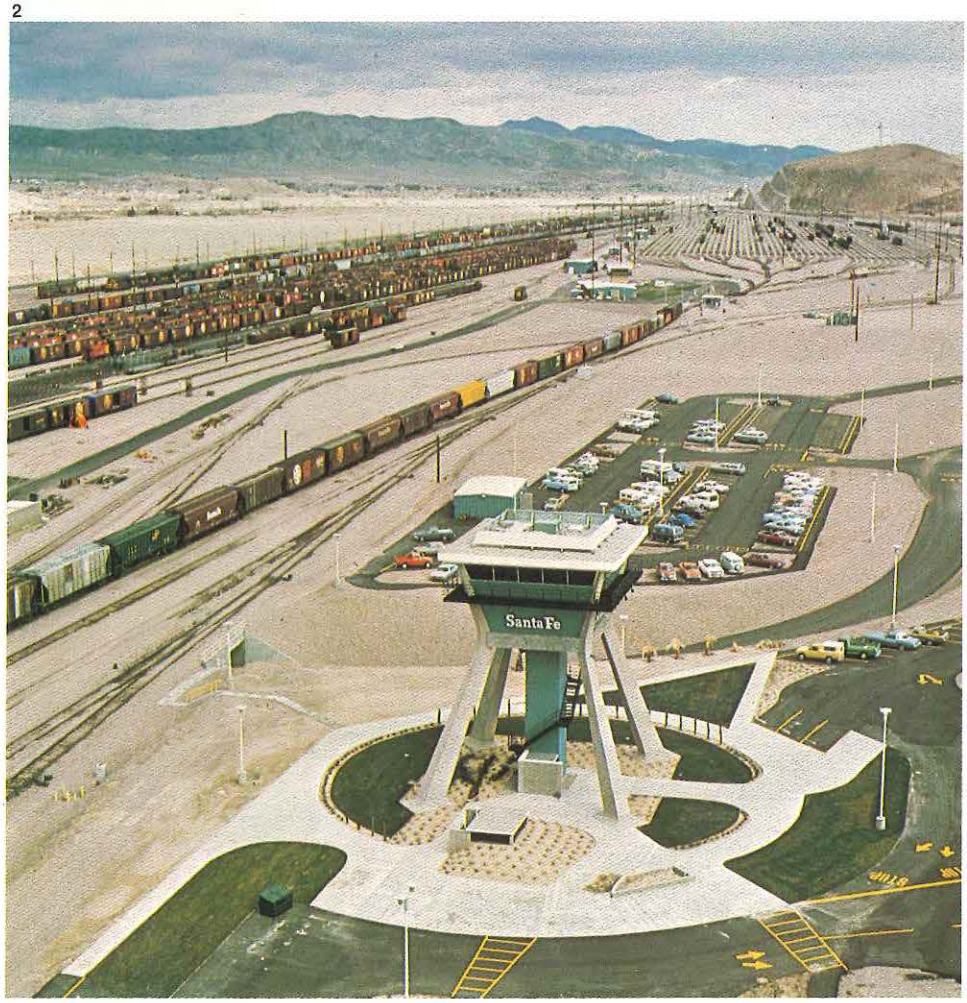
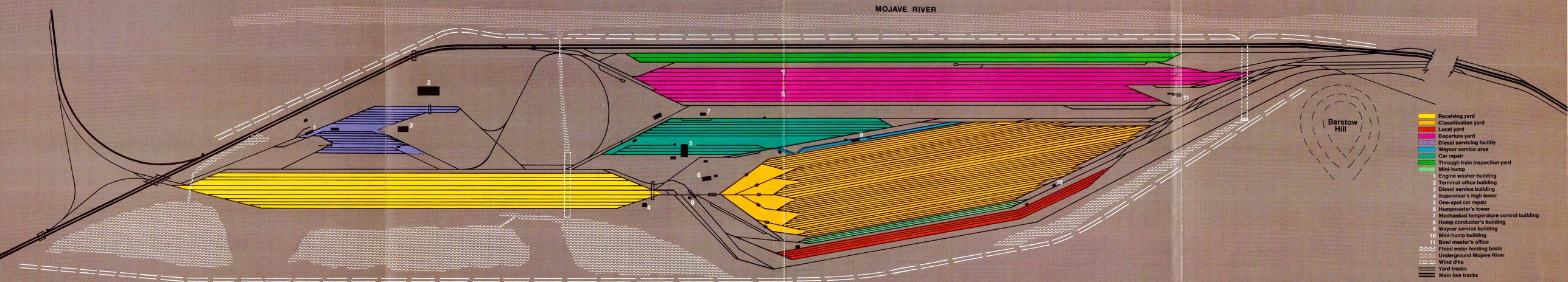


3

1
An assistant general car foreman (foreground) and operations planner supervise activities throughout the yard.
2
The high tower commands an impressive view of the area.
3
The high tower is attractive architectually as well as functional.
4
The terminal office building houses the agents force, terminal computer, communications center and other important operations.

4



How Barstow Works

Barstow Yard covers about 600 acres, has about 113 miles of track, 320 switches, 294,000 cross ties, 600,000 cubic yards of ballast, and can classify more than 2,700 cars daily at peak capacity. It was designed to provide flexible classification track assignments that will allow handling over 75 blocks going in three directions. Eighteen months in the design stage and 25 months under construction, the yard uses the most modern proven components available stressing operational reliability and safety. It can be divided into 9 areas for explanation purposes.

Receiving Yard

Trains may arrive simultaneously in the receiving yard from three directions without disrupting humping operations. Trains from Northern California pass under the main lines to avoid conflict, trains from Southern California enter via a separate lead track, and trains from the East enter at the hump end with alternate leads, depending upon activity in the hump area. There are 10 receiving tracks on 22 foot centers, ranging in length from 6,300 to 8,050 feet, with a capacity of about 1,420 cars.

Classification Yard

There are 48 tracks in the classification yard, with a capacity of over 2,000 cars. Of these, 44 are main hump tracks and four are designated as "mini-hump" or "rehump" tracks. After trains in the receiving yard have been mechanically inspected, and waybills and diversions have been worked by the bill office, they are then moved via switch engine toward the crest of the classification yard. Computers at the hump (3 on line, 1 back-up) already have information on identification and destination for each car on the train. As cars are individually uncoupled at the crest, a series of computer controlled switches and braking devices come into play, aided by input from radar, wheel detectors, a weigh-in-motion scale and other devices, resulting in each car being guided to its proper track at a speed that will ensure safe coupling. Three set-out tracks have been provided at the crest of the hump to accommodate and isolate cars loaded with dangerous commodities that should not be uncoupled while in motion.

Local Yard

There are five tracks in the local yard, from 2,700 to 3,300 feet long, with a capacity of about 300 cars. This yard serves as a "back-up" hold yard and is on line and grade suitable for conversion to classification tracks in future if needed.

Departure Yard

After cars are classified into blocks, two trim engines can work simultaneously, moving blocks to one of nine tracks in the departure yard, which has a capacity of about 1,370 cars. Tracks are on 22-ft. centers, allowing easy access for mechanical inspection and servicing. Auxiliary air, from ground outlets, provides for full servicing of trains before locomotive arrival. Three departures may be conducted simultaneously—one to Northern California, one to Southern California and one eastbound—at the same time three trains may be arriving in the receiving track area.

Diesel Servicing Facility

Inbound road engines move from the receiving yard to one of the pit tracks, where they are sanded, fueled and serviced up through semi-monthly requirements. The consist then moves through the engine washer to the ready tracks, where any unit needing shop work is cut out for movement to the major diesel shops on the east side of Barstow. Crews going on duty pick up their power in the ready yard and move to the departure yard to pick up a train.

Waycar Service Area

Waycars (cabooses) are switched into the north classification track, then to the service area by cable progression system. In the service area they are cleaned, washed and necessary maintenance is performed. Cabooses requiring heavy maintenance are switched to caboose detention track; while serviced waycars move to the east end of the yard and are placed on caboose ready track for use on trains as required.

Car Repair

Wide track centers in the receiving yard, together with planned radio communications, provides capability for making minor repairs to cars from a truck operating in the receiving and departure yards. Those cars identified as bad order, needing repairs that cannot be made in either the receiving or departure yards, are humped into the assigned classification tracks, then switched to repair facilities. A three-track one-spot repair facility capable of repairing 90 cars per day on a 3-shift basis is the center of activities. There are 10 other tracks in the car repair area capable of handling 270 cars per day, designated for such things as heavy repairs, conditioning and classifying cars, preparing MTC cars, re-positioning loads that have shifted en route, unloading wheels and other material, and transferring loads from cars needing further repair to serviceable cars.

Through Train Inspection Yard

Three tracks adjacent to the main lines are used for through trains that are not classified at Barstow. The 22-foot track centers allow maintenance personnel to use mobile equipment for inspection and servicing. Track arrangement allows multiple use of these tracks which permits two or more trains to enter and depart at the same time.

Mini-Hump

Operation of the mini-hump is explained on the following pages.

Classification Yard

The actual switching of cars into the classification yard is an automatic operation handled by computer, with the humpmaster issuing commands to begin the operation and supervising it to assure everything is functioning properly. He also has the capability to override the computer and change signals, switches, or retard cars manually from his console.

The computer network that operates the hump is composed of four "Nova" mini-computers which respectively handle switching, retardation or braking, and car control, with one standby which can replace any of the other three.

In operating the hump, the humpmaster first reviews the inbound train lineup to determine, based on priority, the train identification and associated hump list number of the next train to be classified. Based upon this information, a switch crew is assigned and necessary switch alignment is made to allow movement of the train from the receiving yard to the hump. During this movement the humpmaster will enter the computer command identifying the hump list to be processed—which is the first step in the automatic operation.

The hump computer then provides the humpmaster and hump conductor with a complete listing, called a "hump list," which contains identification of all cars in order as well as any special handling instructions. Simultaneously, the appropriate CRT in the humpmaster's office is activated, which maintains a constant display of the next eight cars to move over the hump. Before the actual automatic operation can begin the computer will physically pause and await a command from the humpmaster. After checking the status of the yard relating to space availability, equipment status, etc., the appropriate command is entered and the operation commences.

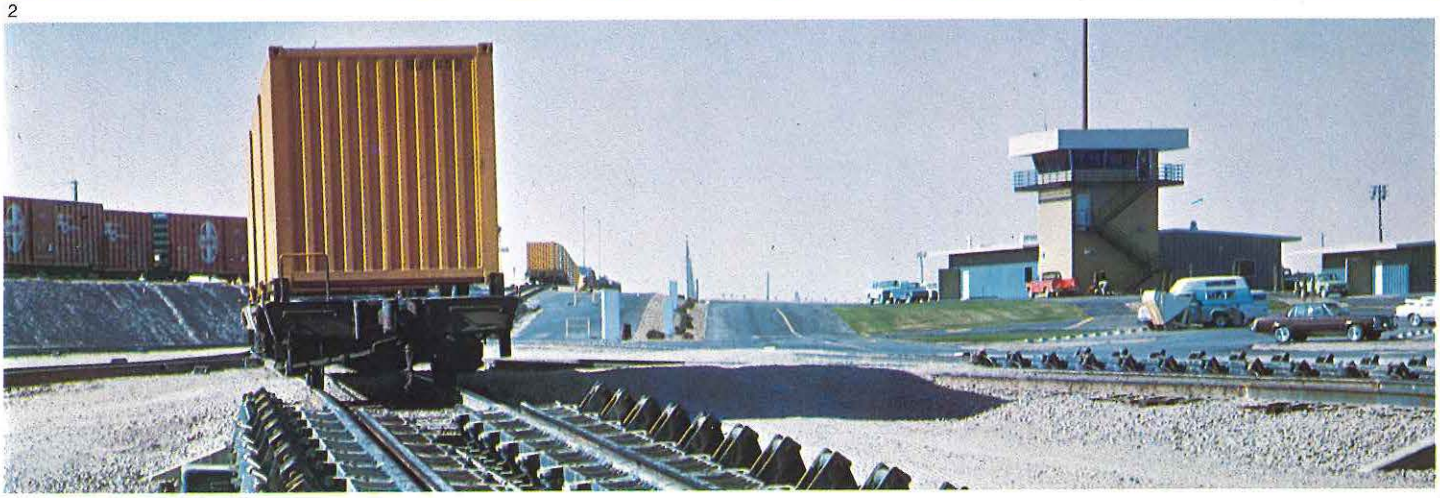
Once classification has started, the entire operation is automatic, except for uncoupling the cars individually as they move over the crest. The only time the humpmaster intervenes is when an exception condition occurs, to which he would be alerted through an alarm. Exceptions involve things such as a misrouted car, a track almost full, an equipment failure, etc. If an alarm of a serious nature occurs, the hump signal changes to stop and the humping operation ceases.

When pull moves are required—removing cars from east end of the classification yard, to the departure yard, or mini-hump—the bowlmaster will take necessary steps to arrange movement.

Trim moves are set up through the computer by the humpmaster. This automatically lines switches to the track

1

2



to be trimmed, and if more than one track is involved, the switches automatically line to the next track when moves on the first track are completed.

The mini-hump or re-hump concept incorporated into the design of Barstow yard is an operational innovation designed to provide refined blocking. It does not actually represent an original idea, for knowledgeable switch crews have been operating on this basis for many years, although they may not have been aware of it. But the Barstow installation was designed to take full advantage of the concept, and an additional hump and controls were provided for the purpose.

The goal was simple—achieve the ability to build more and smaller blocks and put them in station order without tying up tracks in the main classification yard. Having all the cars on a train in station order, or further refined for certain areas of some larger cities, obviously makes the job simpler for train crews handling deliveries and setouts. This cuts over-all transit time, and improves car utilization and service reliability.

In practice cars for one train are switched into one or more specified classification tracks. When it is determined by the bowlmaster that these cars are ready for the mini-hump operations, he arranges for a switch crew to pull from the track(s) in whatever order is appropriate. After advising the terminal computer of the movement so the car location inventory can be updated, he commands the terminal computer to generate the mini-hump instructions, which provides the mini-hump conductor with a printout showing track assignment for each car during the first classification movement. Like the main hump, the mini-hump is equipped with the necessary retarders to provide proper coupling speeds as cars are processed.

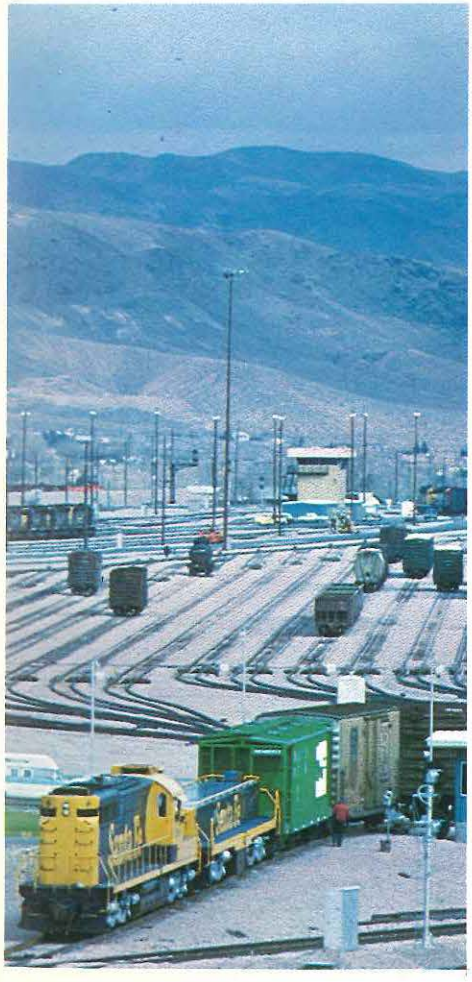
The computer program is designed to minimize the amount of classification switching. If more than one movement is required, however, the instructions provide data as to the order in which the mini-hump tracks should be pulled and track assignments for subsequent classification passes (maximum of four). The crew is advised finally in which order to pull the mini-hump tracks, and then upon advice of the bowlmaster moves the completed train—made up of blocks in station order—to the departure yard and/or local yard.

Initial plans call for cars directed to 14 of the main classification tracks to ultimately move through the mini-hump for additional blocking.

The accompanying diagram shows the simple arithmetic progression in which a random cut can be put in station order in two classifications. The theory underlying the simple sketch has been enhanced through computer programming so that it is even more efficient, and more blocks can be built if desired.

1
The humpmaster supervises the computerized classification yard from a vantage point before an electronic panel.
2
As cars move into the classification yard, computer-controlled retarders slow them to a safe coupling speed.
3
A string of cars is pushed over the hump, where each is uncoupled and allowed to roll into a pre-selected track, depending on destination.
4
This illustration shows the simple arithmetic progression by which cars for 16 stations can be put in station order by two moves over the mini-hump.
Each number shown represents a car destined for a particular station. Thus, number 1 represents a car for the first station the train being made up will serve, number 2 the next station, etc. In practice, the mini-hump conductor receives a list from the computer instructing him which cars should be switched to each track during each move, and the order in which the tracks should be pulled after each classification has been completed.

3



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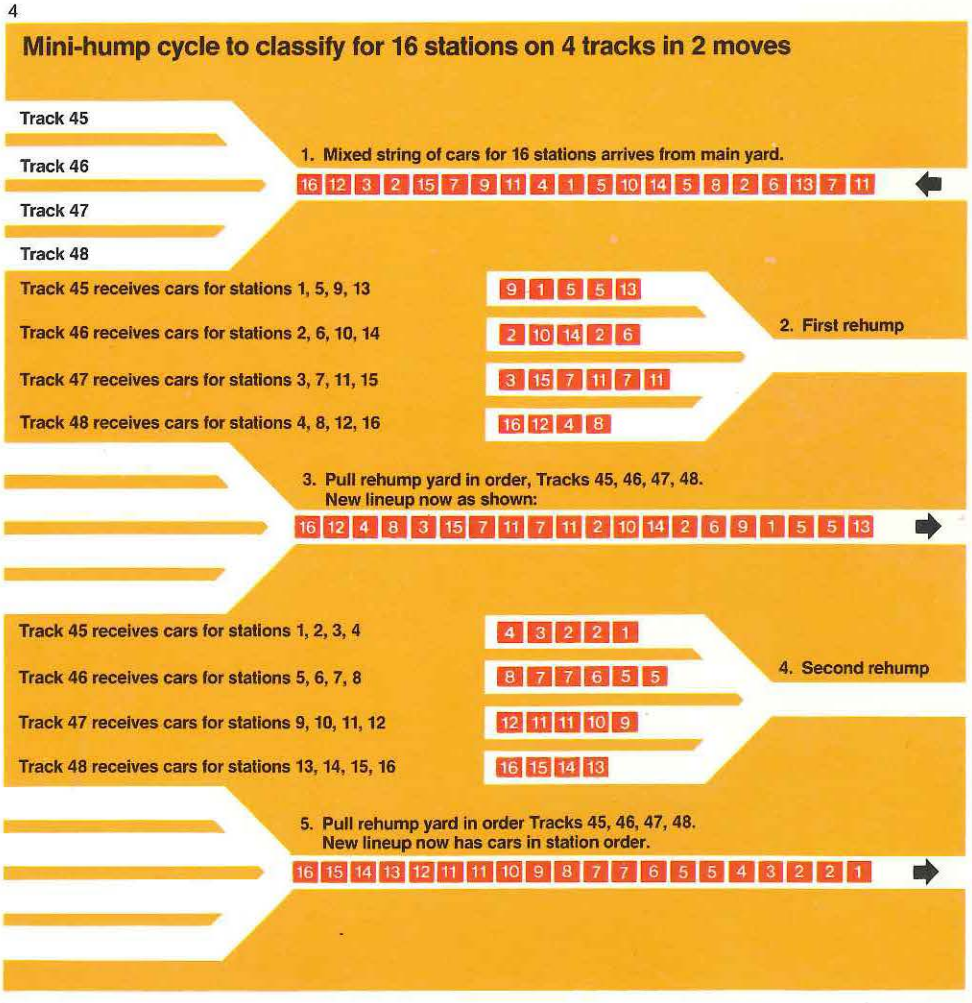


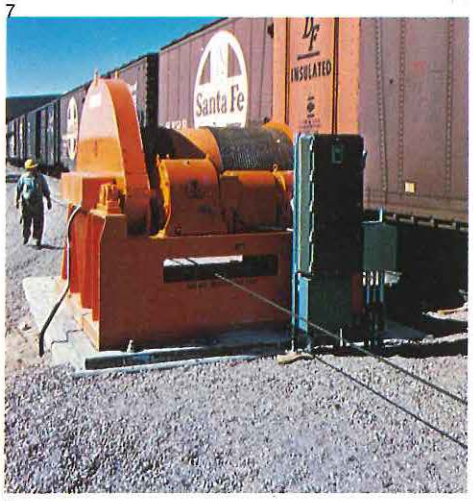
1

5

4

1
Each locomotive unit receives fuel through spill-proof nozzles before departure.
2
Locomotive units also receive sand at the maintenance facility, for use in improving traction as needed.
3
Diesels are serviced around the clock at the new facility.
4
Trains in the receiving, departure and run-through yards are inspected for safety from mobil inspection carts.
5
Center of car maintenance activities is the one-spot facility.
6
A coupler part is repaired in the one-spot.
7 & 8
In the one-spot, cars are moved from one area to another via cable progression system.

7



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8

Computers are Key to Operations

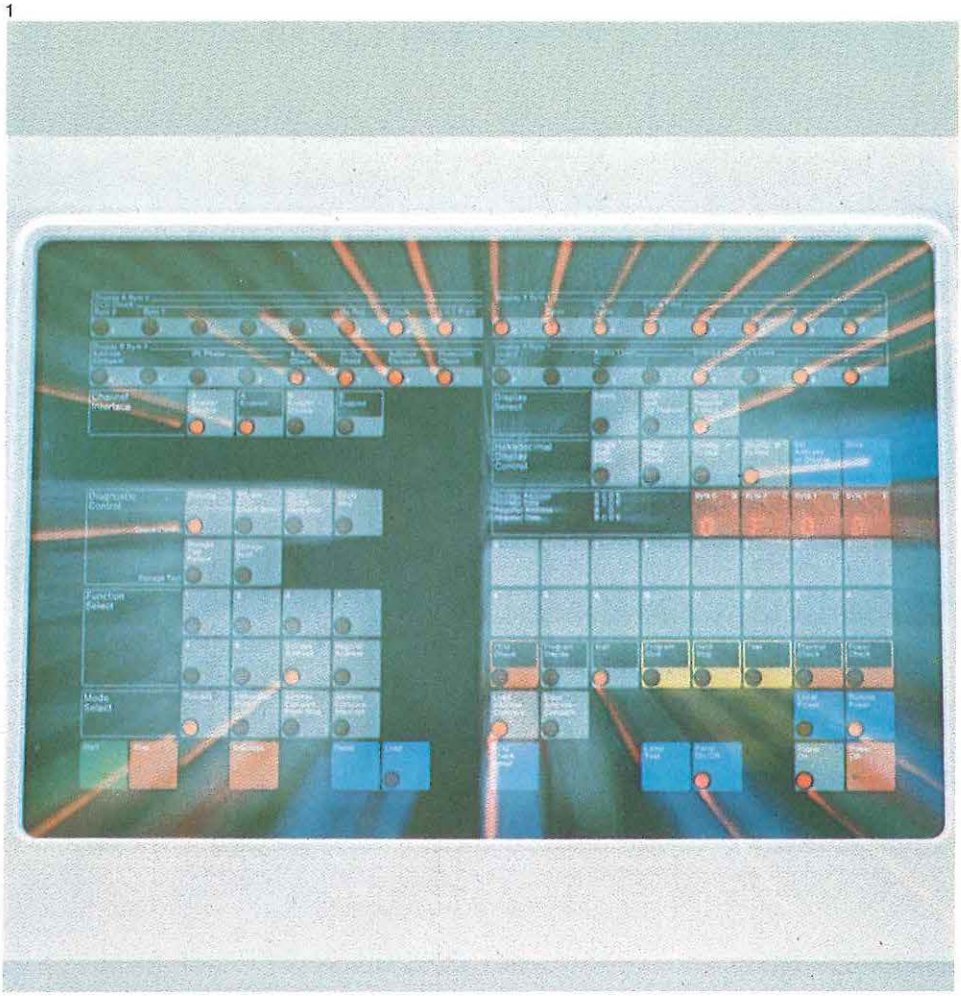
Santa Fe's Topeka, Kansas based teleprocessing computer sends advance data on trains due to arrive to Barstow's IBM 370-135 "Terminal" computer in the Terminal Office Building.

Automatic car identification scanners at strategic points check car numbers before cars enter and after they leave to verify that they are in the proper order. A computer program enhances the "ACI" list to identify cars with unreadable labels.

The terminal computer maintains a record of each car's movement through the receiving yard, classification yard, repair facility, etc., until it leaves the departure yard. The terminal computer provides hump lists to the "hump" computer which handles classification of cars. All data is accumulated by utilization of 3 IBM CRTs in the bill office and 16 teletype CRTs and printers throughout the yard which are in communication with the terminal computer.

The terminal computer issues a "wheel report" or listing by locomotive, car and caboose for outbound trains. This is transmitted to the Topeka computer and personnel at destinations for car utilization, location and other purposes.

1

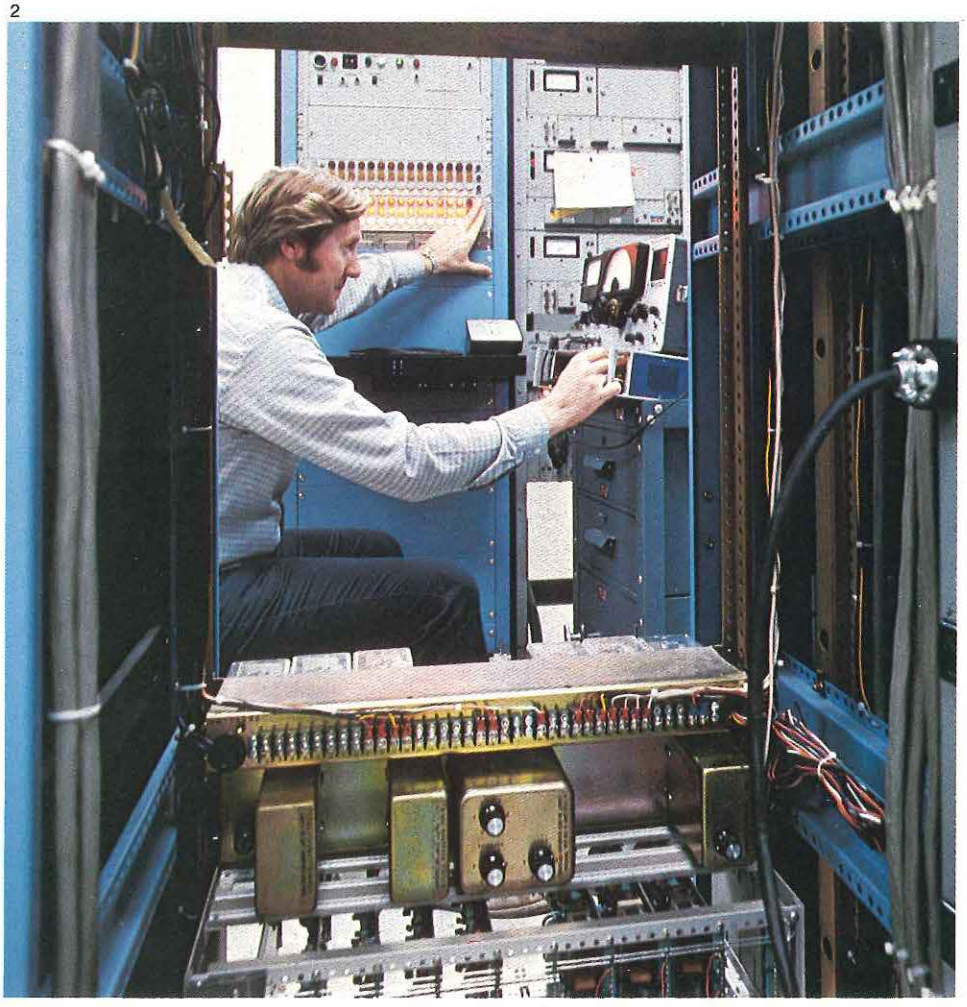


Communications

Operation of the Barstow facilities requires a vast array of communications devices, including nearly 100 portable pack sets, 10 radio base stations, 33 data circuits, radios on vehicles, plus those on all locomotives and cabooses moving through Barstow. There are 15 VHF and one UHF frequencies assigned to Santa Fe here, making it possible for a large variety of functions to be carried on without interfering with each other.

Other electronic devices that come under the communications wing include the ACI scanners, microwave, and an extensive intra-yard communication, paging and telephone system. To keep all of these in proper working order, a special facility was built in the terminal office building. Literally a room within a room, the walls, floor and ceiling of the repair facility are metallic-lined to prevent penetration of radio signals in either direction, thus allowing maintenance personnel to repair and test equipment without interfering with the voluminous radio transmissions that will be occurring within the yard area on an almost constant basis.

2



1
Touch control panel used in operation of the terminal computer.
2
A technician checks out communications equipment.

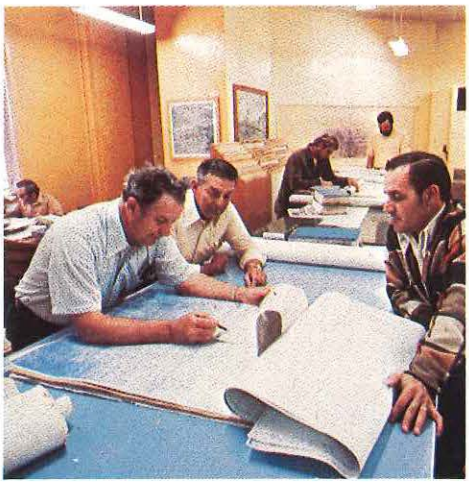
Santa Fe
All The Way

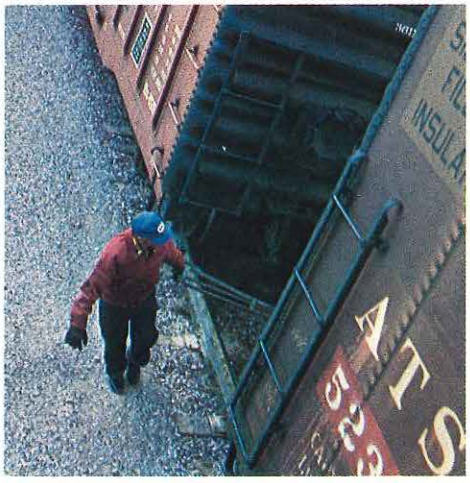
All the design, planning and engineering that went into the new Barstow facility was accomplished by Santa Fe personnel, a feat that is believed to be a first in the railroad industry.

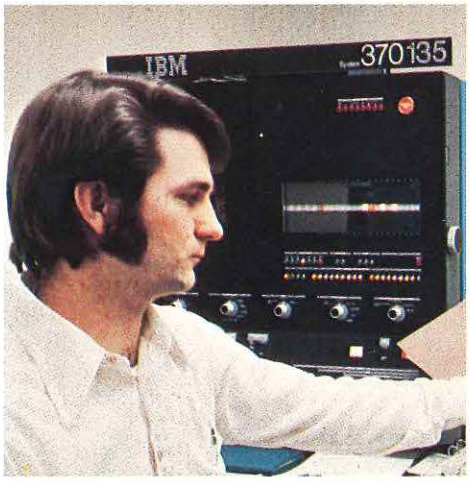
Standard, proven components were utilized throughout the facility. Santa Fe personnel designed the interface control system equipment which links the minicomputer with switch and retarder controls, the circuitry that enables key personnel throughout the area to keep abreast of operations, did the necessary programming, and tied the system in to our system information network at Topeka, Kansas.

Similarly, diesel locomotive and freight car maintenance facilities were designed by Santa Fe, along with the elaborate system of environmental protection, the lighting, and the roadway system. Earthmoving and rock-crushing was done by outside contractors, as was construction of certain buildings, but all construction of railway tracks, installation of maintenance equipment, and sophisticated electronic hardware was done by company personnel.

Barstow is definitely an example of a project that is Santa Fe-*All The Way*.







Santa Fe

On the move toward a better way