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INTRODUCTION

A decade of progress

"Realistic operation" implies that we use our models in a manner that complements their innate realistic appearance. It adds value without adding cost. The movement of every train and every car in those trains has a specific purpose based on the premise that our miniature railroads can emulate the functions of their full-size prototypes. Here conductor Bill Jambor, left, rechecks his train orders while engineer Harold Oakhill reviews his waybills as the KC Local pauses in the siding at Cayuga, Ind., on the author's Nickel Plate Road.

A decade has passed since the original edition of this book appeared in print. In that interval, we've enhanced our understanding of the way the full-size railroads go about the business of moving cargo and passengers, and we've found more authentic ways of replicating these functions while maintaining the desired degree of simplicity and ease of use.

2

Railroading exists to move cargo and people from where they are to where they need to be in an economical but timely manner. Here a Western Maryland crew picks up a loaded boxcar in Parsons, W.Va., in the 1970s; its unseen lading is most likely bags of Kingsford charcoal headed to a distant consignee via a waybill's instructions (Chapters 6 and 7) as the WM local moves under timetable and train-order rules (Chapters 4 and 5).

What's happened since 2003?

In these few pages, we cannot possibly take a detailed look at the entire spectrum of railroad operations and how to model them. So what follows is an overview of *key aspects* of realistic operation—that is, the attempt to make our miniature railroads closely emulate their full-size counterparts not only in appearance but also in function, right down to the movement of every train and every car in those trains.

Chapters 2 (Quick-start guide) and 8 (Signaling) remain largely intact while several others have been updated. But there are two important new sections: Timetable and train-order operations (Chapter 5) and creating more realistic waybills (Chapter 7).

Along for the ride

I enjoy reading first-person accounts of someone's adventures and travels, the problems encountered along the way, and how they coped. I want to go along for the ride, as it were. To that end, you'll take several trips over my own HO railroad and encounter operational challenges on a first-class passenger train, a hotshot but second-class freight train, and a bottom-of-the-pecking-order extra. Finally, we'll hop aboard train No. 45, the KC Local, and refer to our waybills as we switch one town on the Nickel Plate Road's Third Subdivision.

Where do we draw the line?

According to Allen McClelland's long-established Good Enough principle, we can draw the line on realism and modeling quality anywhere we choose, but we should draw that line evenly and consistently across everything we do—quality of modeling, adherence to era and plausibility, operations, and so on.

Interestingly, one of the very best modelers I know has set extremely high standards for almost everything he does. None of his freight cars have molded-on ladders and grab irons, for example. If a car was built after the year he elected to model, it's off limits. Operators not only copy train orders but also operate authentic interlocking plants through armstrong levers or a small CTC machine. It's hard to find fault with a single facet of his superb railroad.

Except for his waybills. Every car does indeed have a small piece of paper that tells the train crew or yardmaster where that car goes. But there's nary a hint as to what a car is carrying or how it got to his railroad. It bears no resemblance whatsoever to a prototype waybill.

This in no way compromises the realism of his operations, as these simplistic waybills convey every bit of information needed to get freight cars from here to there. But with all of the other intense efforts to ensure prototype fidelity, why skimp on some—and only some—aspects of the paperwork?

We'll explore that question and ongoing efforts to bring the authenticity of the paperwork up to the same high standard of the models. But as we do, remember that this expert modeler, who earned his living in the rail industry, sees the new-format waybills as unnecessary effort that conveys little added functionality. Who's to say he's wrong?

In short, there is no universal solvent. What I will present in these pages is several ways to reach a desired end. As they say, your mileage may vary!

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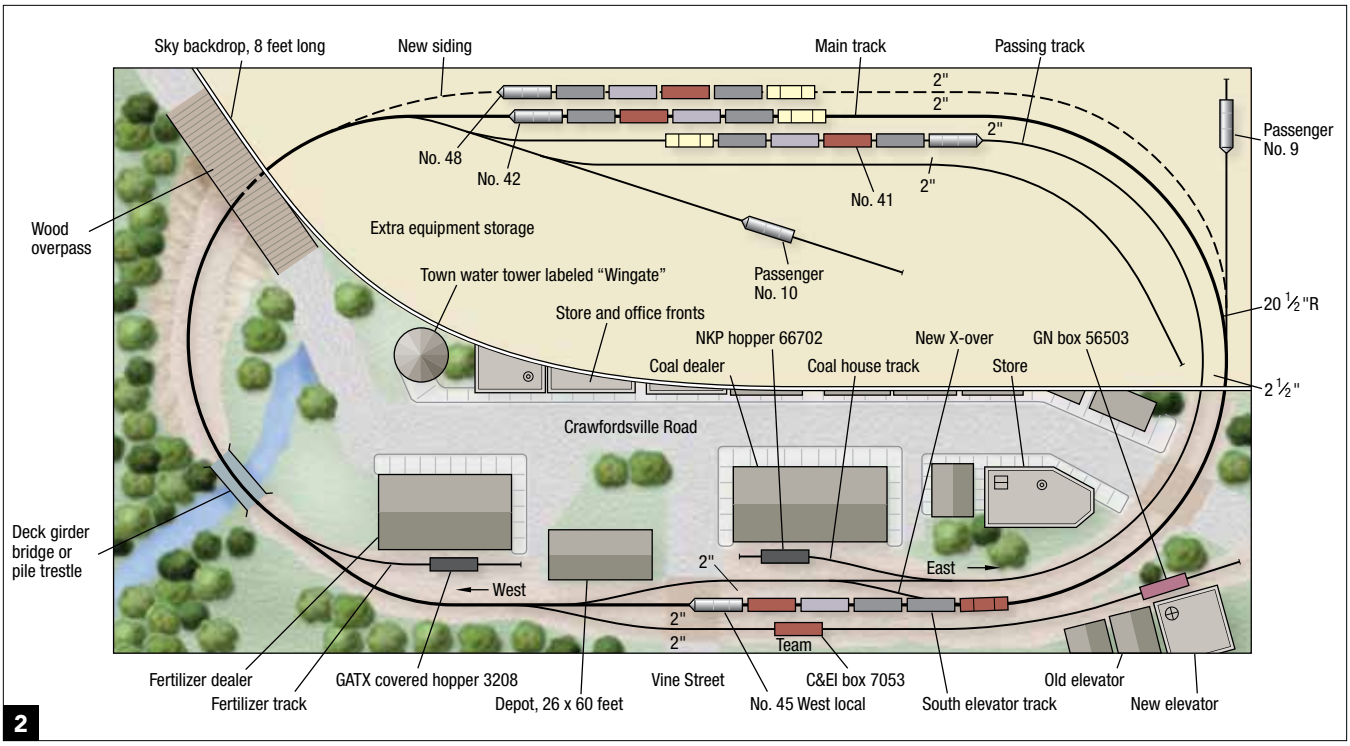
CHAPTER TWO

Quick-start guide to operation

This 1970 view of Wingate, Ind., on the Nickel Plate Road's St. Louis Division, looks east past the depot toward a pair of grain elevators on the right. What look like train-order semaphores are actually manual-block signals, which the operator used to convey permission to enter the block east or west of town after he or she checked with the next station down the line. The need to pick up train orders was indicated by hanging a yellow or red banner (lantern at night) on a metal rung on the signal mast.

One thing's for sure about "operation": It's a lot more fun to do than to read about. I've created this "quick-start" chapter to show you a simple, but reasonably realistic way to have an operating session—today! I'll use a 4 x 8-foot HO scale model railroad depicting the small west-central Indiana town of Wingate, **1**, on the former New York, Chicago & St. Louis (Nickel Plate Road) as an example. You can adapt its lessons to a plan of virtually any size, scale, and scope.



Wingate, Ind., can be effectively modeled in HO (or N) on the front half of a 4 x 8-foot sheet of plywood. A crossover added east of the depot facilitates runaround moves. The rear of the layout is used for staging, but could be another town.

One town or two?

The back portion of the plan, **2**, is shown as a hidden staging yard devoid of scenery, but it could be a second modeled town used temporarily as staging yard. (For variety, you could use Wingate as the staging yard and the other town as the active area during alternate sessions.) The goal is to find a way to suggest that trains go to and come from places beyond the confines of your railroad—"beyond the basement," as Allen McClelland put it.

If you already have a layout, focus on one town for this exercise. If you don't have a layout, you could quickly build this one using sectional track components in HO or N. The N scale version could have more staging tracks because of the closer track spacing. If you don't have room for a 4 x 8, I've also provided a linear version of this plan, **3**, that you can quickly build on a shelf, perhaps atop bookcases. Have your local lumber dealer saw a ⅝" or ¾" 4 x 8-foot sheet of plywood in half lengthwise (two 2 x 8-foot pieces), then saw one of those into two 1 x 8-foot pieces.

Each 1 x 8 piece is used as a hidden staging area to hold trains until they're needed on the 2 x 8 center section. You can "bend" this plan into an L or U shape to fit along two or three walls of a room by adding curved connector pieces to reach the staging yards.

The objectives are to use a system to move cars to and pick them up from the several industries in a small town. You also want to suggest that these cars came from or are going to a more distant place, as the "foreign" railroad names on many of the freight cars indicate. In other words, how does a Great Northern boxcar appear on a railroad in Indiana?

As you move toward these objectives, remember that the bottom line is to enjoying running your models as much as you enjoyed building and detailing them!

1: Locate your railroad on a map

You can't send a loaded car somewhere if you don't know which way it has to go to get there. If you're modeling a segment of a prototype railroad, **4**, you already know compass directions—for example, east is to the right or counterclockwise around your railroad. If you're freelancing, locating the railroad on a map will orient you.

2: Name everything

It's no fun shipping a carload of beef to "the upper loop." Assign place names to each town and track on your railroad. This lets you route cars to specific places called "spots."

Major off-layout destinations or points of origin also need names. This part of the Nickel Plate runs east from St. Louis through the division point at Charleston, Ill., to Wingate and on to the division point at Frankfort, Ind. It continues toward major eastern cities such as Toledo, Cleveland, and Buffalo. You can make trains on this segment of the NKP seem to go to such distant places by using the back portion of the railroad as a common east- and westbound staging yard. You'll think of it as "Charleston" to the west and "Frankfort" to the east **4**.

3: Even east, odd west

There's no need to take time to create paperwork such as waybills, but what's needed is a scheme to cause each car to move in a specific direction. Any car that has a road number ending with an

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CHAPTER FOUR

"Macro" operations: Moving trains

If you enjoy switching out on the main line, running the local is where the action often is. Here an Allegheny Midland light Mikado sets out a carload of kaolin, used to coat "enameled" paper, on the Western Maryland interchange track at North Durbin, W. Va. The WM's Mill Job will later deliver the kaolin to the Westvaco paper mill in the foreground.

Many of us became interested in model railroading because of the action. Our model trains can do pretty much everything that their full-size prototypes do or did, thanks to a pair of rails, wheels with flanges, and some electrical wizardry. Let's examine what it is we're trying to emulate: the types of trains, and then ways to move them safely and efficiently. Then we'll discuss ways to "model" those systems, and the advantages and pitfalls of each.

Locals aren't necessarily short trains pulled by a single engine. If there's a lot of work to do on that division, three or more units may be up front. Here a trio of Western Maryland F units picks up a boxcar loaded with bags of Kingsford charcoal at Parsons, W. Va., on the Cumberland–Elkins line in May 1973.

Smaller railroads usually survive by offering a higher level of personal attention to customers. In August 1972, the Green Mountain switched a talc plant—a good example of a small regional industry—at Gassetts, Vt., on the former Rutland line between Rutland and Bellows Falls.

Freight trains

Let's start by discussing the different types of trains, then go on to discussing how they move.

Local or way freights: For many modelers, this is where the action is as local freights (also known as way freights, peddlers, drills, patrols, shifters, sweepers, and by a host of other colorful monikers) switched towns along the line, **1**. Their role is to do most of the en route pickups and setouts to minimize delays to through and fast freights. This includes moving cars to a different spot within the same industry.

Most railroads ran daily locals in both directions or operated in one direction one day and returned in the other direction the next. Crews on opposing locals cooperated to minimize the runaround moves needed to switch facing-point spurs where possible. The part of the Nickel Plate I'm modeling ran only one daily local, scheduled as westbound second-class freight No. 45.

Some railroads ran "turn-around" locals, which typically met in the middle of a division, swapped crews, and then continued their runs. This allowed crews to get back to their home terminals each night.

Locals aren't necessarily short trains. They may look like through freights pulled by several units, **2**. Conversely, on short lines a through freight may look and act like a local, as there simply isn't enough traffic to warrant both, or customer-service concerns demand more personalized attention, **3**.

Turns: If there's enough interchange with a major crossing railroad or traffic to or from a major customer, a railroad may operate a "turn" to that point. A turn is typically a freight that heads out from a yard to a specific point short of the next division-point yard, sets out and/or picks up important cars for or from a major industry or crossing railroad, and then returns to its point of origin.

Through freights: Yards would quickly become plugged if freights weren't regularly dispatched. Cars of "dead freight" of low priority are usually moved in through freights from one division-point yard to the next. Such trains are blocked with "propers" for the next yard and "throughs" for points beyond that yard. They may also have hot cars for interchanges on their division blocked on the head end so they can make a quick setout at important junctions with foreign lines. This ensures more rapid movement of important merchandise such as fruit and vegetables, beer, and auto parts than could be accomplished by having it picked up or set out by a daily local.

Fast freights: Some trains comprise only a single block or a very few blocks. The Texas & Pacific's *Fruit Block* is an example. The train was blocked at its point of origin and hustled to its destination or the railroad that handled the next leg as fast as the railroad could manage. As little switching as possible was done at division-point yards en route to avoid delays. Yard switching can consume incredible amounts of time, so pre-blocked through trains can maintain much faster schedules.

Even a fast freight may have some "shorts" on one end for the yard switcher to cut off (see photo 2 in Chapter 1). A block of hot "throughs" may then be tacked on, along with a new caboose for the next division's crew. (In the steam era, cabooses were often assigned to conductors and went wherever they went.) Meanwhile, the road engine is being serviced or replaced, and reefers on the head end are being iced. This entire process could be done in well under an hour.

Fast freights often had marketing designations—symbols—as well as numbers. For example, what NKP's marketing and sales people saw as MB-98 usually ran on the schedule of what the operating department regarded as train No. 98. But if No. 98 were substantially delayed for any reason, the symbol could be shifted to another train to maintain the schedule that had been sold to the freight customers.

Train MB-98 was a hot eastbound out of St. Louis (Madison, Ill.) that began its run toward Buffalo at 11 a.m. each day, **17**. Half an hour later, No. 62 (PB-2) started its eastbound trek out of Peoria, Ill. MB-98 arrived in Frankfort, Ind., at 7 p.m., PB-2 15 minutes later.

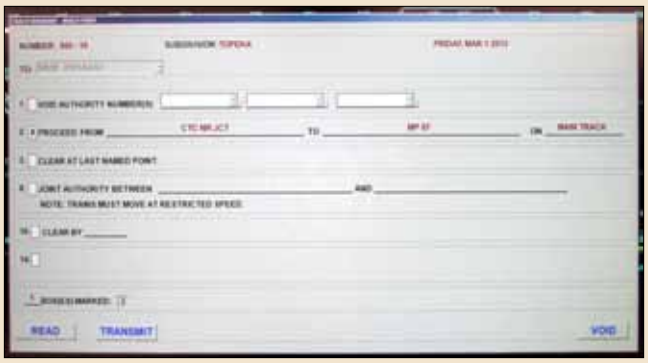
Track Warrant Control

Simple to implement, easy to use, quick to create the feel of a real dispatching system—Track Warrant Control (TWC) is the prototype's gift to model railroad operators who want to move beyond simple verbal or "Mother, may I?" dispatching.

How simple and easy? Some years ago Bill Kaufman and I were invited to the first operating session on Richard and Venita Lake's El Reno & Eldorado Railroad in St. Louis, Mo. The crew comprised Bill, me, Richard, Venita, two neighbors who were not model railroaders, and two model railroaders with no previous operating experience.

In an hour, Bill and I created the needed track warrant forms and a train sheet, then gave the crew a hands-on demo in how to use the forms. We finished by having everyone take a turn copying and repeating one warrant using FRS (Family Radio Service) radios:

"Track Warrant number 7. To 2932 East at Doughertys.



This screen shot shows what a BNSF dispatcher sees while creating a track warrant in their TMDS Track Warrant module. When complete, this warrant will give authority to BNSF 4101 East from end of CTC NR JCT to milepost 57 on the main track. *Patrick Flynn*

"Check box 1, Track Warrant number 4 is void.

"Check box 2, proceed from Doughertys to Zayante.

"Check box 6, hold main track at last named point.

"Repeat when ready."

The operating session, being a first-run, turned up the expected gremlins. But moving the trains over the railroad using Track Warrant Control went without a hitch.

Track warrants came into use in the early 1980s, made possible by reliable two-way radio communication between dispatchers and train crews. Changes in labor agreements eliminated the operators, who had been the interface between the dispatcher and the train crews under timetable and train-order operations.

In place of the train order form with its blank-page format, track warrant forms substituted preprinted instructions with check boxes and fill-in blanks. On a model railroad, no operators are needed, but a train crew has to pause to copy a new warrant each time it reaches the end of its movement authority.

Just as under timetable and train-order rules, or in any other dispatching system, the train dispatcher still has to have a way to track the movement of trains and to keep a record of the track warrants he/she issues. The dispatcher's train sheet from the timetable and train-order era can handle track warrants with little modification. Hand-drawn directional arrows in the columns showing authority limits and restrictions are about the only changes needed.

In place of a train-order book where the dispatcher writes down the train orders he is issuing, a pad or book of blank track warrants serves to record

powering the switches. The dispatcher simply illuminated a letter "S" to give a train crew the authority to operate the switch manually to take or leave the siding.

Today, hard-wired CTC machines have been replaced with computer screens and keypads.

On a model railroad, CTC offers a high degree of realism while allowing crews to enjoy authentic operation without the need to learn the intricacies inherent with TT&TO. The downside is the cost and complexity of designing, building, installing, and maintaining a CTC machine, detection circuits, and signals.

Track Warrant Control and Direct Traffic Control

The advent of reliable two-way radio systems and changes to labor agreements allowed dispatchers to communicate directly to train crews without going through operators. To avoid mistakes, Track Warrant Control (TWC) uses standardized track-warrant forms with blanks to fill in and boxes to check. (See the sidebar and examples above).

Direct Traffic Control (DTC) is similar to Track Warrant Control in that train crews use a standard form and communicate directly with the dispatcher to authorize movements. DTC uses pre-defined blocks—that is, defined sections of main track, each with a unique name. Movements are made by authorizing a train to occupy one or more blocks. It's essentially a modern version of the old manual block system with radios and

authority as the DS fills them out as he dictates warrants to train crews.

Modern computer dispatching systems have changed how things are recorded and tracked in the dispatching offices of today's Class 1 and large regional railroads for track warrants, just as they have changed CTC. Track diagrams on computer monitors have replaced train sheets. Data entry masks or input screens allow dispatchers to create trains and then log in the authority they grant with each track warrant. Internal logic helps to prevent overlapping, conflicting authority and displays trains and authority on the digital track diagrams.

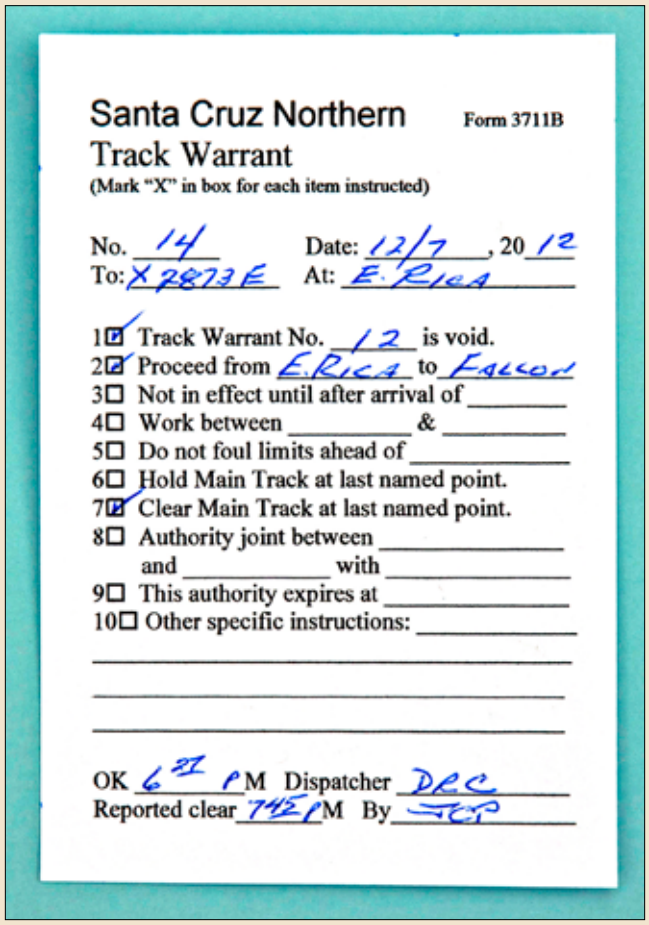
Burlington Northern Santa Fe's Train Management and Dispatch System (TMDS) is one such comprehensive computer-aided dispatch system. It has modules for both Centralized Traffic Control and Track Warrant Control. The photo at left shows the TMDS Track Warrant mask used for assigning directional authority to a train.

Train crews continue to use paper forms to record track warrants. Prototype forms have 17 or more check boxes on a full 8.5" x 11" page.

Input from professional train dispatchers has resulted in the updated and improved SCN track warrant form shown at right. It is still quarter-page size with only 10 check boxes. Gone is the attempt to improperly allow directional authority to be given twice on one warrant. Box 2 granting directional authority has been paired with Box 3, restricting such directional authority until another train arrives at the location where track warrant authority begins.

Similarly, Box 4, granting work train authority in both directions, has been paired with Box 5, which restricts the work train. Finally, a specific check box for joint authority (Box 8) has been added.

— *Jim Providenza*



Santa Cruz Northern Form 3711B

Track Warrant

(Mark "X" in box for each item instructed)

No. 14 Date: 12/7, 20 12

To: X 2873 E At: E. Rica

1☒ Track Warrant No. 12 is void.
2☒ Proceed from E. Rica to Fallon
3☐ Not in effect until after arrival of _____
4☐ Work between _____ & _____
5☐ Do not foul limits ahead of _____
6☐ Hold Main Track at last named point.
7☒ Clear Main Track at last named point.
8☐ Authority joint between _____ and _____ with _____
9☐ This authority expires at _____
10☐ Other specific instructions: _____

OK 6 37 PM Dispatcher DRC

Reported clear 7 42 PM By TCP

This example of the SCN's new track warrant first voids a previous warrant issued to SCN 2873 East, grants 2873 East authority to proceed between E. Rica and Fallon, and tells the crew to take the siding at Fallon. *Jim Providenza*

technology replacing operator-manned block stations.

Procedures directories

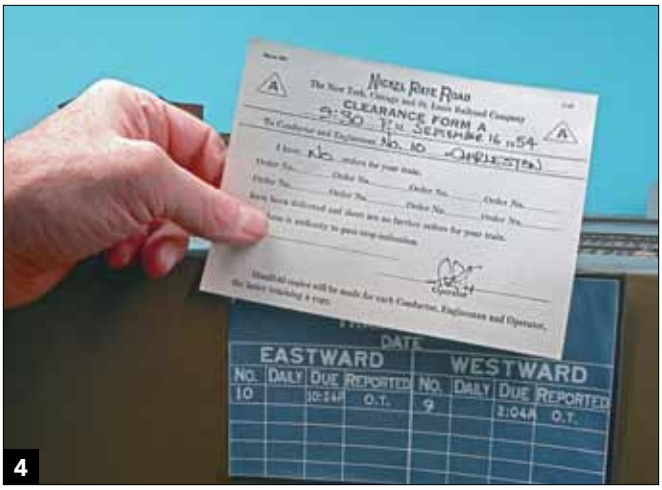
Even a professional railroader can't remember every detail he or she will ever need to know about train procedures, such as the blocking of and work performed by every train on the system. Railroads large and small therefore benefit from a train procedures manual that describes each train's consist by block and the work it does along the line.

Blocks within trains may be placed to make it easier to do en route as well as in-yard switching. A block for an intermediate junction with a branch might be put behind the locomotive(s) so it can easily be set out for later movement up the branch by a branch local or mine shifter.

This information is helpful to yardmasters, who direct the makeup of each train, as well as to the crews that operate them. A condensed version of each train's work description makes an excellent cover sheet for each packet of waybills handed to outbound crews.

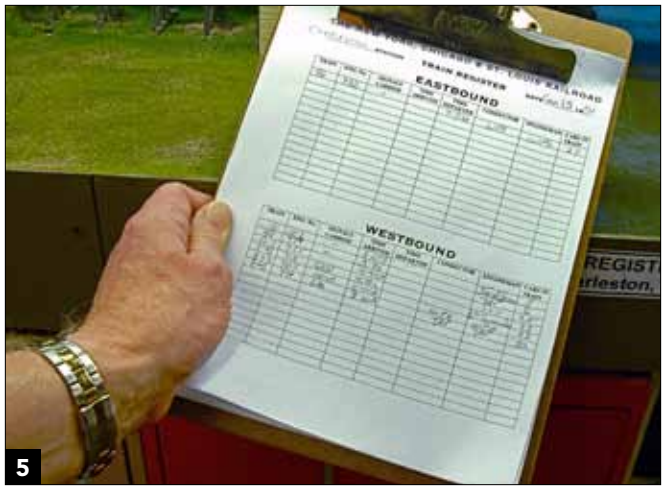
Doug Gurin and Allen McClelland discussed the Virginian & Ohio's train procedures directory on pages 75–80 of the January 1979 issue of *Railroad Model Craftsman*; that article was reprinted in *The V&O Story*, a soft-cover book by McClelland (Carstens Publications).

The Nickel Plate issued a small mimeographed booklet that showed the schedule and connections for each symbol freight, **17**.



4

At Charleston, Ill., the crew of No. 10 receives a Clearance Form A that authorizes them to assume the timetable schedule and tells them that they have no orders as they begin their eastbound run over the Third Subdivision.



5

Every train has to register in or out of a register station. Eastbound first-class train No. 10 is superior to all other trains on the subdivision, but its crew still has to sign the register so all other trains will know what time it left Charleston, Ill.

departure time at Metcalf (10:55 p.m.). You can arrive early at a station where time is shown, but you cannot depart ahead of the scheduled time. You can depart up to 12 hours late from a station; after that time, your schedule ceases to exist, and you are no longer a scheduled train. The only way you can move after your schedule expires is for the dispatcher to issue an order making you an extra.

No such calamity occurs on this early autumn evening, however, and you stay close to the advertised for the entire run. Passing Frankfort's WY Tower, you're now within yard limits, where all except first-class trains and engines must be able to stop within half of their sight distance. But as a first-class train, all inferior trains and yard engines are expected to be in the clear for you. As you cross the Monon and Pennsylvania and ease to a stop at the NKP's brick depot in downtown Frankfort, you check the clock and note with satisfaction that it's 11 minutes before midnight, exactly on time.

Upping the ante

Now that you've experienced the basics of running a superior train on a published schedule, let's hop aboard a westbound "fast freight," which—like "through freights"—is designated as a second-class train in the schedule of ETT no. 67.

You're called for No. 47, which carries the symbol NS-1 (Buffalo, New York, to St. Louis). It recently arrived from Lima, Ohio, off the Sandusky Division and is due out of Frankfort at 5:55 p.m. behind Lima-built S-1 Berkshire 718.

You pick up your engine on the ready track by the towering concrete coal dock in Frankfort and ease on down to the eastbound yard office (there is no operator in the westbound yard office) to pick up your orders and discuss the run with the conductor. He hands you your copy of the Clearance Form A showing one Form 19 order, #211 (**7**, the 11th issued today in the 200 series reserved for the Third Sub), which says:

No 42 eng 738 wait at Charleston for No 47 eng 718

Note that the superior train is addressed first in the order. The boldface type in the timetable schedule indicates that nearby Oakland, Ill., is the likely meeting place for Nos. 42 and 47. No order is needed to establish a meeting point, as No. 47 is obligated to be clear of superior (by direction) No. 42's time at any station along its run. The dispatcher apparently expects No. 42 to be running a little behind schedule, however, so he chose to hold No. 42 in Charleston Yard until you arrive.

The Form A also notes that you have one message, which reads:

No. 47 pick up six westbound loads from Milw at Humrick.

Humrick is a busy interchange, with 12,000 loads swapped between the NKP and the Milwaukee Road's Southeastern line in 1953. Many loads are reefers filled with cases of beer from Milwaukee headed for St. Louis markets.

You check the train register for overdue (by 12 hours or less) superior trains, see none, and sign the register to show No. 47 out of the westbound yard at Frankfort only a few minutes late. You cross over to the Clover Leaf District main at WY Tower, and, when the caboose has cleared the interlocking plant, accelerate out of town. There's a line of vehicles in both directions waiting as you flash across four-lane U.S. 52 and see the fixed yellow distant signal for the Chicago, Indianapolis & Louisville (Monon) crossing at Linden. But the home signal is green-over-red, a "clear" signal indicating "proceed," **8**.

Next up is Veedersburg, and again the towerman has you cleared to cross the Peoria & Eastern (New York Central System) diamond just west of the depot.

Soon you begin the drop down to the four through-truss spans that mark

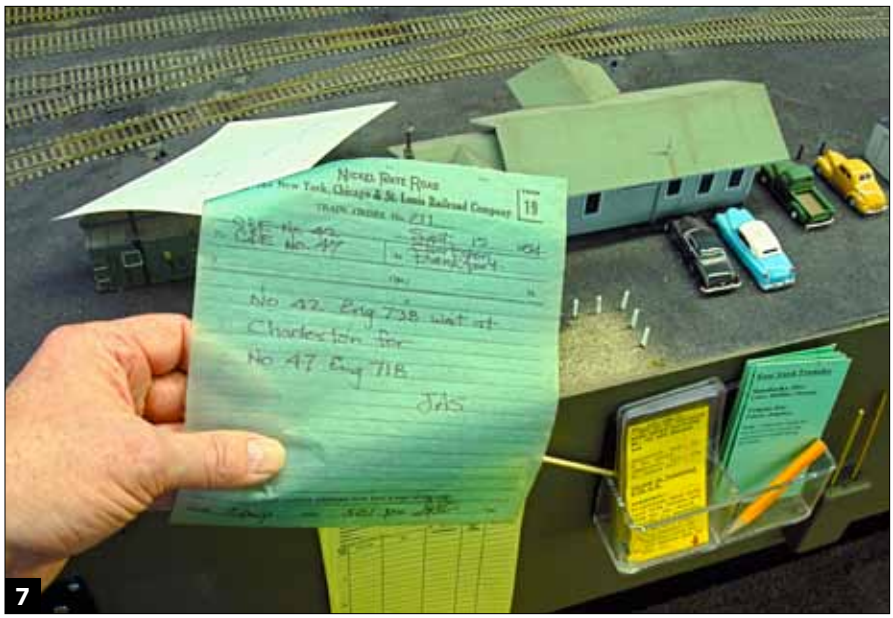
No. 10 races by Extra 612 West (note the white flags) in the passing track at Metcalf, Ill. The passenger train's crew had no knowledge of the existence or whereabouts of the extra, nor did they need to; it's the responsibility of the extra's crew to be in the clear at least 5 minutes prior to the arrival of the varnish. (Trains have to clear following first-class trains by the time shown at the next station to the rear.)

the NKP's crossing of the Wabash River, **9**. You pass the yellow distant signal at Cayuga and see a red-over-red signal at the white frame tower that marks the Chicago & Eastern Illinois crossing: stop and stay stopped. Rather than easing up to the home signal, you stop well clear of all of the street crossings in Cayuga, not so much as a favor to motorists but to give yourself a running start for notorious Cayuga Hill, which begins just beyond the diamonds. It's "only" a 1.29-percent grade, but it still has most of the reverse curves built into the line in the 1800s when a three-foot-gauge predecessor railroad depended on the friction created by these curves to help slow downhill trains in the era before air brakes.

You'll need to tap into every bit of your engine's performance and your own skills to make it up the hill without slipping and stopping. A stop means you'll have to leave part of your train on the hill while you take the head end across the Indiana–Illinois state line to the summit at Humrick, then retrieve the balance.

As you wait, a trio of blue-and-orange F units escorts a C&EI freight through town, **10**. As soon as the caboose clears the diamond, the towerman resets the plant to give you a high green. Two short blasts on the whistle and you ease your charges back into motion. You work up to 20 mph, cross the deck-girder bridge over the Little Vermilion River, **11**, and make it up the hill without stalling.

The big Berkshire keeps it feet under it as No. 47 passes the east switch for the long passing track at Humrick, but you start easing off the throttle as you approach the wood-and-brick interlocking tower at the Milwaukee diamond: The train-order



Before beginning its run at Frankfort, the crew of No. 47, carrying symbol NS-1, receives order #211, which informs superior (by direction) No. 42 to wait for them at the other end of the subdivision. Being superior, No. 42 is addressed first in the order.