The Trailing Edge

July 2022

Fulfilling a Childhood Dream – Operating a GM EMD E-8A Locomotive

After my locomotive qualitative evaluation, pointing at the "F"

Some people will tell you that the secret to a happy life is to "Follow Your Dreams". Other more pragmatic people will tell you that the secret is to be able to recognize opportunity when it presents itself and take advantage of it. While I have made a career of flying for the Air Force and flying in many different types of interesting airplanes, as well as building and flying my own airplane, there was another dream that I had which I wondered if an opportunity would ever present itself to pursue.

Throughout my life I have maintained interests in many different areas, many of which covered different areas of transportation. Clearly I have spent much time operating airplanes and automobiles. I have operated many boats, including canoes, rowboats, sailboats, and been onboard motor boats. I have toured great ships (RMS Queen Mary, USS Lexington, USS Iowa, USS Alabama, USS Drum) and even spent a night at sea on the USS Ranger. I even paid for a cruise to Ensenada.

As far as trains, I have had a model railroad at various times in my life, similar to my brother. One of our uncles was a conductor for Norfolk and Western, and thanks to him I was able to have two locomotive cab rides around a rail yard, one while quite young and another in 1984. In both cases, I really didn't have enough knowledge of what was going on to really appreciate it.

I have ridden on the narrow gauge trains at Six Flags over Texas, Disneyland, Disney World, and Knott's Berry Farm. I have ridden on the Durango and Silverton as well as the Cumbres and Toltec. I have ridden smaller trains

in Forest Park (Fort Worth), Griffith Park, and Irvine Park. I finally was able to ride standard gauge trains at the Fort Worth Tarantula and at the Southern California Railway Museum.

At the Southern California Railway Museum in Perris CA, on weekends you can purchase tickets to ride the trolley on a loop track around the museum. You can also purchase tickets to ride the standard gauge passenger train out and back over about 1.7 miles of track, departing each hour for about 15 minutes. My daughter really enjoys riding on any kind of train, and we have done these rides multiple times.

Who's That Knocking At My Door? Mr. Opportunity?

The most difficult thing about taking advantage of opportunity is to recognize it when it presents itself. Back around March 2022, I was reviewing possible activities for us to do with our daughter. I went to the web site for the Southern California Railway Museum (https://socalrailway.org/) to see what the current ride schedule was. While there, I noticed a new heading that said "Run One". That sounded intriguing, so I clicked it. To my surprise, the museum has a program where you can "rent" a locomotive for an hour, operating it up and down the museum track under the guidance of a "qualified engineer", hereafter, in keeping with airplane parlance, referred to as the "instructor".

Given the size of these locomotives, I would have expected the rental rate to have been quite steep, but it was only $250 to $350 an hour, depending on which locomotive you chose. While not a rate I would want to pay on a regular basis, it did seem quite reasonable for a one-time event. Certainly for something that I had been looking for an opportunity to do for so many decades. Plus you get a free train engineer's hat! I checked with CINCHOUSE, also known as the Minister of War and Finance, for her opinion. She thought it was a great idea, and would fit in with her plans to be down in that area for something else.

If the price still seems steep, one hour rental can be shared by up to four people. Minimum age for "training" is 18 years, but minors can participate if accompanied by an adult. My instructor told me that he had recently done a session with a 6-year-old. That sounds like quite the birthday present!

I was told that the popularity of this program had greatly increased since it was recently added to their web site, including the ability to schedule through the web site. The program had existed for many years but was not well advertised. Likewise, scheduling had to be done by phone call. With web scheduling it became far more accessible to us functioning introverts.

The program is available throughout the day on Fridays, and at 0900 and 1630 on Saturdays and Sundays. The difference comes because the regular train rides are run on the same track on the hour from 1100 to 1600.

When you arrange your training session, you have a variety of locomotives to choose from: three switchers ($250), one freight locomotive ($300), or two passenger locomotives ($350). I chose the Union Pacific 942 passenger locomotive, an EMD E-8A with the bulldog nose because when I was a kid in the 1960s, most any reference in print, books, TV, or movies to trains seemed to reference the fancy streamliner passenger trains, such as the Santa Fe Super Chief, headed by four or more EMD F-7 locomotives or other trains headed by EMD E-8 locomotives. For example, the movie *White Christmas* at 0:43:03 run time shows a Santa Fe train headed by F-7 ABBA locomotives, followed immediately by a Southern Pacific train headed by F-7 ABB locomotives (please ignore the fact that these were supposed to be the same train running from Florida to Vermont, or that Santa Fe and Southern Pacific both operated west of Chicago. Remember, Hollywood is in California). I always thought that odd, because by that time none of the locomotives I actually saw in service were of this type.

Arranging for Training

With the approval of CINCHOUSE, I went back to the web site and looked for a Saturday that I would be available. I signed up for 0900 on 23 April 2022. A day or two later, I received a very nice e-mail from a lady at the museum asking for me to reschedule, since the day I picked was not supposed to have shown as available, since they were having a special festival that day and the Run One program was not available. That's the fun of having a separate service do your booking. Eventually I returned to my calendar and rescheduled for 0900 on 21 May 2022.

On 20 May 2022, as soon as I could get off work, we piled into the Tesla Model 3 and headed toward our hotel in Moreno Valley. Because it had already been quite warm and sunny in the Antelope Valley, none of us thought to check the weather forecast for Perris. As I exited the car to plug in the Tesla Supercharger in Moreno Valley, I noticed that the temperature had dropped significantly. The forecast for the next morning was to be overcast and chilly. The good news—this supercharger was in the Target parking lot. The bad news—it's May and there isn't a lot of demand for sweatshirts. CINCHOUSE proceeded into Target to do some shopping. She found a sweatshirt for me, one size too big, on clearance for $7 (down from $21). Score! The only down side was it was the hideous fluorescent green that you see in the lead picture of this story. Actually, I figured that it would look like I showed up with my railroad safety vest on!

The next morning CINCHOUSE and her sidekick dropped me off at the museum before the appointed hour. I checked in and was handed the usual one each liability waiver that had the usual verbiage of "you can get hurt doing what you are about to do", and "if you get hurt, it ain't the museum's fault". One curious statement on the waiver was that "I acknowledge that it will be loud and noisy in the locomotive cab". Have these people ever been in an airplane cockpit? Do I need a noise cancelling headset to drive this thing? As it was, it was no louder than driving my Mustang down the highway with the top down.

My Instructor

My instructor engineer for the day was Carlos, an employee of the museum (as opposed to the rest of the people there who were volunteers). Later, in discussions while going back and forth, I would find out that in a previous life he drove the Red Trolley at Disney's California Adventure. He stopped doing that when everyone was laid off because of the pandemic closure. Of interest, his wife still works at Disneyland as one of those nice people who let you in the front gate after you've provided proof that you actually bought a ticket and have a reservation. If you ever wondered if those people get annoyed with clueless patrons who don't know the system, yes, they do. Be extra nice to them and have your ducks in a row. They will appreciate it.

As part of the introduction, he asked me if I had ever driven a train before. Wanting to let him know that I could follow directions, I replied "No, but I have flown lots of types of airplanes". This pleased him, as he replied "Oh, you're a pilot?" He then allowed as how he had been a helicopter pilot in the US Army.

With the locomotive boasting 2250 horsepower total, he asked if this was the most powerful thing I had ever operated. I said "No" and listed several airplanes that would exceed that. Discounting jet aircraft, which are difficult to compare thrust to horsepower since it is speed dependent, I would eventually decide that the most powerful thing I had ever commanded was when I had a chance to pilot an MC-130H with 18,360 horsepower available. We did find the appropriate extrema—the locomotive was certainly the heaviest thing I had ever operated. At 340,300 pounds, it was certainly heavier than a KC-135 or a C-141A.

Test Location

The track available for the qualitative evaluation was a portion of the museum's track that runs north from the museum. To minimize the number of railroading rules that must be observed, the portion of the track I was allowed to use was between the museum station and the next grade (road) crossing. This left about 4300 feet of track available. My instructor explained that nothing at the museum was procured "new", and that held for the track as well. All of these rails had previously been used somewhere else, and that much of it had been straightened from previously curved track. While the rail is serviceable and the foundation is solid, the quality of the track is not as high as on mainline track. If the locomotive or cars happen to be at a particular speed, all of the dynamics will couple up in resonance and the train will oscillate side to side.

While I have not been able to confirm it, my instructor told me that the track right of way that these tracks were laid on was part of the original right of way of the original Southern Pacific transcontinental railroad. This was not "the" transcontinental railroad built by the Union Pacific and Central Pacific to Promentory Point with the golden spike. This was a later railroad built after the Civil War. This was the railroad that runs through the Gadsden Purchase, that southern part of Arizona that the United States bought from Mexico for the purpose of getting suitable terrain for the railroad.

Test Item Description

This text lifted directly from a sign in the locomotive cab:

Union Pacific 'E-Unit' 942
Built: 1953 by EMD (Electro-motive Division of General Motors)
Length 70 ft. 3 in. Weight 340,300 lbs Horsepower: 2250

The 942 served Southern California as power for the famous Chicago-to-Los Angeles streamliner, "The City of Los Angeles", as well as other Union Pacific passenger trains of the 50's and 60's. It is part of a family of steamlined diesel locomotives that replaced the steam engine at the front of America's famous passenger trains.

In 1972, when Amtrak took over operation of the nation's passenger trains, the UP sold the 942 to the *Chicago & North Western RR*. It was renumbered 510 and assigned to Chicago commuter service. It was retired in 1988. It was restored by Museum crews in 2012.

Introduced in 1938, the E-Unit became the industry's standard passenger locomotive. More than 1,300 were produced over a 25 year period, during which time the design was continually modernized and given higher horsepower ratings. The E-unit is really two locomotives under one hood, and has two 12-cylinder Diesel engines inside. Each engine drives an electrical generator which in turn powers two motors that are geared to the axles (four of the locomotive's six axles are powered). The 942 is a model E-8A, capable of producing 2,250 h.p., and has a top speed approaching 100 m.p.h.

Diesel Engines (Prime Movers)

(*For clarity, I will use the word "engine" to refer to the actual Diesel powerplants, the things with the cylinders and pistons and oil all over. The entire vehicle, including cab, wheels, and couplers, will be referred to as the "locomotive".*)

The locomotive was powered by two (2) identical General Motors (GM) Electromotive Division (EMD) 567B Diesel engines. These V-12 engines produced 1,125 horsepower each, running at or below the amazingly high speed of 800 RPM. Yes, you read that right—the maximum RPM of these Diesel engines was less than the preferred ground idle speed of the Bearhawk (1000 RPM). Like ship engines, producing power with high displacement and low RPM makes for low wear and long life with high reliability. Each cylinder had a 10 inch stroke with an 8.5 inch bore, which meant that one (1) cylinder had a displacement of 567 cubic inches, which alone was more than the whole Bearhawk engine (540 cubic inches)! For those of you without calculators, that would be 6,804 cubic inches (111.5 liters) for the whole engine.

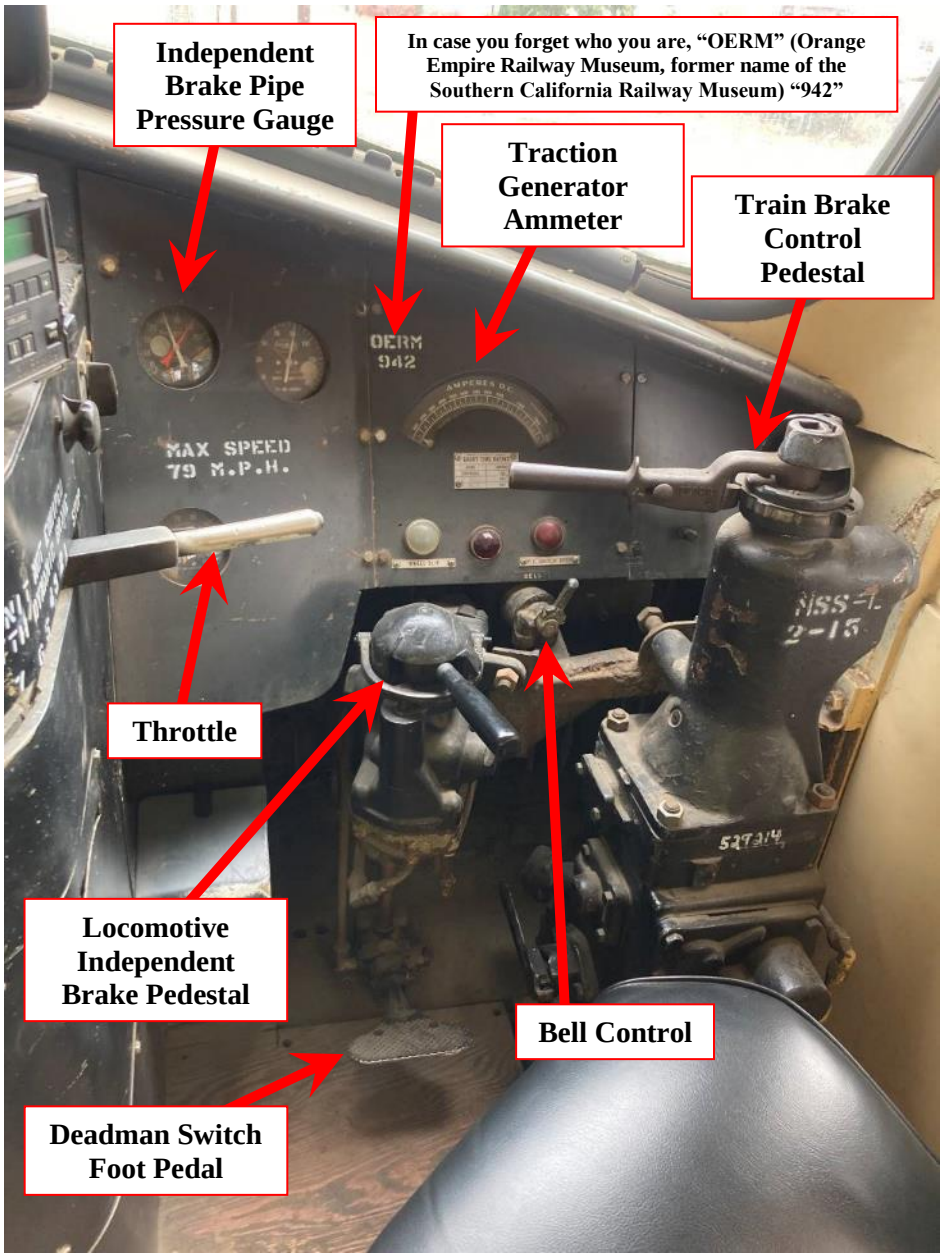
The Diesel engines ran on a two-stroke cycle, which required forced induction. Input pressure was provided by a Roots blower. The engine was liquid cooled. Output power came out both ends of the engine. At one end was a DC generator and at the other end was an air compressor.

Engine Startup

Other than the throttle, all engine controls were located on a panel next to each engine, back in the bowels of the locomotive. Starting the engines was done from these panels. This area was indeed loud, and hearing protection would be recommended. From a cold start, it would take about an hour before the locomotive was ready to move. During this time the engines would come up to operating temperature, and the air compressors would be pressurizing the various very large compressed air tanks. Since there may be no air pressure to operate the brakes while the locomotive was shut down, the brakes were applied using the old-fashioned hand brake. When the locomotive was ready to move, the hand brake must be manually released. This cannot be done from the cab, but requires walking through the locomotive to the rear wall.

Cab Controls

My instructor described the control pedestal of this locomotive as being from the "transition" period. If you chose to operate one of the museum's switchers, you would see an even older control set up. I'm not exactly sure what those looked like (since I didn't see them), but I suspect they would appear more similar to the controls used in a typical steam engine. After all, the way we tend to design new things is to make them like what we know, which is the previous version of the thing. Modern Diesel locomotives have the controls integrated together on what is essentially a desktop. This locomotive still had some similarities with steam engines with the throttle, independent brake, train brake, and other controls all separate and in different locations. The throttle was pulled rearward to increase power, similar to the throttle on steam locomotives. Modern throttles push forward for more power, similar to a car accelerator or airplane throttle.



Cab Controls

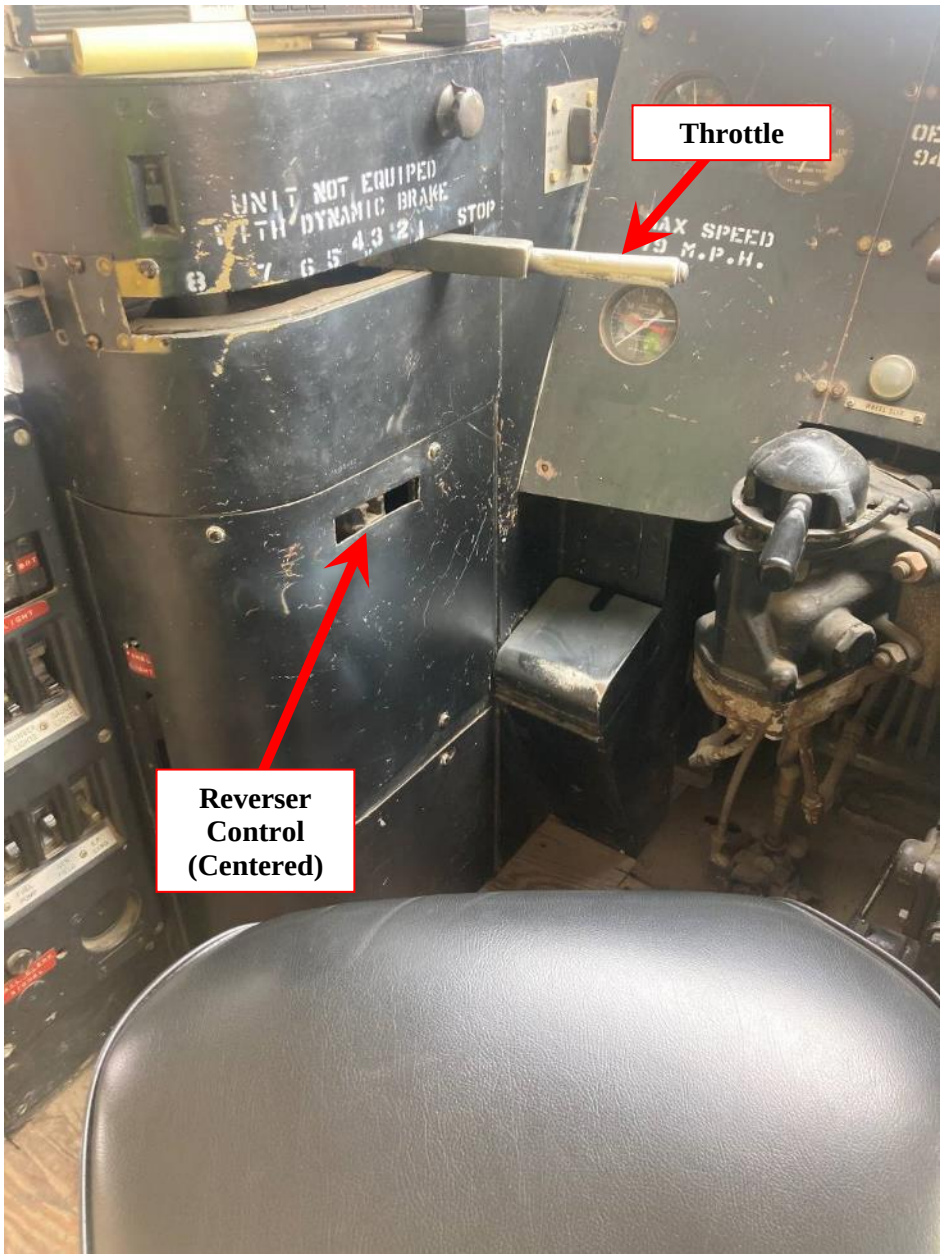
Bell

The locomotive bell rang at a repetition frequency of about 2 Hz when activated. It was controlled by a small lever in the cab and was activated pneumatically. You could actually hear a release of air pressure when turning off the bell. When the locomotive is at a stop, the bell must be activated before starting to move, and must keep ringing until the locomotive is obviously moving. Additionally, the bell was activated at all times when moving around a station platform.

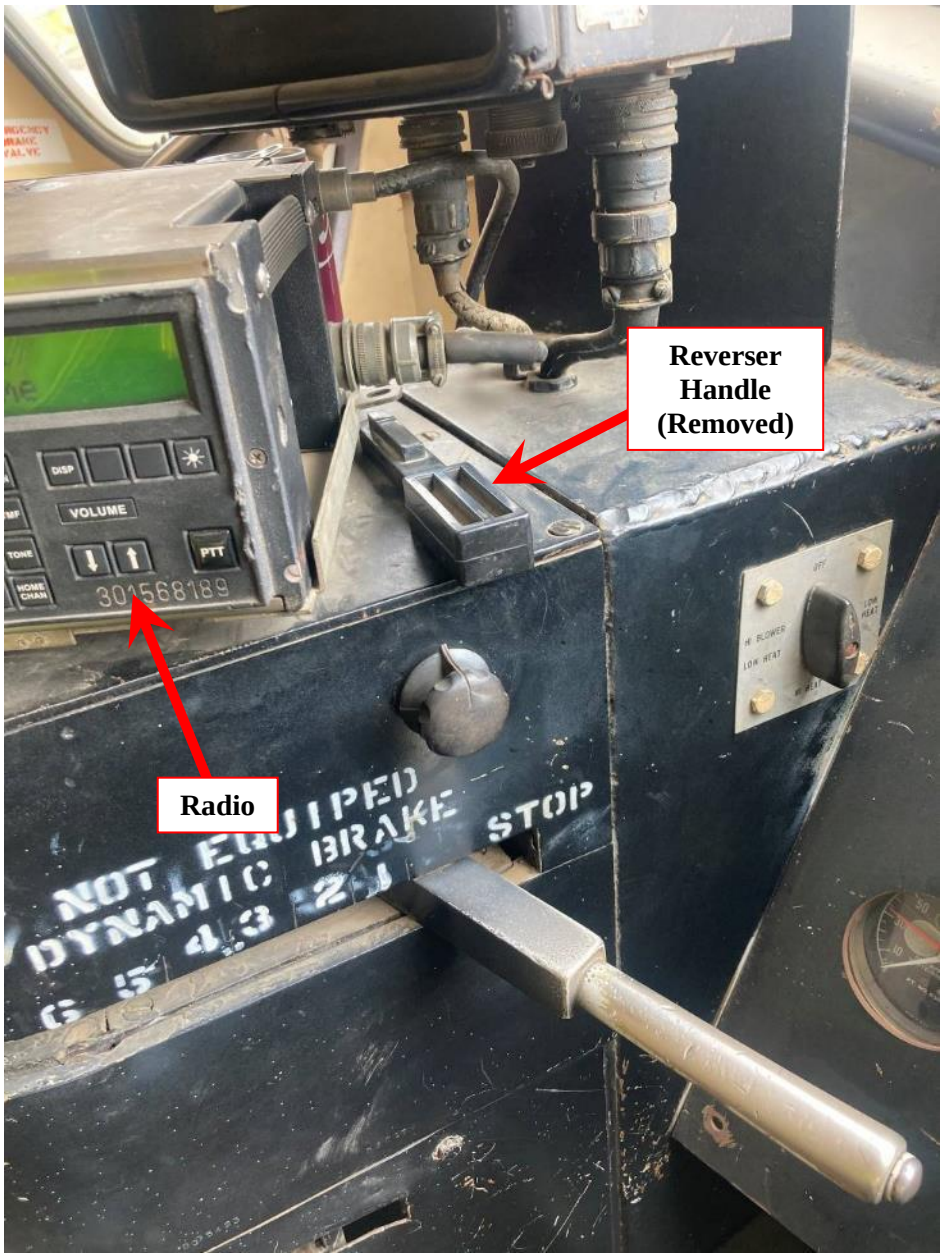
From other sources, apparently the pneumatically activated bell traces its roots back to steam locomotives, when compressed air was abundant because of its use for braking. In later steam locomotives, a steam turbine drove a dynamo which provided electricity for the headlight, but was used for little else. Of course, on older steam locomotives, the bell was activated by the fireman manually pulling on a rope.

Reverser

The reverser was roughly equivalent in function to the key switch and the gear selector in your car. The reverser came in two parts, a removeable handle and a slot to insert the handle into. After inserting the handle, the reverser could be moved to either the forward or reverse position. When the reverser was moved to halfway between forward and reverse, the handle could be removed. Without the handle inserted in the reverser, the reverser could not be moved to either the forward or reverse position. As such, removing the handle from the reverser gave a reasonable assurance that the locomotive would remain stationary, even if the throttle was advanced. Of course, someone else could come along with their own reverser handle and use it to drive the locomotive, but that's probably not a big problem, given reasonable access security.



Notched throttle and Reverser. Fancy lettering was clearly not a priority at EMD



Removed Reverser Handle and radio. The radio was used for communicating with other parts of the museum

Throttle

The throttle (perhaps not the best name for this control, but it's what we'll go with) controlled the engine RPM and thus power output. Unlike your car accelerator which provides continuous control of RPM, the throttle was quantized into eight individual notches. I asked my instructor why the throttle was quantized in notches, but he could not give me a good answer. Other sources have suggested that having a quantized throttle works better under Multiple Unit (MU) control, where one cab controls multiple locomotives. While not a digital system, you can think of a continuous control being like 1024 notches, which would be harder to detect and select than just 8 notches. Further thinking about this suggests that perhaps this was a way of dealing with the incredibly long time constant between throttle input and train response. In an airplane, we operate near full throttle most of the time, and start the takeoff by selecting full throttle. Doing the same in a locomotive would certainly cause immediate wheel slip. In a car, we can add a little throttle and see an almost immediate response, and then adjust the throttle based on that response. However, in a locomotive it would be difficult for an engineer to know how to add "a bit" of throttle and

then wait several minutes to see if that was enough. As implemented, an engineer can develop a feel of if a situation needs about one or two notches more or less throttle.

As marked on the control column, there were 8 notches and a location marked “STOP”. When the engines were in “idle”, the throttle lever was between the locations marked “1” and “STOP”. I did not investigate whether that position was the “STOP” position, or if there was one more position forward of the idle position that did something else. Thus, I will refer to this in-between position as the “idle” notch. In this position, the engines were at their idle RPM, and the generators appeared to be turned off, as the meter showing their output current went to zero.

Pulling the throttle lever back from the idle position to notch 1 caused the engine RPM to increase a set amount, and the generator output began. Further increases in the throttle were more akin to climbing stairs than walking up a ramp. That is, you can’t just pull the throttle from notch 1 to notch 8 in one motion. From notch 1, you pull back on the throttle toward notch 2, where you will hit a stop, but the throttle will not stay in notch 2. You then move it forward to notch 1 and then back to notch 2, where this time it will stay. Further increases require a similar motion. Think of it like climbing stairs by going two steps up, then one step back, two steps up, one step back, and eventually one step up to where you want to be. For reducing throttle, the throttle could be moved down any number of notches in one single motion, much like sliding down the banister of our staircase example.

Why was such a weird motion required to advance the throttle? Locomotives have very little tractive effort available because of the low coefficient of friction between the steel wheel and the steel rails. The traction motors can easily provide enough torque to overcome this friction, resulting in wheel slip. Wheel slip in a steam locomotive is very obvious because of the rapid “chuf chuf” of steam escaping the cylinders. In a Diesel-electric locomotive, the sound of the slipping wheels is easily overwhelmed by the noise of the engines and other mechanical devices, such that it is easy to slip the wheels and not know it. A light was provided in the cab to indicate wheel slip. Making it possible to only increase the throttle by one notch at a time discouraged the engineer from opening the throttle too quickly.

Generator Field Switch

An important switch on the control pedestal was the generator field switch. This switch controlled the field in the traction generators, much like the alternator switch in an airplane controls the field to the alternator. If the field was shut off, the generator produced no electrical power. The interesting point of this switch was that if it was in the “OFF” position, the throttle could be advanced and engine RPM would increase, but since no electricity was produced, the locomotive would not move. Thus, turning the generator field switch OFF was sort of like locking the “transmission” in NEUTRAL. This was a useful mode for demonstrating throttle movement before you were ready for the locomotive to actually move.

Where did the electricity come from to energize the generator field when the generators were not producing power? I didn’t ask, but I presume there was another generator that provided the electricity to power the headlight, other lights, and power for control circuits. I suspect the generator field was powered by this other source.

Electrical control panel. At the top is the radio power and the Gyralite indicator. Below them is the headlight bright/dim switch. Below that on the left is Gyralite switch (misspelled "GRYA"). On the bottom row the third switch controls the Generator Field

Ammeter

As expected, the large ammeter in front of the engineer showed the output current of the direct current traction generators. The current output did not respond immediately with the throttle. Moving the throttle from idle to notch 1 resulted in an almost immediate increase in RPM of the Diesel engine. When the locomotive was at a stop, this same throttle motion took about five seconds for the ammeter to load up to at least 250 amps, which was essentially the minimum useable current. When the locomotive was moving, the same throttle motion from idle to notch 1 took much longer, on the order of 15 seconds, for the ammeter to load up to 250 amps. I asked my favorite EE to explain this difference in response time, and he couldn't immediately come up with a good answer that either he or I liked. It seems that electric generators and motors are difficult to understand, what with all of the inductance and back-EMF going on. I'm ready to listen to anyone who has a better explanation for why the lag in generator response depends on whether the motor is turning or not.

Train Brakes

Explaining how the train "Automatic Air Brakes" controller worked is not simple because the concept of operation of train brakes is very different than any other vehicle. The key point of the design is to fail safe. That is, if something goes wrong, the brakes are applied and the train comes to a stop. Pretty much everything I know about train air brakes comes from this YouTube video by Hyce at https://youtu.be/MiAzj2SSKy4 .

The locomotive had a large air compressor connected to each engine, and these air compressors charged a large compressed air tank called the main reservoir. This reservoir was typically charged to 130 psi.

When pulling a train, the locomotive was connected to the first train car by an air hose, and each subsequent car was connected to the car in front of it by an air hose. This air hose ran the length of the train and was referred to as the brake pipe. Because of its length, the brake pipe had significant volume, which means it took a while to change the pressure in it, as a significant volume of air must be moved into or out of the brake pipe.

It would be totally impractical to use the brake pipe to fill the brake cylinders of all of the cars to apply the brakes because of the immense volume of air required to be moved. As such, a rather clever differential system was used. Each car had its own brake reservoir (air tank) which was pressurized through a check valve from the brake pipe. The brakes on each car were applied by a special valve (that I don't fully understand yet) that applied pressure to the brake cylinder from the car brake reservoir at a pressure equal to the difference in pressure between the brake pipe and the car brake reservoir. For instance, assume the car brake reservoir was pressurized to 90 psi. If the pressure in the brake pipe was reduced to 80 psi, the valve would apply 10 psi of pressure to the brake cylinders. The benefit of this weird system was that if the brake pipe was separated from the rest of the train, the pressure in the brake pipe would drop to zero (gauge pressure) and the car brakes would be applied, thus failing safe. Most cars required at least a 6 psi reduction in pressure in the brake pipe for anything to happen. Thus to get the brakes "set" (in contact with the wheels, but no significant friction) would take a 6 to 10 psi reduction.

The air brake control pedestal had a lever that moved from left to right through five different positions. The first position was called the "release" position. In this position, the brake pipe was connected directly to the locomotive main reservoir. This position allowed for rapid filling of the train brake reservoirs. When the reservoirs were at the same pressure as the brake line, the train brakes would "release". If left in the release position, the train brake reservoirs would eventually pressurize to 130 psi. You would not want to operate the train in this condition, because the first brake application would deplete the train brake reservoirs slightly, and then when the brakes were released, the reservoirs could only recharge at the rate that the air compressors could provide air.

A better way to operate this system would be to run the train reservoirs at a lower pressure, such as 90 psi. After a brake application, the reservoirs could recharge quickly from the main reservoir which was at 40 psi higher pressure. Thus, the second position on the air brake control pedestal was called the "running" position. In this position, the brake pipe received air pressure from the main reservoir through a feed valve which charged the brake pipe to 90 psi. Thus, the feed valve was like the regulator you use on your shop air to reduce the pressure for your pneumatic drill or rivet gun. As the name suggests, this was the position used for normal operation of the train.

The third position was the "lapped" position. I'm not sure of the origin of this name, but its purpose was to hold the brake pipe pressure at whatever its current value was. If there were leaks in the brake line, this position would add air at the same rate that it was leaking out so as to maintain the desired pressure.

The "lapped" position was used in combination with the fourth position known as the "service" position. In the service position, the control would decrease the brake pipe pressure at a constant rate. When the desired pressure was reached, the control was moved back to the lapped position. If the control was left in the service position, the brake pipe pressure would continue to decrease at a constant rate until reaching zero. Think of it as a rate command system. Just like when rolling into a bank, you deflect the ailerons to roll at a particular rate (service position). Upon reaching the desired bank angle, you center the controls (lapped position).

The fifth position was the "Emergency" position. This position simply vents the brake pipe to the atmosphere, resulting in an almost immediate decrease in pressure to zero. Not only does this aggressively apply full brakes, but I can imagine it would be quite loud in the cab as well.

Locomotive Independent Brakes

Each locomotive has its own brakes which can be actuated independently from the rest of the train. In this locomotive, the independent brake control pedestal was of the self-lapping type. It was similar to the train brake control in that the leftmost position of the control lever was the "release" position and the rightmost position was the emergency position. These have the same functions and purposes as described for the train brakes control above.

In between the two end positions is the self-lapping range. The left end of this range is equivalent to the "running" position above. As the lever was moved to the right, the pressure in the brake pipe reduced to a pressure

corresponding to that position and held that pressure. Thus, it was a position command system, much like how a particular throttle position in your airplane commands a certain engine power. Moving the lever all of the way to the right (but not into emergency) reduced the control pressure for the independent brakes at a constant rate until reaching zero.

Applying the train brake also caused a similar reduction in control pressure for the locomotive independent brake. For certain situations, this could be defeated by a procedure referred to as "bailing off" the locomotive independent brake. In this case, the independent brake control lever was pushed down and moved to the desired position. The portion of the control that the lever pushed down on looked like the bail (handle) on a bucket, presumably giving us the term "bailing off". This could be used for better train control. For instance, when slowing the train to a stop, the train brake was applied and the locomotive independent brake was released. In this condition, the locomotive can continue pulling the front end of the train as the train brakes bring the train to a stop. The result of this is that the train remained stretched out, preventing "slack action" when the train started moving again.

Dynamic Braking

Dynamic braking was similar to regenerative braking in an electric car. Instead of friction between brake shoes and wheels, deceleration force was provided by wiring the traction motors to act as generators, being turned by the wheels and outputting electricity. While in an electric vehicle this electricity is used to recharge the battery, in a locomotive there is no such battery to put this electricity into. Instead, this electricity was diverted to large resistor banks on top of the locomotive, where the energy was rejected as heat.

The benefit of dynamic braking is that it provides braking at the locomotive with no wear to brake shoes, so its use does not accelerate a maintenance action. Counterintuitively, there is a fuel economy hit to using dynamic braking. While the traction motors are producing energy which is being sent to the resistors, those resistors must be cooled by running fans to blow air over the resistors. These fans require power, and that power is produced by an engine driven generator. While using dynamic braking, the engine must throttle up to drive the generator to provide electricity to drive the cooling fans.

This locomotive was not equipped with dynamic braking, as clearly called out by the placard markings painted on the control pedestal. However, my instructor mentioned that some of the unmarked, unused controls in the cab hint that this locomotive may have been equipped with dynamic brakes in the past.

Headlight

This locomotive was equipped with a headlight on each end of the locomotive. On the front of the locomotive, this was the lower light. In normal operation, the headlight in the direction of movement was set to bright and the other was set to dim. Since it was daytime, we were constantly reversing direction to run back and forth, and we had exclusive use of the tracks, we just left the headlight in dim and didn't bother switching. There were enough other steps in the checklist as it was.

The top headlight on the front end was an oscillating type, meant to flash you like a rotating beacon and catch your attention. This effect can be seen in the "Cars" movie when Lightning McQueen accelerates to cross the railroad grade crossing just in front of the train (0:22:56 run time). Watch the oscillating light on the train locomotive. The movie depicts the oscillating pattern of the "Mars Light". This locomotive was equipped with a similar light from a different manufacturer called a "Gyralite", which used a different oscillation pattern from the Mars Light. This can be deduced from the switch label "GRYA" (sic) on the control pedestal. Whoever made the label apparently wasn't too concerned about spelling accuracy. More information about the Mars Light and Gyralite can be found by searching Wikipedia for "Mars Light".

Deadman switch

I know that *you* have never dozed off in class or while driving, but, believe it or not, some people have been known to doze off at the controls of a locomotive. In a car or truck, this could result in rapidly failing to make appropriate steering inputs and running off the road. Since there is no steering control in a locomotive, and the throttle is set and doesn't require constant holding, the most likely event if an engineer stops engineering is that the train will just keep going until it runs into something it shouldn't.

An early safeguard against this happening was a foot pedal that the engineer would have to hold down at any time the locomotive was in motion. If the pedal was released the emergency train brakes would apply and bring the train to an abrupt halt. While this addressed one problem, it caused another. What if the engineer got a cramp in his foot and wanted to move it briefly? Now he would have to carefully transition the pedal from one foot to the other.

This locomotive appeared to have the pedal for such a deadman switch, but I was told that it had been deactivated.

Modern day locomotives take a different approach to this problem. They work on the theory that if the engineer is at his post engineering, then he should make some sort of control input, be it a throttle movement or brake application, at least once a minute. If the alerter system does not detect a control input within the last minute, it will alert the engineer through either a light or chime. The engineer must then respond by activating a switch, usually implemented as a pushbutton (like modern day slot machines) or hitting a spring. This action will notify the alerter that the engineer is still on the job.

(I remember as a kid studying wave harmonics and damping by hitting the spring doorstops at my grandmother's house and watching how the vibration shapes would change with time.)

Starting Checklist

So what actions were required to get this locomotive moving? There was no posted checklist (though you would think there would be), but this is what I managed to pick up.

1. Activate Bell
   As mentioned earlier, the bell must be activated when starting motion from a dead stop.

2. Insert Reverser Handle
   If reverser handle is already inserted, you can skip this step

3. Move Reverser handle forward to go forward, aft to reverse

4. Blow horn (2 short blasts to go forward, 3 short blasts to reverse)
   So not only do you get to blow the horn—you're required to!

5. Move throttle to notch 1
   Always start in notch 1 to minimize wheel slip

6. Wait for the generators to load up to at least 250 amperes DC
   If you release the brake before the generators are producing sufficient current, there is a risk of the locomotive rolling backwards instead of moving forward.

7. Release locomotive independent brake
   Since we were only operating the locomotive with no train, we were not using the train brakes other than for demonstration

8. After locomotive is definitely moving, turn off Bell

Horn handle

Stopping Checklist

1. Throttle to Stop position (engine idle)
   Since the locomotive is so heavy and the track is essentially flat, it will coast for a long distance

2. Gradually apply locomotive independent brake

3. When locomotive stops, move locomotive independent brake to fully applied position

4. Blow horn 1 short blast
   This is the signal that the locomotive has stopped and intends to remain stopped.

5. Move reverser to center position
   With the reverser in the center position, the locomotive should not move if the throttle is bumped.

6. If leaving engineer's position, remove Reverser Handle

Starting the Event

After meeting my instructor and exchanging names and pleasantries, he invited me to join him in the cab. To enter the cab required climbing up the vertical ladder on the side of the locomotive. He hopped on the ladder and went up with no effort. I had seen these ladders in pictures and on models, but had never given any thought to what it involved. Because the ladder is vertical, you can't stand up on any one step like you could on a step ladder or even an extension ladder. Large handrails are provided on either side, which you should use both hands on to keep yourself from falling backwards. It works best if you hold your body as close to the ladder as possible, rather than leaning back on fully extended arms. I've seen at least one source that states that the E and F series locomotives were not popular for use in switching yards because crews would need to frequently get on or off the locomotive, and these ladders were more difficult to use than proper stairs provided on other locomotives.

Once in the cab, I was invited to take a seat in the fireman's chair, which was on the left side of the locomotive, far away from any controls. From this position, I could apply the emergency brake, turn on the windshield wipers, or use the fire extinguisher. That is to say, if I stayed in the chair, I pretty much couldn't get myself in trouble. Having me far away from the controls was important to the instructor at this moment, as he set the locomotive independent brake, and then proceeded back through the engine compartment to the rear of the locomotive to release the hand brake that had been applied when the locomotive was parked the previous night.

On a side note, the fireman's chair was a leftover from out-of-date legislation from the days of steam locomotives. Back in the day of steam locomotives and before automatic air brakes were the norm, legislation was passed defining the minimum crew for a single train. The intent was to prevent railroads from operating trains unsafely with insufficient crew in the name of saving money on manpower costs. This legislation required a train crew to consist of an engineer, a fireman, a conductor, and one or more brakemen. This was a reasonable crew when the legislation was passed. However, technology marches on, and legislation is slow to respond. Automatic air brakes made the brakeman redundant (except in switching yards for coupling and decoupling cars). A fireman had a very important job in steam locomotives, but no similar job in Diesel locomotives. However, the law is the law, and for many years of the early Diesel locomotives, there was a required position for a fireman, but no actual duties for him to perform. Eventually the law would be changed, and now trains run with just an engineer and a conductor, with a brakeman only needed occasionally for switching duties. This legal change also had a lot to do with the demise of the caboose. Without a large crew to house, plus other logistical issues with attaching and removing the caboose, there was no longer a need for it. Now the conductor typically rides at the head end of the train in the locomotive with the engineer.

Fireman's Chair

Another fun legislative requirement that existed at least for a while was that the front end of the locomotive must be marked with an "F". While it was fairly obvious for this locomotive, some hood unit diesels were not clear if they were set up to run with the long hood or the short hood forward.

Legislatively required "F" placard

The instructor assumed the position of engineer to pull out of the station because…rules. While not stated overtly, what I gathered was that since I was not in a formal upgrade program and I hadn't had "ground school" or passed a written test, there were very limited things that they were allowed to let me do. This basically came down to running on an isolated piece of track with no grade crossings and no stations.

Because we were the first train to operate that day, when we arrived at the edge of the museum property (the tracks extend well beyond the museum property), the fence gate was closed. Yes, the museum property has a fence around it, and the gate must be opened to let the trains out. My instructor pulled up to the gate, safed the locomotive, told me not to touch anything, then dismounted the locomotive to go open the gate. He reentered the locomotive, invited me to the engineer's seat, and started my lesson.

Speedometer

Safing the Locomotive

This brings up the question of how do you set up a 170 ton locomotive so that you can safely get out of it, confident that it is not going to move without anyone qualified at the controls? This was especially important when you leave unqualified people in the cab and aren't confident that they will heed your warning not to touch anything. Since you are at a stop, the throttle lever was in the idle position. The locomotive independent brake was set to the fully applied position. The reverser was centered and the handle was removed. In this position, the "transmission" was in "neutral" so the engine cannot apply any power to the wheels. As a final insurance, the generator field switch could be set to OFF, such that the traction generators can produce no power.

Cab Environment

The waiver that I was required to sign before engineering the locomotive warned that the cab of the locomotive was a noisy environment. I'm not sure what they were basing that on, because it did not even approach the noise level of a typical GA or military cockpit. There were no headsets required or provided, and conversation was at a normal or possibly slightly elevated volume. While I didn't fire up the sound pressure level (dB) app on my iPhone, the noise level didn't seem any louder than driving my Mustang convertible with the top down.

View forward out of the cab

The Lesson

After discussing the starting checklist, the first run was done in the forward direction limiting the throttle to notch 1. After about 20 seconds, the locomotive had accelerated to 10 mph, and the throttle was pushed to idle. Even without a train, at 170 tons the locomotive had a lot of inertia, and could freely coast the length of the track available. Approaching the end of the approved track, I gently applied the locomotive independent brake to bring it to a stop.

The next job was to back the locomotive to where we had started. The locomotive has less rearward field of view than a P-51B or P-51C. There were side mirrors on either side, which were tall and skinny, and gave an adequate view to the rear. If you wanted a better view, you always have the option to just stick your head out the window. Otherwise going in reverse was just like going forward, except the reverser was in the reverse position, and you tooted the horn three times instead of two. All reverse runs were done in notch 1 of the throttle.

On some forward runs, my instructor had me start in notch 1, then quickly advance the throttle to notch 2, and then to notch 3. With no train behind us, the locomotive accelerated quickly, and after a few seconds in notch 3 we were at 20 mph and the throttle went back to idle. At about 20 mph the locomotive hit resonance with the less than perfect track and began to wobble side to side. While not terribly uncomfortable, you wouldn't want to go faster and make it worse.

And thus it went, going back and forth like a horizontal yo-yo until time ran out. I spent this time asking my instructor every train related question I could think of from the last 60 years, which is how I accumulated much of this information. The rest came from Internet or other sources either in preparation for this event or afterwards to try to better understand what I had seen.

Clean Up

As we reached the end of our allotted time, my instructor needed to set up for the next events, which were the train rides for the public. It turned out that he had another "Run One" event scheduled for the afternoon after the train rides in this same locomotive, so he planned to just use this locomotive all day.

The train rides go a bit farther up the tracks than I was allowed to go, which meant the train had to pass through a grade (road) crossing. The gates were activated when the locomotive entered a particular section of track and the wheels and axles completed an electric circuit between the rails. When the train is not operating, the museum keeps the gates switched off so that a vandal cannot just connect a jumper wire between the rails and close the gates.

To activate the gates, my instructor had me drive the locomotive beyond my previous limit, coming to a stop just short of the grade crossing. We performed the safing procedure described before, and my instructor dismounted the locomotive. He walked over to the gates, opened the right box, and flipped the switch. As he did, the crossing gates came down. He closed the box and climbed back up the ladder into the cab. He then had me back the locomotive up to my previous limit, where we switched places and he backed the locomotive close to the train.

I asked him to take me into the engine compartment to show me what was there. It was definitely hotter and noisier than in the cab. I exited the locomotive through a door in the center of the engine compartment, which was a shorter ladder because the floor of the engine compartment was about two feet lower than the floor of the cab.

After dismounting the locomotive, I watched as my instructor and the brakeman coupled the locomotive to the train, getting the coupler to couple (which took two tries) and connecting the brake pipe.

Emmy and Tuki waiting for Daddy to get done going back and forth

Smelling the flowers. While waiting for Daddy, Emmy pulled Mommy into the gift shop and scored a steam locomotive and an engine named "Emily" from Thomas and Friends

Future Plans

The museum would like to extend their track so that they can run all of the way up to Perris station. This won't add a significant amount of distance to the train rides that they can use, but it should give more exposure to the museum when people see the train at Perris station.

But that's as far as this locomotive will ever go. Much like our airplanes cannot fly in certain airspace without being equipped for ADS-B Out, this locomotive can no longer be operated on the mainline railroad (known as Class I railroads). Operation on Class I railroads requires Positive Train Control (PTC), which among other things allows automatic brake application without the engineer's input if certain signals are violated. Union Pacific tours the country with their Big Boy 4014 steam locomotive, and this requires operation on Class I railroads. As such, the Big Boy was required to be retrofitted with Positive Train Control equipment. No waivers for antique locomotives.

So What's Next?

I doubt that I will go back any time soon to "engineer" another Diesel locomotive, as I suspect the experience would not be that different. I do, however, highly encourage you to try doing it yourself. If you are visiting from out of town, I'll be happy to drive you down to the museum. I'll even come along in the cab with you and watch you have as much fun as I did.

However, the museum is currently working on restoring a steam locomotive, and the web site clearly implies that it will be available for a "Run One" experience. From what I've seen on various YouTube videos, the control inputs required for a steam locomotive are very different from a Diesel locomotive. At least the air brake operation is similar. It will probably be a few years before this is available, but you can bet that I will be there when it does become available!

I was also told to expect an increase in prices for the "Run One" program. I'm told that the prices I saw on the web site were set about ten years ago when Diesel fuel prices were a lot lower. The museum board of directors was discussing raising the prices. Don't be surprised if the $350 deal goes up to something like $500.

If this experience intrigues you, you probably should act fast!

- Russ Erb