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BALDWIN 2000 H. P. DIESEL ELECTRIC PASSENGER LOCOMOTIVE

PROGRAM FOR QUALIFYING FIREMEN

## GENERAL DESCRIPTION OF LOCOMOTIVE

This locomotive is a single unit 2000 horse power, double ended Diesel Electric type powered by two 8 cylinder 1000 horse power four cycle engines with direct connected main generators. The locomotive is a class 0-6-6-0 design with two three-axle trucks. A traction motor is mounted on each outside axle of both trucks. The two traction motors of the forward truck are driven by the forward or No. 1 engine unit and the rear traction motors are driven by No. 2 engine unit.

## INSTRUMENTS AND CONTROLS

Instruments and controls necessary for locomotive operation are conveniently located in the engineer's cab. All other instruments and controls are suitably located in the engine room near the equipment concerned.

## CONTROL STAND IN CAB

The control stand contains the throttle lever and the reverse lever. Locomotive speed is controlled by means of the throttle which regulates the diesel engine speed thru a pneumatic actuator operating on the speed control shaft of the engine governor.

The reverse lever determines the direction of rotation of the traction motors by controlling an electro pneumatically operated reversing switch in the traction motor field circuit.

## CONTROL SWITCH STATION

The control switch station is mounted on the left side of the control stand and contains the following switches:

1. Control
2. Attendant
3. Defroster
4. Front Head Light
5. Rear Head Light
6. Heaters
7. Spare
8. Gauge Lights
9. Classification and Marker Lights
10. Number Lights

### DEADMAN FOOT PEDAL

This pedal is located on the cab floor in front of the enginemans seat. A service application will take place any time the pedal is released when both brake handles are in the running position. Before this application takes place, however, a warning whistle will sound, and if the foot pedal is then depressed within a 4 to 6 second period the application will be suppressed. To release a safety control application, depress the foot valve pedal and move the automatic brake valve handle to "LAP" position until the application portion releases. Then move automatic brake valve handle to "RUNNING" position in the normal manner.

### SANDER VALVE, FRONT AIR HORN, BELL RINGER

These are conveniently located in front of engineer's position. The button for the rear air horn is mounted on side wall at engineers seat.

### SPEED INDICATOR

Located at rear and above control stand

### CAB SIGNAL SWITCH

This is a combined acknowledging and cut-out switch, and is located on right wall of cab.

### BUZZER

Located under control stand and will sound when locomotive wheels slip.

### ENGINEER'S INSTRUMENTS

The dash board in front of the engineer position contains the following instruments:

Two (2) Ammeters

One (1) for the No. 1 power plant

One (1) for the No. 2 power plant

Two Duplex air gauges

Switch for controlling M.G. (Motor Generator) set for cab signal system.

### FIREMAN'S POSITION

The following instruments controls and signal lights are arranged on the instrument panel in front of the fireman's position.

- (1.) Boiler remote control panel.
  - (a.) Ground light - Boiler off light - Low Oil light.
  - (b.) Train line shut off switch.
  - (c.) Soot blower switch.
  - (d.) Separator blow down switch.
  - (e.) Master switch.
  - (f.) Train line steam pressure gauge.
  - (g.) Gauge light rheostat.
- (2.) Emergency engine stop switch.

A cabinet containing head-end lighting equipment is located on rear wall of cab (A 1 end), and suitable switches and meters associated with this equipment are mounted above the cabinet.

Also located at rear wall of each cab is mounted two liquid level gauges indicating amount of fuel oil and boiler water contained in supply tanks on locomotive.

### ENGINE ROOM

Instruments and controls for starting, stopping, and isolating the diesel engines are located on instrument panels mounted on the side wall of the engine room adjacent to each engine. These panels include the following:

1. Cooling water temperature gauge.
2. Lub oil pressure gauge.
3. Duplex fuel oil pressure gauge.
4. Fuel oil transfer pump switch.
5. Auxiliary generator switch.
6. Engine stop switch.
7. Isolating switch.
8. Engine start button.

Located in each electrical equipment cabinet is mounted a Power cut-out switch. Also in A 1 electrical equipment cabinet is mounted a Master switch, and a Battery cut-out switch.

## FIREMEN PROGRAM

### FIRST DAY

#### HEATING BOILER VAPOR CAR HEATING CO., INC. TYPE CFK 4225-2A

##### DESCRIPTION

These units have a rated capacity of 2250 lbs. of water evaporation per hour. Once a steam generator is started, its operation is automatic and full operating steam pressures are reached within a few minutes.

The heat absorbing portion of the unit consists of three sets of coiled water tubing connected together to form a single tube several hundred feet in length. The burner, which is of the air atomizing type, burns Diesel fuel oil. The flow of the hot gases of combustion is first downward and then outward thru the nest of coils.

Water enters the outer coil and, by the time that it leaves the inner coil, 90 to 95 per cent has turned to steam. The steam, with the remaining water, enters the separator where the water is removed and from where the steam flows to the train line.

Water in the separator above the height of the standpipe flows out thru this pipe and thru a steam trap and the coil of a heat exchanger on its way back to the supply tank. The feed water being pumped into the steam generator also passes thru the heat exchanger where it absorbs heat from the returning water.

The steam pressure switch controls the speed of the motor, pump and blower fan. This, in turn, governs the steam out put of the generator.

##### BEFORE STARTING

1. Set pressure switch (governed by number of cars in train) preferably to not less than 150 lbs.
2. The following valves should be open:
  - Water suction stop valve (located near treater tank)
  - Atomizing air shut-off valve.
  - Coil shut-off valve.
  - Steam trap shut-off valve.
  - Return water shut-off valve.
  - Separator blowdown valve to drain separator.
3. The following valves should be closed
  - Coil blowdown valve.
  - Water suction drain valve.

Water suction drain valve,  
Water pump test valve.  
Train line stop valve.  
Wash out solution return valve

### TO START

Engine on locomotive should be running to provide proper voltage.

1. Close steam generator main switch
2. Close ignition switch. (See that re-set buttons on control panel, stack switch and high temperature switch are in.)
3. Fill coils with water as follows:
  - (a) Turn operating switch to "Test".
  - (b) Close separator blowdown valve.
  - (c) When water rises to middle of separator gauge glass or appears out of try-cock, this indicates coils are filled.
  - (d) Turn operating switch off.

NOTE: While coils are being filled with water (which may require 5 or more minutes) check to see that spark is available by looking through peep hole glass.

4. Check atomizing air gauge. It should read from 20 to 23 pounds.
5. Close fuel manifold by-pass valve.
6. Open separator blowdown valve.
7. Turn operating switch to "Run". Fire should start immediately.
8. After fire has operated just long enough to bring steam gauge pressure up to 20 or 25 lbs., close separator blowdown valve.
9. The train line stop valve should be cracked slightly and opened gradually to maintain at least 150 lbs. on generator steam pressure gauge.

NOTE: If the unit is equipped with remote control, open train line shut-off valve by depressing lever on solenoid pilot valve before opening stop valve.

### CAUTION

Do not start generator if coils are not filled with water. If generator does not start or function properly, first check to see that all valves are in proper position.

## RUNNING ATTENTION 1/2 HOURLY

1. Use soot blower valves as follows:
  - (a) Set pressure switch to at least 150 lbs.
  - (b) Open steam admission valve to soot blower valves.
  - (c) Alternately pull each soot blower valve for several 3 second blows.
  - (d) Close steam admission valve.
  - (e) Pull each soot blower valve again to drain lines.
2. Open the separator blowdown for from 3 to 5 seconds.

## REMOTE CONTROL EQUIPMENT

The remote control panel is located on the fireman's side of the cab. Mounted on it are a master switch to make the panel operative and push-button switches to operate the soot blower, separator blowdown and train line shut-off valves. Three alarm lights are mounted on the panel and are connected to the alarm circuit of the locomotive. The lights indicate boiler off, hot engine and low oil. A trainline steam pressure gauge is also mounted on the panel.

The soot blower and separator blowdown valves can be operated by pushing the respective buttons. The steam admission valve to the soot blowers must be left open while the steam generator is operating under remote control.

The trainline shut-off valve can be closed from the cab by lifting the cover and pushing the button, but, in order to open this valve it will be necessary for the fireman to go back to the steam generator.

He should first close the stop valve, then open the latching reset on the trainline shut-off valve by depressing the lever to the position marked open, and finally slowly open the steam generator stop valve.

## TO STOP GENERATOR

For 15 minutes shut-down, it is only necessary to close trainline stop valve. For terminal stop, proceed as follows:

1. Set generator pressure switch to 200 lbs.
2. Close stop valve.
3. Turn operating switch to "Off".
4. Open coil blowdown valve.

5. When steam pressure falls to 100 lbs. close coil blowdown valve and open separator blowdown valve.
6. Re-fill coils.
7. Close atomizing air admission valve.
8. Open switches.

### TROUBLE SHOOTING

1. If motor fails to run in test position (No alarm):  
See that re-set button on relay panel is in. If lights on generator gauge panel are not lighted, it would indicate that either the main switch is open, or that one of the main fuses is blown. (Fuses are generally located in low voltage cabinet of locomotive.)
2. If motor fails to run in start or run position (Alarm bell will ring): See that the stack switch and the high temperature switch re-set buttons are in and that coil blowdown valve is fully closed, allowing plunger to trip switch.
3. If the fire fails to start and the motor shuts down, check the following:
  - (a) Ignition failure caused by ignition switch being tripped to "off" by overload in rotary converter circuit, defective or improperly adjusted spark plugs, chafed or broken cable connection.
  - (b) Insufficient atomizing air pressure due to closed air admission valve, improperly adjusted air pressure reducing valve, or clogged strainer in the air line.
  - (c) Lack of fuel. If less than normal pressure shows on the manifold fuel pressure gauge, see that the manual by-pass valve is closed, turn fuel filter handle, check for a clogged strainer in the fuel line or a leak in the fuel suction line. If manifold gauge shows pressure and the nozzle gauge does not, check the atomizing air pressure and for clogged fuel strainer in the line near the spray head. If nozzle pressure is excessive, check for plugged nozzle.
  - (d) Lack of water. Test the water pump output to be sure that there is a normal flow of water into the coils.
4. Boiler shuts down during operation:  
  
In addition to the items listed in the preceding section, check the following:
  - (a) Re-set button out on the high temperature switch. (Caused by excessive steam temperature.) This is usually due to either a lack of water in the coils or the burning of excessive fuel. Check nozzle fuel



pressure and reduce if too high. Do not attempt to adjust the fuel control. Refill the coils with water before re-setting the high temperature re-set button.

- (b) Re-set button out on the stack switch. This is usually due to the sooting up of the steam generating coils caused by incorrect air damper adjustment. The generator should operate with a clear stack. Other causes may be a lack of water in the coils or the burning of too much fuel. Check fuel nozzle pressure and reduce if too high. Refill the coils with water before re-setting stack switch button.

### SEPARATOR WATER LEVEL

If the separator does not maintain a proper water level-  
CAUTION- do not make an immediate adjustment with the fuel metering key. Wait about five minutes for the level to adjust itself. If it does not and the water level is too high:

1. Check nozzle fuel pressure-it may be too low.
2. Check to see that the steam trap and return lines are open. The feed water flowing thru the heat exchanger should show a temperature rise. If it does not, the heat exchanger may be scaled or the steam trap strainer may be clogged.

If the water level in the separator is too low:

1. Check nozzle fuel pressure-it may be too high.
2. Check for full water pump output.

### TO TEST WATER PUMP OUTPUT

Open the water pump test valve and observe the water flowing from the valve. It should run in a steady stream without any evidence of air being pumped. Another check can be made by opening the air bleeder valves slightly which should make it possible to obtain even spouts of water about one inch high. If this is not possible, it would indicate an air leak in the water suction line, a clogged strainer in the water treatment tank, or possibly a restriction in the water suction line. See that the suction line drain valve is closed. Some locomotives have a steam admission valve to the suction line-be sure that it is closed. Make sure that the water treatment tank cover handle is turned down tightly to prevent suction leak. If unit is equipped with an injector type water treater, make sure that the supply of treatment is not depleted and that the solution valve is not turned so as to allow air to enter the pump.

### TO CHECK AND SET FUEL NOZZLE PRESSURE

To check and set nozzle fuel pressure, first be sure that there is a normal flow of water into the coils. Then turn operating switch to run and see that all five relays on the relay panel are contacting so that the steam generator is operating at full capacity. The nozzle pressure gauge should read from 25 to 28 pounds. The pressure can be adjusted by turning the fuel metering key.

## FIREMEN PROGRAM

### SECOND DAY

#### REVIEW BOILER OPERATION

#### EMERGENCY ENGINE STOP SWITCH

This switch is located on dash board in front of fireman's position. It is in the diesel engine fuel pump motor circuit and must always be left in ON position, except in an emergency condition. If the emergency engine stop switch in either cab is placed in OFF position, the fuel pump motor on both engines will stop.

#### EMERGENCY FUEL CUT OFF VALVE

This valve is provided in the main suction line to the fuel transfer pumps for shutting off the fuel supply in case of fire. If operated this valve must be reset manually. It is located under a trap door accessible from inside of engine room. The valve can be closed by pulling either the pull ring located in the cab behind the fireman's position, or under the skirt of locomotive on right side in rear of A 1 truck.

#### TO ISOLATE AN ENGINE

If trouble develops with one engine, it can be isolated as follows:

Throw isolation switch on engine control panel to OFF position. This will open the traction motor circuit, and reduce diesel engine speed to idle.

#### STOPPING DIESEL ENGINE OR ENGINES

1. Place "Aux-Gen" switch in OFF position.
2. Place isolation switch in OFF position
3. Place stop switch in OFF position.
4. Place fuel pump switch in OFF position.

## FIREMEN PROGRAM

### THIRD DAY

#### OVERSPEED STOP

If the engine speed should exceed the predetermined setting of the overspeed stop, the fuel injection pump control shaft will be moved to the no fuel position by the overspeed stop thus shutting down the engine. To reset the overspeed stop insert the fuel pump priming bar into the housing to engage the tripping lever and pry downward. When not in use the fuel pump priming bar should be kept in the clip provided for it directly below the overspeed device.

#### TO CUT OUT A POWER UNIT

- (a) Proceed as outlined in "Stopping diesel engines".
- (b) Place power cut-out switch in "OFF" position.

#### TO START ENGINE AND PUT BACK ON LINE

At engine control panel

There are two engine control panels, both of which are located in the aisle of the engine room, adjacent to their respective engine.

Each engine is started independently as follows:

1. Place engine stop switch in ON position.
2. Place fuel pump switch in ON position.  
Note that both hands on oil pressure gauge register at least 25 pounds.
3. Press engine start button.  
This should crank diesel engine, If engine fails to fire after being rotated 8 to 12 seconds, release start button and ascertain reason.  
If the start button is released before the lubricating oil pressure reaches 15 pounds the engine will automatically stop.
4. Place "Aux-Gen" switch in ON position  
(The battery charging ammeter will register a current of between 5 and 50 amperes, and will approach zero as the battery becomes fully charged.)  
If both diesel engines are to be started do not close this switch until the second engine has been started.  
If the battery is too weak to crank the second engine then switch should be closed.
5. Place isolation switch in ON position.

## TO CUT OUT A TRACTION MOTOR

Proceed as outlined under "Isolating an engine".

## PROCEDURE FOR CHANGING ENDS

1. Make a full service reduction with the automatic brake valve, and place handle in "LAP" position.
2. Close double heading cock.
3. Place automatic brake valve handle in running position, and remove handle.
4. Close double cut-out cock under independent brake valve, and remove brake valve handle.
5. Place reverser handle in OFF position, and remove same.
6. Turn key for locking control push button switch box to closed position, and remove key.  
Proceed to opposite end.
7. Apply brake valve handles.
8. Open double heading cock, and double cut-out cock.
9. Insert reverse lever.
10. Insert key for push button switch box and turn key to unlock push buttons.
11. Close control push button switch.
12. Make brake test.

## FIREMAN PROGRAM

### FOURTH DAY

#### CHECKING DIESEL ENGINE LUB. OIL LEVEL

The lubricating system is filled thru the filler cap on the valve gear side of the engine case near the pump end of the engine. The oil level should be maintained between the high and low oil level marks on the dip stick located adjacent to the oil filler cap. The engine oil should not be checked for level for at least five minutes after stopping. The oil level should be checked daily.

#### ENGINE COOLING SYSTEM

The engine cooling system consists of an engine driven centrifugal pump, radiator, cooling fan and automatically controlled shutters.

#### FILLING WATER SYSTEM

The cooling system can be filled either thru the filler cap located on the cab roof over the radiator section or thru the filler lines located on each side of the locomotive. Use the side filler lines whenever possible to prevent air pockets from forming in the system.

The engine system water supply can be replenished in an emergency from the steam generator water supply.

#### TEMPERATURE CONTROL

The engine water temperature is controlled by the radiator shutters and electrically driven fans which are automatically controlled. Manual controls are provided which can be used if the automatic operation fails to function properly.

The function of the automatic temperature control is as follows:

1. The shutter switches and the fan switches located in the No 2 equipment cabinet, should be in the "Automatic position".
2. The temperature of the water flowing into the engine acts upon a bulb which is connected to a variable air pressure valve called a "Grad-u-stat".

3. The varying air pressures determined by the "Grad- $\bar{u}$ -stat" acts on an air cylinder which operates the shutters. These air pressures also actuate pressure switches which control the speed of the fan motors.
4. The cycle of automatic operation is as follows:

#### Increasing Water Temperature

Operation	Inlet Water Temperature OF.
Shutters open full and fan motors operate at slow speed	154
Fans operate at medium speed	156
Fans operate at maximum speed	158

#### Decreasing Water Temperature

Fans operate at medium speed	156
Fans operate at slow speed	154
Fans stop. Shutters close.	152

When the automatic temperature control does not function properly, the temperature control mechanism may be manually controlled.

By throwing the shutter switch to the "open" position the shutters will open full. Should the water temperature drop too low in this position, it can be increased by partially closing the shutters. This can be accomplished by disengaging the shutter control handle from the quadrant and moving it to the required shutter position.

The fans can be controlled by throwing the fan emergency switch located in the control equipment cabinet. This is a small double pole, double throw toggle switch. When this switch is in the up position, the fans are connected for automatic operation. When in the down position, the fans will run at maximum speed. When in the open position, the fans will not operate.

#### WINTER OPERATION

When the locomotive is operating in freezing weather, it will be necessary to supply steam from the boiler to the heating coil in boiler water supply tank to prevent the water from freezing. Valve No. 3 controls the supply of steam to the heating coil. It should be opened only enough to keep the water temperature above freezing.

If the locomotive is to be left outside during freezing weather, precautions must be taken against freezing the engine

cooling water and boiler water systems. Steam should be supplied to the locomotive steam line by an outside source. By opening steam valve, as shown on water piping diagram, the engine system will be supplied with sufficient steam to prevent freezing. The boiler water supply tank, steam generator coils, steam separator and water treatment tank should be drained to prevent freezing.

#### LOW OIL PRESSURE SHUT-DOWN

A safety device is incorporated with the fuel system which will shut the diesel engine down if the lub oil pressure drops below approximately 15 lbs. This safety device is automatically cut out through the action of a contactor during the time that the engine is being rotated for starting. Low lub oil pressure may be the result of one or more of the following causes:

1. Low oil level.
2. Fuel dilution.
3. Leak in pressure system due to broken lines or loose connections.
4. Faulty oil pressure pump.



## FIREMEN PROGRAM

### FIFTH DAY

#### ENGINE FUEL SYSTEM

Fuel is supplied to the engine by an electrically driven pump operating on storage battery current. This pump draws fuel from the supply tank thru a suction strainer and forces it thru a filter system to the fuel header supplying the injection pumps. A by-pass valve located at the end of the header regulates the fuel supply pressure to the injection pump. The excess fuel from this valve is returned to the supply tank. Individual injection pumps are located adjacent to each cylinder with high pressure lines to the injection nozzle mounted in the center of the cylinder head. The injection nozzle is a multi-orifice type and sprays a symmetrical pattern into the combustion chamber.

#### FILLING FUEL TANK

The fuel tank is filled from either side of the locomotive. A gauge is located near the fill connection indicating the level of fluid in the tank.

#### FUEL FILTERS

The fuel pump is protected by a metal edge type fuel strainer placed on the suction side of the pump. This strainer should be removed periodically for cleaning.

The fuel injection pumps are protected by a double unit, cotton waste type filler in series with a triple unit cotton twine type filler. These filter elements should be replaced periodically.

#### LOSS IN FUEL PRESSURE

A loss in fuel pressure may be the result of one or more of the following causes:

1. Fuel pump failure.
2. Fuel pump motor failure.
3. Leak in suction strainer.
4. Plugged suction strainer.
5. Plugged fuel filters.
6. Pressure regulator valve stuck open.

#### HEAD END TRAIN LIGHTING

A head end lighting generator is mounted on each main

generator. It is driven by vee belts from the "Aux-Gen" and will be running at all times that the diesel engine is running. The circuit to each generator is controlled by suitable switches located on the back wall of the cab A 1 end. These switches are marked "Head End Gen.#1" "Head End Gen.#2.

To cut in the head end lighting system

Place both switches in ON position. Both of these switches should be left in OFF position when the head end lighting system is not in service.

The amperes and voltage of train lighting can be checked by means of selector switch and meters located on right of the switches.

Before the head end lighting switches are cut in when coupling to a train it must be known that the coupling has actually been completed and man in the clear to avoid spark burns.

## FIREMEN PROGRAM

### SIXTH DAY

#### AIR SYSTEM

##### AIR COMPRESSOR

Each power unit in the locomotive is equipped with a two stage air compressor which is driven by the main generator shaft thru a flexible coupling. The compressor has its own lubricating oil system and the oil level should be checked daily and maintained within the limits indicated on the dip stick.

Main reservoir pressure is regulated by an unloading governor set to close at 125 pounds and open at 150 pounds. Main Reservoir pressure is indicated on a duplex gauge at the engineer's position. If the pressure rises above the governor cut out setting make sure the governor cut out cock is open. Daily inspection should include checking the safety relief valve operation and draining all points in the system provided with cocks for blowdown.

##### MAIN RESERVOIR AND FILTER BLOWDOWN

Condensates in the main reservoirs are handled by automatic blowdown valves and require no attention other than periodic inspection. All filters in the system should be drained daily thru the blowdown cocks provided.

##### CONTROL AIR SYSTEM

Air is supplied to a control reservoir by a feed valve set at 70 pounds pressure. This air is used for engine speed and exciter field control, and motor reverser switches. A further reduction of pressure to 17 pounds by a separate regulator valve furnishes air for cooling system shutter control and cooling system fan motor control switches.

##### CAB SIGNAL SYSTEM

This locomotive is equipped with code cab signal system.

The equipment box is located in the nose of locomotive A 1 end. There are four cab signal indicators located as

follows, one in each cab, and two in the engine room. There are three warning whistles located as follows, one in each cab and one in the engine room. On the right wall of each cab is mounted a combined acknowledging and cut-out switch. On the dash board in front of engineer's position (A 1 end) is mounted a switch for starting or stopping the M.G. Set that furnishes proper voltage for the cab signal system. In the nose of locomotive (A 1 end) right side is located the cock that controls the air to the whistle.

To cut cab signal system in

Place M.G. switch in ON position

Place handle that operates combined acknowledging and cut out switch in middle position. (Locomotive operating end)

Check that combined acknowledging and cut-out switch in opposite cab is in cut-out position.

Check that main switch (located on right end of equipment box) is in ON position.

Open air cock that controls air to whistle.