FMW INSPECTION REPORT OF

ERIE LACKAWANNA Nº 3372

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MOTIVE POWER REPAIR DIVISION

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INTRODUCTION

FMW Solutions LLC ("FMW") was retained to perform an in-depth inspection of former Erie Lackawanna / New Jersey Transit ("EL") diesel-electric locomotive No. 3372 ("No. 3372"), which is a 1971-built General Electric U34CH type locomotive. The locomotive is owned by the United Railroad Historical Society of New Jersey ("URHS").

A one day inspection of the locomotive was performed by FMW *Director of Motive Power Services* Doug Crawford and FMW *Director of Short Line Services* Bruce Crawford on May 24, 2022. This inspection enabled the FMW team to review all major, accessible areas of the locomotive. The locomotive has been out of service since the early 1990s, though FMW understands that the prime mover may have been started sometime in the mid-2000s.

FMW's inspection revealed multiple issues with the locomotive, however it is our believe that nothing our team found is of "terminal" nature. As such, we are confident that this locomotive is a prime candidate for restoration to operation, as is outlined by the URHS. The following sections of this report outline the detailed findings of FMW's inspection.

1. HISTORY OF EL 3372

Former Erie Lackawanna Railroad ("EL") diesel-electric locomotive No. 3372 is a true New Jersey relic and a last of its kind. By the late 1960s, the commuter train equipment operating between Hoboken, New Jersey, and points elsewhere in the Garden State were at the end of their useful life. The locomotives at that time were nearing thirty years in age and the passenger cars hauling commuters on a daily basis had been built to operate behind steam locomotives in the first half of the 20th Century.

The EL worked in conjuction with the New Jersey Department of Transportation ("NJDOT") to source a new era of commuter rail locomotives and passenger cars. Pullman-Standard answered the call for passenger cars, delivering a fleet of "Dieseliner" cars, which featured extruded aluminum body, climate control, and modern amenities. To haul this fleet of new equipment, NJDOT was approached by General Electric with a motive power solution.

By 1970, GE's "Universal" series of locomotives had been in production for 14 years, and many of the original quirks associated with the design had been resolved. Known by many in the industry as "U-Boats," these locomotives were a robust attempt by GE to complete with the EMD "General Purpose" and "Special Duty" line of locomotives.

GE had introduced the 3,300 horsepower U33 series of locomotives [below] in 1968, and mechanical engineers at the company had determined they could increase power output of the prime mover to 3,600 horsepower by using steel-crowned pistons and an increased compression ratio. The passenger locomotive proposed by GE called for a head-end power ("HEP") generator to be driven off of the prime mover, which limited the speed of the engine to 900 RPM to ensure proper frequency of the HEP generator. This lower engine speed limited traction horsepower to 3,400.

NJDOT placed an order for 32 locomotives in 1970 (EL 3351-3382), with delivery between 1970 and 1973. Because the HEP needed to be delivered at 480v, 3 phase alternating current, and because it was tied directly to the prime mover, the prime mover of the locomotive needed to operate at a steady speed of 900 RPM, as opposed to the maximum RPM of 1050 for the locomotive. Therefore, regardless of the engine notch, the locomotive would operate at a continuous speed of 900 RPM when in passenger service.

Along with the Comet cars, the U34CH pioneered the push-pull operation of commuter trains in New Jersey. This is the same arrangement that commuter trains operate in today. As described by the URHS:

> *The U-boats represented the turning point in New Jersey railroad history, as they bridged the gap between the first generation diesels from the pre-Conrail era and the modern head end powered passenger equipment of today. The story of New Jersey railroading would not be complete without including the U34CH, which is why the URHS finds it imperative to save the last one in existence.*

No. 3372 was built in April 1971 as construction number 37650 in Erie, Pennsylvania. It operated on behalf of EL until 1976, when EL was merged into Consolidated Rail Corporation ("Conrail"). The locomotive was renumbered 4172 [below] and it continued in operation for Conrail until 1983, when NJT took over all commuter rail operations. No. 3372 operated on behalf of NJT through the early 1990s, when the fleet was replaced by EMD GP40PH-2B locomotives.

Once replaced by other locomotives, NJT sold all locomotives for either scrap or export to other countries, except for No. 3372, which was donated to the URHS. It is unknown if any of the locomotives sent to Mexico and Brazil remain today. No. 3372 was stored for a number of years at the New York and Greenwood Lake Railway, where it remained until 2014.

Most recently, the locomotive was returned to the URHS West Boonton restoration facility, and this report documents the initial, detailed mechanical and electrical inspection of the locomotive in support of its proposed restoration to operation.

2. RESULTS OF LOCOMOTIVE 3372 INSPECTION

FMW performed a visual inspection of No. 3372, which included inspecting all accessible components of the locomotive. The following subsections of this report outline FMW's general findings.

As reported in the introduction, FMW believes the locomotive is in fair condition, and nothing was identified during this initial inspection that our team would deem "terminal" to the future restoration to operation of No. 3372, as planned by URHS. This inspection was completed by FMW *Director of Motive Power Services* Doug Crawford [SHOWN AT RIGHT] and FMW *Director of Short Line Services* Bruce Crawford on May 24, 2022.

2.1 WHEELS, TRUCK & UNDERCARRIAGE

FMW inspected all wheels on No. 3372, utilizing an AAR wheel gauge. Those measurements are provided in Table One - flange height was recorded as acceptable on all wheels, thus it is not included in Table One.

TABLE ONE: WHEEL REPORT

WHEELSET	LEFT SIDE		RIGHT SIDE	
THICKNESS:	FLANGE	TREAD	FLANGE	TREAD
AXLE 1	0/5	26	0/8	28
AXLE 2	0/4	28	0/7	28
AXLE 3	0/8	26	0/3	26
AXLE 4	0/2	24	0/5	24
AXLE 5	0/2	27	0/0	28
AXLE 6	0/3	36	0/3	34

There is enough tread left to re-profile the wheels, but there is not sufficient tread remaining to cut an as-new profile on all wheels. Given the anticipated future use, the wheels will be serviceable for a considerable time with a renewed profile. The front truck is missing a brake cylinder on the fireman's side, though it is reported to be on the premises. The remaining brake rigging appeared straight and serviceable.

The truck castings appeared sound and no cracks were observed. Side bearing clearance is acceptable. Axles showed minimal lateral play and are well within FRA guidelines.

Side bearing clearance

Box lateral in pedestal

Missing brake cylinder

No derailment damage was observed on the fuel tank. Most components exhibited surface rust, including the fuel tank and air pipes. The air tanks appeared sound and have been drilled to alleviate hydrostatic testing requirements. The 752E8 traction motors showed indications of 81:22 gearing (75 mph) that, while once common, is fairly rare today. Axle alternators were missing on several axles. The locomotive frame, couplers, draft gear and coupler pockets all appeared to be in good shape, showing only minor corrosion.

2.2 CAR BODY

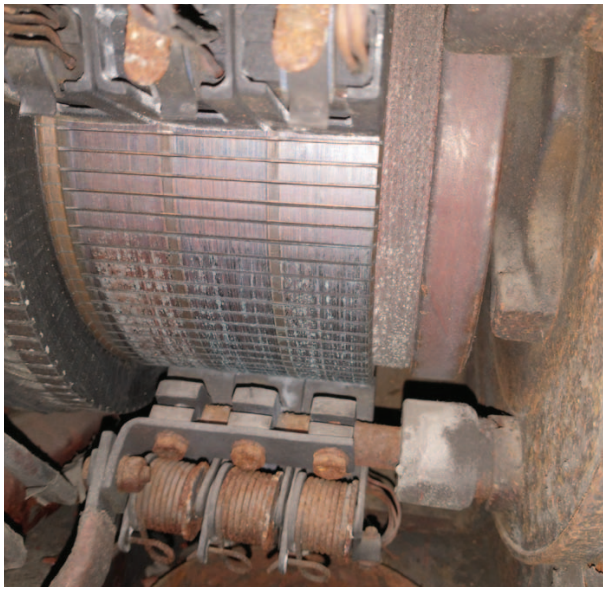
The car body shows signs of surface corrosion and fatigue. There is some perforation on the cab walls and around radiator cooling air inlets but, for a 50-year old GE locomotive, the car body is in remarkably good shape with minimal perforation and surface rust. The car body appears to be straight with no major crash damage evident. That said, the paint is beyond its service life.

The cab is spartan, and it shows little sign of abuse or corrosion and appears complete. Several pieces of glazing are cracked and will need to be replaced.

2.3 HIGH VOLTAGE SYSTEM

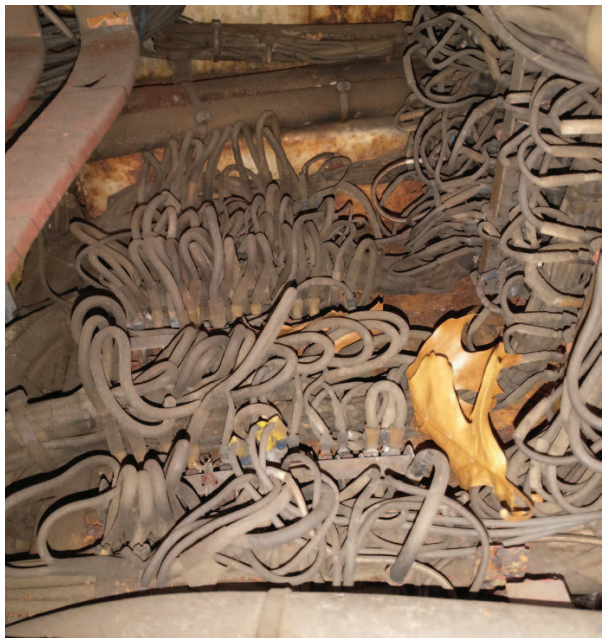
The high voltage system has been vandalized, with multiple pieces of its aluminum cable having been stolen. Traction motors 1, 3, 4, 5, and 6 have had the leads cut [SEE BELOW]. Vandals also removed cable and lugs from the locomotive frame in several spots necessitating new lugs and cable on the locomotive side in addition to the traction motor cable repair. Further, cable and bus bar/components were removed at the main alternator and the diode/rectifier assembly.

On the positive side, the main alternator was re-wound in 1988, just a few years before the unit was parked, and it exhibits no signs of electrical ground. The alternator slip rings appeared in typical condition. FMW completed ground checks at the reverser high voltage leads and they showed clear, however the ground relay cutout was found to be open. The reverser itself, as well as the power contactors, appeared serviceable, and the exciter commutator is tarnished but usable.



2.3 LOW VOLTAGE SYSTEM

The low voltage half of the electrical cabinet show signs of damage from the aforementioned car body water leaks. While the cabinet is rusted, it has not yet perforated.



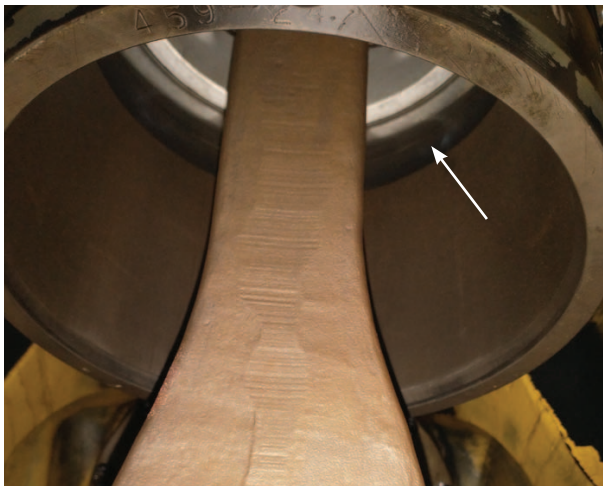
Terminals and terminal boards will need replacing before unit can be placed into service. Further, many of the low voltage relays show signs of corrosion and this will surely cause intermittent electrical issues in the future from both sticking contacts and interlocks. Added resistance at wire terminal ends will also be an issue. The photographs above show general condition of the low voltage wiring system.

The headlights are missing at the rear of unit. It is anticipated that there will be multiple circuits that will require repair, but No. 3372 does not require a total low voltage rewire. Insulation condition appears quite good, and it is primarily terminal ends, boards, and minor vandal damage that will require repair. Multiple checks on low voltage wiring in the electrical cabinet revealed no grounds.

All the panels and GE blue cards appeared present and complete, however we anticipate card damage from age and the high humidity. The aux gen. commutator appeared tarnished but otherwise usable.

2.4 MECHANICAL SYSTEM

The radiator fan angle drive and drive systems for it, compressor, traction motor cooling fan, and HEP alternator appeared complete, free, and functional. The water cooled compressor exhibits substantial surface rust, but no apparent physical damage was noted. FMW was not able to check if it was seized.

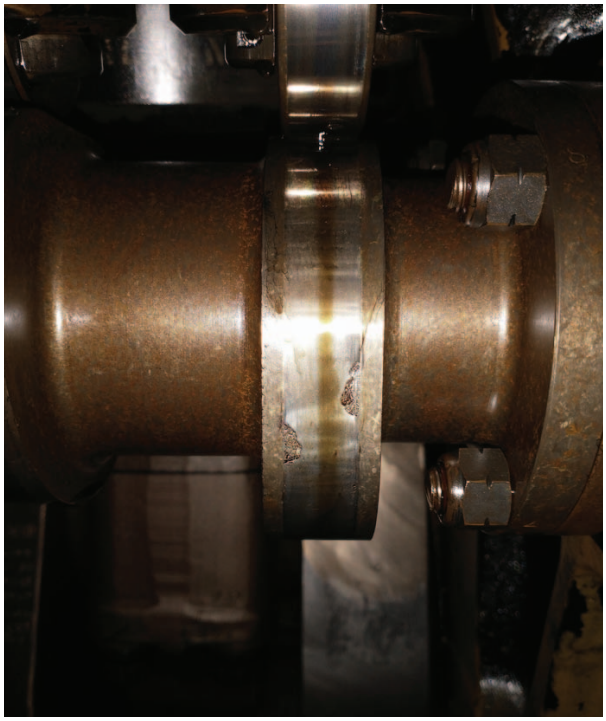


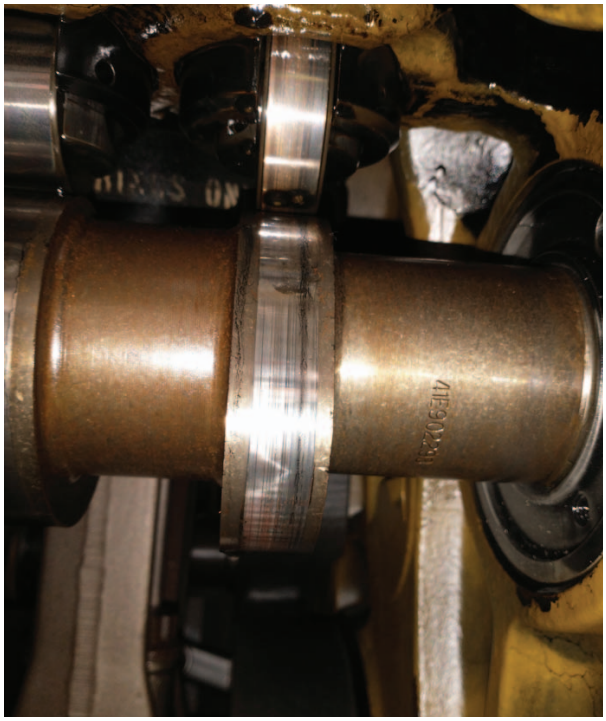
The prime mover block, crank, and rods appeared whole and undamaged. The crankcase is exceptionally clean. No signs of water damage or corrosion from an uncovered stack was observed upon inspection of crank areas or rods. Very light surface corrosion was seen on the bottom of several liners. It appears the crank had been rotated a few degrees in recent years (note the band lacking surface rust on liner below the piston [ABOVE LEFT] and the four rows of shiny commutator bars in the aux gen. [NOT PICTURED]. No signs of rod or main bearing distress were observed.

The fuel racks were seized on all but L5, R3, and R7 injection pumps [BELOW LEFT]. The system appeared complete otherwise. The intake manifold was inspected on the engineers side and showed typical minor carbon deposits in the intake ports with minimal oil evident [BELOW RIGHT]. The turbine side of turbo was covered and

the system appeared complete otherwise. The lack of leaf litter also indicates that the stack has been covered at least the majority of the time.

The prime mover had several cam segments spalling with accompanying crosshead issues. This is damage from use, not storage, and it was most likely present/occurred when the unit was still in service with NJT. There were no signs of major oil or water leaks in the car body from last time engine was run. Oil in the sump was at a normal level, and it did not show signs of water contamination.





2.5 HEP SYSTEM

The head-end power system and panels were found to be complete, except for some minor under frame vandal damage. One card in the HEP panel was replaced not soon before unit was retired, indicating potential issues with the regulator.

4. FINDINGS

Following discussions with URHS President Kevin Phalon, FMW understands that a complete class overhaul is neither desired nor feasible. Based on the overall condition of the unit and its anticipated use, we believe that No. 3372 can be restored to operating condition with the use of field repairs. These repairs would take place in phases to facilitate fundraising opportunities.

While No. 3372 is an older GE locomotive, FMW would point out that many parts both electrical and mechanical were utilized into the Dash 9 models which are still in service today, thus there many of the components are readily available. For other legacy parts, such as the blue cards, FMW is able to repair these in-house.

Our team therefore suggests undertaking the following restoration plan.

Phase One: An initial two week work blitz could see the locomotive returned to idling condition. In this phase repairs would be made to allow the unit to be started and idled for a period of time during an open house.

The detailed work for Phase One would include:

- Free up/repair injection pumps.
- Repair/qualify low voltage circuits for: fuel pump, starting circuit, charging circuit, water temperature, oil temperature, and governor circuits
- Check compressor oil
- Lube drive shafts, fan bearings, and angle drive
- Check/service acc case drive oil
- Fill cooling system and repair water leaks
- Replace air, fuel, and oil filters
- Pre-lube and repair oil leaks
- Bar engine over
- Perform close inspection of oil cooler for leaking between coolant and oil
- Adjust valves, check injection timing, set racks
- Install batteries
- Pre-lube again
- Start engine
- Address cam segment/cross heads and other issues as needed.

Other possible issues after starting could include but not be limited to cam segments, crossheads, sticky valves, turbo, governor faults, leaky radiators, more oil and/or water leaks, compressor seizing, thermostat/diverter valve malfunction, injectors and injector pumps, etc. Typically, after sitting dry for

long periods, the water pump seal leaks but, it usually stops after a minimal time idling.

Phase Two: HV, LV, compressor/air, and cosmetic repairs would be made to allow the unit to move under its own power as well as become presentable. Detailed scope of work tasks would be finalized as timing and fundraising dictates.

Phase Three: Low voltage and panel repairs would be completed along with any other necessary mechanical repairs (such as air brake renewal) to allow the unit to pull passenger cars at track speed and be FRA compliant. Detailed scope of work tasks would be finalized as timing and fundraising dictates.

Phase Four: The HEP system would be returned to service. Detailed scope of work tasks would be finalized as timing and fundraising dictates.

The railroad preservation industry is continuing to turn its sights on the restoration of second-generation diesel-electric locomotives, and the goals outlined by the URHS in its ambitions to restore No. 3372 are realistic and of significant value to the railroad preservation of New Jersey. We look forward to assisting URHS over the coming years to see No. 3372 roar back to life and, again, haul passenger trains in the Garden State.