TECHNOLOGY DIGEST

Timely Technology Transfer

"PREVENTION OF SPILLAGE DURING DIRECT TRUCK TO LOCOMOTIVE FUELING,"

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Summary

A study conducted by the Association of American Railroads (AAR) has determined the primary causes of fuel spills during direct truck to locomotive (DTL) fueling. Spills occur most often because of overfilling when the automatic shut-off mechanism in the fuel delivery system does not function or because the operator is unable to reliably determine the fuel level in the locomotive. Prevention of spillage requires concurrent use of several types of spill prevention measures. Short-term remedies to prevent spills include providing preventive maintenance for locomotive fuel tank gauges, sight glasses and automatic shut-off systems; training fuel delivery personnel; metering fuel delivery; eliminating the practice of filling the tank to its maximum possible capacity (aka "topping off") and providing systems to collect spillage at fueling areas. Long-term remedies include reliable, low maintenance tank gauging systems and new fuel delivery systems with reliable, durable, universally compatible, fail-safe, automatic shut-off features.

DTL fueling offers many benefits to railroads but as the practice becomes more common, the number of fueling locations and potential spill sites increases. New and existing environmental regulations will pose increasingly burdensome costs on the railroad industry if fuel spillage cannot be prevented.

Suggested Distribution:

- ☐ Environmental
- ☐ Fuel Purchasing
- ☐ Fueling Facilities
- ☐ Mechanical

Association of American Railroads
Research and Test Department

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INTRODUCTION AND CONCLUSIONS

Increasingly, railroad locomotives are being fueled directly from tank trucks at trackside (Figure 1). An Association of American Railroads (AAR) survey indicates that this type of fueling is occurring at over 500 North American locations and this number is likely to grow. Advantages of this form of fueling

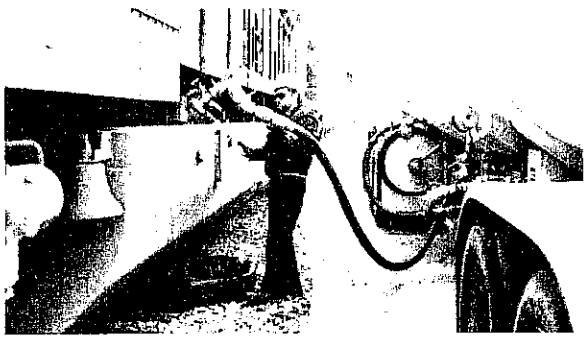


Figure 1. Direct Truck to Locomotive Fueling

relative to fixed facility fueling include reduced direct labor, flexibility in purchasing and issuing fuel, reduced capital and operating costs, increased locomotive utilization, operational flexibility, and minimized train delay. However, there are also potential concerns associated with direct truck to locomotive (DTL) fueling. Chief among these are environmental concerns that stem from the increased potential for releases to the environment and the cleanup and compliance costs should a release occur.

Fuel spillage can contaminate surface water, stormwater, soil, and groundwater. Such spills can lead to costly cleanup efforts. Cost for remediation of sites contaminated by diesel fuel spillage can range from $20 to over $60 per gallon spilled. Furthermore, heavy fines may be levied on the owner or operator of a facility responsible for the spillage. Releases that contaminate stormwater runoff at permitted facilities or threaten waterways must be reported under federal regulations, and additional reporting may be required under state and local regulations. If the industry cannot prevent fuel spillage at DTL sites, improvements in facilities and/or operations will be required by regulators to prevent subsequent releases. If releases continue, systems to collect spilled fuel or other preventive measures comparable to fixed facilities may eventually be required. Some DTL fueling operations presently incorporate containment features; however, installation of extensive containment may not be economically acceptable at all DTL fueling locations.

The most frequent cause of fuel spills is overfilling the locomotive fuel tanks. Overfilling commonly occurs because the automatic fuel shut-off system fails. It can also occur when fueling personnel who are "topping off" the fuel tanks cannot reliably determine the fuel level in the tank because the fuel sight glass is unreadable, and the locomotive fuel tank gauge is inaccurate. The sight glass and fuel gauge on the same locomotive frequently indicate substantially different amounts of fuel in the tank at the same time. This is illustrated in Figure 2 in which the gauge reads 1,000 gallons while the sight glass on the same locomotive simultaneously reads 4,000 gallons (which in this case was believed to be approximately correct).

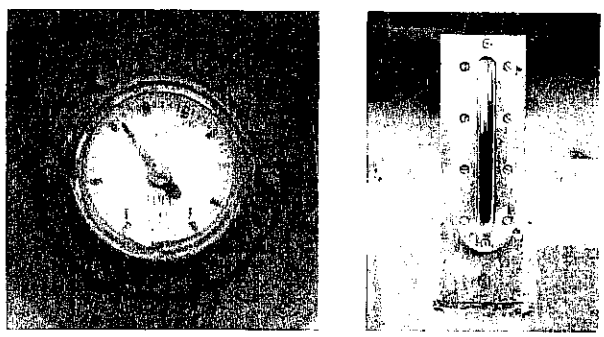
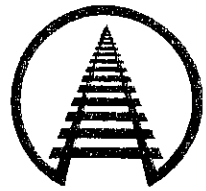


Figure 2. Inconsistent Readings on the Fuel Gauge and Sight Glass on the Same Locomotive at the Same Time

SHORT-TERM SOLUTIONS

Prevention of spillage during fueling requires concurrent use of complementary systems. This is particularly true given the limitations imposed by currently available equipment. The most needed short-term improvement is accurate, readable sight glasses and fuel gauges. These provide information to help operators avoid overfilling the tank. Proper functioning of the automatic shut-off system requires that the fueling receptacle on the



locomotive tank (referred to as the "adapter") and the fuel delivery nozzle be compatible. Both the fuel gauging system and the automatic shut-off systems must receive regular, scheduled maintenance for them to function reliably.

Operator awareness and training is also vital to prevent spillage during fueling. Fueling personnel should be aware of the liability associated with fuel releases to their company, the railroad, and to themselves. Training should include thorough instruction on the operation of the truck, pumps, fuel delivery and receiving systems, and spill response and cleanup notification procedures. Several railroads have developed detailed operating manuals for DTL fueling.

Attempts to fill the tank to the absolute maximum possible capacity should be eliminated. This can lead to spillage during and after fueling. If all fuel caps are not thoroughly secured and the locomotive is parked on, or subsequently travels over, track with uneven cross-level, fuel will spill from the open spout. During fueling, the operator should remain near the nozzle at all times. If this is not possible, then a remote control system that enables the operator to immediately terminate fuel delivery should be employed. Another option is to use meters which can be set to deliver a predetermined quantity of fuel based upon the amount of fuel already in the locomotive tank.

In addition to these operational and maintenance measures to prevent spillage, additional protection against releases to the environment can be obtained by installing spill collection systems. Combined use of several of these systems and practices at each location can provide needed redundancy in short-term spill prevention during fueling.

Finally, DTL contractors should be held responsible for preventing spills. Contracts between the railroads and DTL fueling suppliers should specify training requirements for the operators and clearly delineate environmental responsibilities and liabilities. At new DTL sites, railroads should collect and analyze soil samples to determine if any contamination exists prior to beginning DTL fueling activity. Additional protection can be obtained by conducting such analyses at regular intervals at active DTL locations. Ideally, complete unconditional responsibility and liability for spillage and cleanup at a site should be assigned to the fueling vendor. However, vendors may be reluctant to accept such terms and small operators may not have sufficient resources to accept such liability.

LONG-TERM SOLUTIONS

Long-term solutions involve development and implementation of improved technology for fuel delivery and accurate monitoring of the amount of fuel in the tank. In the past, protection against spillage was afforded by automatic shut-off systems. The unreliability of these systems coupled with expanded environmental regulation led to containment systems to collect spilled fuel. However, expanding use of DTL fueling and the proliferation of fueling locations preclude containment as the sole option. Attention needs to be refocused on a fuel delivery system that virtually eliminates the possibility of spillage. Because of the frequency of power sharing arrangements, the automatic shut-off systems employed by different railroads must be fully compatible and still retain their functionality and reliability. Current technology and operations do not achieve this level of performance. Improvements in the fuel delivery and monitoring system must meet operating and performance requirements to satisfy the needs of the railroad industry. These requirements include:

- Safe operation
- High reliability and accuracy
- Automatic shut-off that will function at delivery rates ranging from 0 to 300 gpm
- Economic feasibility
- Sound ergonomic design
- Minimal retrofit requirement for fueling facilities and locomotives
- Adaptable to both mobile and fixed fueling facilities
- Low maintenance

CAUSES OF SPILLS

Overfilling fuel tanks causes most spillage and results from failure of automatic fuel shut-off systems, unreliable information about the amount of fuel in the tank or improper procedures by fueling personnel. The most common complaint among fueling personnel is that inaccurate gauges and unreadable sight glasses make it difficult to reliably determine fuel levels before and during the fueling process.

Automatic shut-off failures can occur due to defects in either the fuel nozzle or the locomotive tank and it is often difficult to determine which is at fault. Scheduled preventive maintenance on both the nozzle and locomotive fuel tank components of the shut-off system is necessary to reduce spills. An added complication is that railroads lack a standardized fuel delivery system. Although adapters are in use that enable a nozzle of one design to deliver fuel to a tank with another design, these adapters render the automatic shut-off system inoperative.

Several other maintenance and training problems can cause fuel spills. Uneven cross level of the track at the fueling site can cause the locomotive fuel tank gauge or sight glass to be inaccurate or cause the automatic shut-off system to be inoperative. Fuel may be forced out of other fill ports on the tank if their caps are not fastened securely. Plugged vent pipes also cause spills by creating pressure in the locomotive tank during fueling and result in fuel "blow back" when the nozzle is released.

Overfills can also occur because of lack of operator attention, inadequate training or improper practices. Spills can result if an operator is distracted from the nozzle or is depending on the automatic shut-off feature of the system. The automatic shut-off system can fail in the "on" position resulting in an overfill. Alternatively, the system may fail in the "off" position leading frustrated fueling personnel to override the automatic shut-off mechanism by fastening the nozzle in the open position (Figure 3). Frequent turnover of contractor personnel can result in poor service and under-trained operators, increasing the potential for spillage.

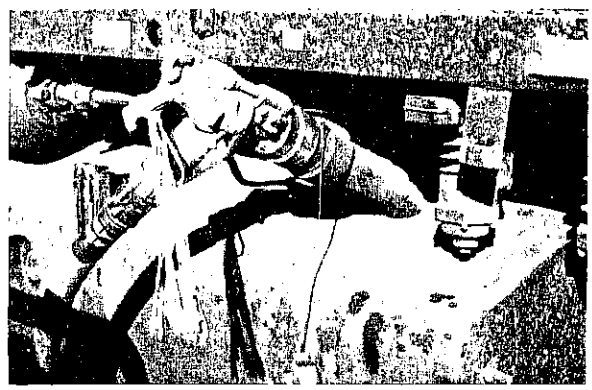


Figure 3. Fueling Nozzle Tied With Rope to Override the Automatic Shut-off

DEVELOPMENT PROGRAM

Technological advances in fuel delivery and tank gauging systems offer promise for virtually fail-safe fueling, as well as the potential for improved strategic management of fuel consumption and cost. Development of these systems will require input from the railroads, locomotive manufacturers, fueling system suppliers, and fuel vendors. Application of this technology to the railroad industry can be achieved by further testing and development to meet industry requirements. The AAR is considering a program that would consist of the following:

- Development of performance specifications for a standard locomotive fuel delivery system
- Evaluation of state-of-the-art systems to accurately measure and communicate the quantity of fuel in a locomotive tank

Such a program would provide railroads with the technology needed for more effective fuel management, as well as for the elimination of spills.

Note: Contact Chris Barkan at (202) 639-2276 with any questions or comments about this document. Email: CBARKAN@LMS.AAR.COM

A MORE DETAILED REPORT, WHICH MAY CONTAIN REVISED INFORMATION, WILL BE AVAILABLE AT A LATER DATE THROUGH THE AAR, PUBLICATION ORDER PROCESSING, 50 F STREET, NW, 5TH FLOOR, COG WASHINGTON, DC 20001