SpillX Demonstration Results
BNSF Railroad - Clovis, New Mexico Facility

Report Generated by SpillX in Conjunction with BNSF Fueling Operations Staff

May 21 & 22, 2012

EXECUTIVE SUMMARY

Evaluation of the SpillX fueling system was conducted on May 21st and 22nd, 2012 and consisted of fueling 20 locomotives using a combination of the existing fueling nozzles and the SpillX system in various configurations. The demonstration was conducted to document current operating parameters of the facility and the benefits that could be achieved by incorporation of SpillX with no infrastructure upgrades.

In addition to demonstrating flow rates, the testing also illustrated how the system functions, how it performs in DTL operations, improved safety and environmental benefits offered by the nozzle design and dry break connections and the controlled shut-off of fuel which reduces fatigue on fueling infrastructure. Additionally, SpillX illustrated various options for interchangeability and demonstrated the process for rebuilding the nozzles on the bench.

Discussions also involved the ability to incorporate a customer controlled shut-off feature which could be integrated with the existing on-board fuel monitoring systems to control the level in the tanks of the locomotive. In addition, the possibility to incorporate pull-away protection into SpillX in the event that a locomotive moves while still connected to the fuel crane was also discussed. It is believed that both of these features could be incorporated into the SpillX system; however were not demonstrated during the testing.

Testing results indicate that the SpillX system is capable of significantly improving the fueling rates at the Clovis facility with no modifications to the infrastructure. The installation of SpillX on a locomotive requires less than 15 minutes on the fuel platform and installation of the nozzle on the fuel cranes or DTL trucks takes less than 5 minutes. Fueling rates nearly doubled with use of SpillX over the current system and reached in excess of 600 gpm by increasing the pressure at the fuel platform. Actual test data and nozzle flow curves are presented in appendix A & B.

INTRODUCTION

SpillX has been developed to take advantage of the dry break fueling connections and higher fueling rates currently utilized in the aviation industry. Through the use of this technology SpillX has developed a locomotive fueling system using a nonproprietary military specified dry break connection that is capable of fueling locomotives at 600 gallons per minute.

The SpillX system is comprised of a nozzle which weighs less than 10 lbs., a receiver which is installed into the fill tube of the locomotive and a float mechanism which determines when the tank is full and stops flow of fuel into the tank through the receiver. SpillX can be installed on a locomotive in less than 15 minutes and on a fuel crane in less than 5 minutes.

OBJECTIVE

Several objectives were identified during the development of the test plan. These included:

1. Document current fueling rates for platform and DTL fueling operations
2. Document fueling rates of facility and DTL using SpillX
3. Increase platform pressures and determine maximum flow capabilities of each system
4. Demonstrate installation of the SpillX components
5. Demonstrate interchangeability options

Secondary objectives of the testing were to demonstrate the increased safety and reduced environmental impact offered by the system through the use of the dry break connections.

PLATFORM FLOW RATES

Testing began by documenting the current fueling rates of the Clovis fueling platform. To do this, locomotive 1643 was filled using the current nozzle at standard platform pressures. During this process it was observed that each time the nozzle was engaged, it automatically shut off. This occurred several times before the operator was required to hold on to the nozzle during fueling to ensure it did not shut off until the tank was full (pictured to the right). The operator indicated that this was a common occurrence. During this testing 675 gallons of fuel were added to the tank at a rate of 243 gpm. As a result of having to hold the nozzle open, the operator did overflow the locomotive and fuel was discharged through the vent port on the opposite side of the tank. Upon shut-off of the nozzle, a pressure spike was observed that could be seen with nozzle and hose jumping.

The fueling platform was then tested using the SpillX components installed on locomotive 4715 and a nozzle installed on crane 1 of the platform. Approximately 1,250 gallons were added to the tank at a rate of 534 gpm.

The SpillX system, which incorporates an automatic full-level shut-off mechanism, stopped fuel flow into the tank at 4,850 total gallons in the tank. Stopping the flow of fuel into the tank occurred over a period of approximately 5 seconds and resulted in no noticeable pressure spike on the fuel platform lines and pumps.

Nozzle	Line Pressure	Flow Rate
SpillX	54 psi	534 gpm
Current	62 psi	243 gpm

INCREASED PRESSURE FUELING RATES

In an effort to maximize fueling rates at the Clovis facility a test was conducted by closing the by-pass valve in the pump house to increase the line pressures to the maximum capacity. This was only for testing purposes and the valve was immediately opened upon the completion of each test.

Closing the valve increased the deadhead pressure of the line to 105 psi. Testing with the current nozzle at the increase pressure resulted in a line flow pressure of 90 psi and a flow rate of approximately 293 gpm.

The same test was conducted for the SpillX system and the line flow pressure was decreased to 73 psi with a nozzle pressure of 36 psi and a final flow rate of 600 gpm (612 gpm according to pump house data).

Nozzle	Line Pressure	Flow Rate
SpillX	73 psi	600 gpm
Current	90 psi	293 gpm

INTERCHANGEABILITY

In an effort to aid in the transition of the fleet from one system to the other, SpillX has tested various options that would enable railroads to quickly and easily fuel locomotives regardless of what equipment is installed on the locomotive.

SpillX Dry Break / Valve Coupling
As can be seen in the picture to the right, a valve has been installed at the end of the hose which enables an operator to secure the fuel in the crane while the nozzles are being switched. Dry break poppets are incorporated into the male cam locks on the inlet of each nozzle to secure any fuel remaining in the nozzle.

To switch between nozzles, the operator closes the valve, opens the quick release cam lock, removes the nozzle and installs the other and then locks it in place. Once the new nozzle has been secured, the valve is opened and the system fuels normally.

Flow testing of this concept indicated that the flow rate of the current nozzle was marginally impacted (from 243 gpm to 211gpm) through the introduction of the 2 1/2 inch valve and coupler. The restriction in the SpillX system was much more substantial (from 534 gpm to 244 gpm). SpillX is currently investigating development of a larger valve and coupler to reduce this pressure drop and increase the flow of the SpillX nozzle in this configuration.

SpillX Manifold
The SpillX manifold is designed so that both nozzles can be attached to the fuel crane simultaneously and either can be used depending on how the locomotive is equipped. The manifold adds approximately 35 lbs. to the fuel crane and during demonstrations; the manifold had to be lightly pushed back into the basket. This concept prevents nozzle changing and ensures that both nozzles are always connected to the crane.

Testing of both nozzles on GE locomotives while attached to the manifold resulted in the following flow rates for each system:

Nozzle	Line PSI	Flow Rate
SpillX	46	440
Current	58	226

SPILLX DEMONSTRATED ADVANTAGES

- Increased existing flow rates with no infrastructure modifications
- Locomotive mounted hydraulic shut-off mechanism can be installed trackside in less than 15 minutes
- Allows for customer controlled shut-off of fueling
- Lighter nozzle
- Ability to rebuild nozzle on the bench
- Controlled shut off reduces line hammering and pressure surges
- Dry break connection ensures fuel is always contained
- Range of interchangeability options

CONCLUSION

Testing results indicate that existing infrastructure is currently being underutilized and that the SpillX system is capable of significantly improving the fueling rates at the Clovis facility with no modifications to the infrastructure. Fueling rates nearly doubled with use of SpillX over the current system and reached 600 gpm by increasing the pressure at the fuel platform.

SpillX offers the railroads the ability to take immediate advantage of facilities with excess pump capacity and provides the ability to increase fueling rates as facilities and trucks are replaced/upgraded in the future. Additionally, the internal shut-off mechanism contained on the locomotive would enable customers to control the amount of fuel added to the tank by integrating the system with the electronic controls of the locomotive if so desired in the future.

Safety and environmental concerns are addressed through the use of a dry break connection that must be secured to the locomotive before fuel can begin flowing from the nozzle and provide for a controlled shut-off to limit pressure spikes during shut down. Installation requires less than 15 minutes per fill port and installation of the nozzle on the fuel cranes or DTL trucks takes less than 5 minutes. The nozzles are capable of being rebuilt by railroad employees or contractors on site and typically take less than one hour.

SpillX provides an alternative fueling system for railroads which is much safer, faster and provides flexibility to expand capabilities in the future.

APPENDIX A – Recorded Test Data

The platform data below was generated by onsite monitoring of each fueling event. For each locomotive fueled, the locomotive number was recorded, the fuel crane used for fueling (1 being the east crane on the Clovis, NM facility to 5 which was the west crane), and the nozzle configuration used during fueling. The beginning gallons were recorded using fuel gauges and sight glasses where applicable, then ending gallons were recorded using same gauges and total gallons were determined. Total time was recorded using stop watches and the GPM was determined by dividing total gallons by time. The line pressure was recorded using pressure gauges installed at the base of the crane and nozzle pressure was recorded on the SpillX system using one of the ports built into the nozzle. Current nozzle pressure was unable to be recorded due to lack of ports on the nozzle.

Platform Data

Date	Time	Locomotive	Fuel Crane	Nozzle	Beg Gallon	End Gallon	Total Gal	Total Time (sec)	Line PSI	Nozzle PSI	GPM
21-May	10:23 - 10:26	1643 EMD	2	Current	2850	3525	675	167	62		243
21-May	10:30 - 10:36	8711 EMD	5	Current - Manifold	700	2825	2125	573	58		223
21-May	10:58 - 11:01	4715 GE	1	SpillX	3550	4850	1300	146	54	26	534
21-May	12:03 - 12:08	4056 GE / 6986 GE	1 & 3	SpillX on Both	2750 / 2725	5000 / 5000	4575	272	66 - 64	26 / 24	505
21-May	2:48 - 2:52	6995 GE	4	Current High Pressure	4300	4750	450	92	90		293
21-May	3:01 - 3:04	6923 GE	2	Current	4320	4700	380	89	61		256
21-May	3:31- 3:35	7691 GE	Truck 109/Trailer 631	Current	3800	4525	725	223			195
21-May	3:47 - 3:50	6873 GE	Truck 109/Trailer 631	SpillX	3900	4525	625	175	6	6	214
22-May	8:46 - 8:51	6758 GE	5	SpillX Manifold	3900	4750	850	116	46		440
22-May	9:32 - 9:34	7257 GE	5	Current Manifold	4300	4700	400	106	58		226
22-May	1:41 - 1:46	4787 GE	5	SpillX w/Cam Lock & Valve	3000	4175	1175	289	60	6	244
22-May	1:47 - 1:52	4787 GE	5	Current w/Cam Lock & Valve	4175	4800	625	178	60		211
22-May	2:08 - 2:212	4303 GE	3	SpillX High Pressure	2700	4400	1700	170	73	36	600

The HIT data was recorded using BNSF software which tracks fueling events for the facility. The gpm recorded in the system was based on an additional two minutes added into the event and the "time adjusted" column accounts removal of these two minutes. For events where the emergency fuel stop button was activated at the conclusion of the fueling event, an accurate time was unable to be determined.

The pump house data was recorded during the fueling event when personnel were present to report the data.

HIT Data					Pump House Data			
Nozzle	Time	Total Gallons	GPM	Time Adjusted (GPM)	Total Gallons	GPM		
Current	10:20:52 - 10:25:16	639	145	266	759	248		
Current - Manifold	10:30:49 - 10:40:29	2069	213	272	N/A	N/A		
SpillX	10:55:57 - 11:00:00	1218	299	594	1210	536		
SpillX on Both	10:02:32 - 10:09:00	4594	689	514	4580	516		
Current High Pressure	2:47:57 - 2:49:29	430	265	E-Stop Time Out	425	298		
Current	2:59:25 - 3:03:01	371	103	232	365	264		
Current	DTL Fueling					203	Truck Flow Meter	
SpillX	DTL Fueling					215	Truck Flow Meter	
SpillX Manifold	8:47:38 - 8:51:50	888	210	404	835	425		
Current Manifold	9:29:07 - 9:30:52	432	246	E-Stop Time Out	238	422		
SpillX w/Cam Lock & Valve	1:37:34 - 1:44:49	1191	164	227	N/A	N/A		
Current w/Cam Lock & Valve	1:46:17 - 1:52:47	651	100	145	N/A	N/A		
SpillX High Pressure	2:06:03 - 2:11:53	1672	303	E-Stop Time Out	N/A	612		

APPENDIX B – Nozzle Flow Curves Data

The graph below illustrates nozzle pressures for both systems used during testing. The SpillX flow curve is based off of actual nozzle pressure readings for tests conducted at Clovis. The testing was unable to document any current nozzle pressure readings (lack of ports in the nozzle to measure pressure) so the flow curve presented is from published materials available on the manufacturer's website.