A ROADMAP STUDY FOR INCLUSION OF TANK CAR VALVES IN THE UMLER COMPONENT REGISTRY

2 February 2015

DRAFT

Author: Jack Heilpern (Railinc Consultant)
Email: heilpern.jack@gmail.com
Home office/fax: 704.948.3893
Mobile: 704.668.8579
Contents
I. Executive Summary ................................................................................................................. 3
II. Scope and Project Objectives .............................................................................................. 3
III. Background on Tank Car Rail Traffic ............................................................................. 4
IV. Tank Cars and Tank Car Components .............................................................................. 6
V. Pressure Relief Devices ....................................................................................................... 11
VIII. Process Analysis .............................................................................................................. 18
IX. The Business Case – Costs & Benefits ........................................................................... 20
X. Recommendations ............................................................................................................. 25
APPENDIX I ............................................................................................................................ 28
APPENDIX II .......................................................................................................................... 29
APPENDIX III ........................................................................................................................ 33
I. Executive Summary

The rapid growth of oil-by-rail shipments has intense scrutiny on safety issues relating to the North American tank car fleet. This study’s purpose is to evaluate the option to add tank car valves to the Component Equipment Performance Monitoring system in Umler, as one piece of an industry-wide effort to improve tank car safety.

The recommendations in this study have been developed with input from leaders and managers at tank car builders, valve manufacturers, repair facilities, and fleet owners. Technical (system) input was supplied by Railinc. The major recommendations are:

- Proceed as quickly as possible with the system development work to capture tank valve data in the component registry.

- Ideally, the system work, policy formulation, industry agreement, repair job codes and training to be complete prior to the effective date for new tank car construction standards.

- Focus initially on capturing data for pressure relief valves (PRVs); do so for all newly built or rebuilt tank cars including cars built to the new DOT 117 standard and cars retrofitted to that same standard, as part of the manufacturing / retrofitting process.

- Backfill the component registry with PRV data from the fleet owners’ asset management systems where data is readily available.

- Capture the balance of such valve data on a ‘going forward’ basis, as tank cars are recertified, or repaired for any other reason.

- Consider capturing data for all valves for new and retrofitted tank cars.

Please note that because of (a) the urgent and fluid nature of the rule-making process; (b) the rapid increase in demand for tank cars generated by the surge in oil mined via fracking, and (c) the impact on new tank car construction and old tank car retrofitting caused by (a) and (b), all dates and tank car fleet estimates are tentative and subject to revision. As such, all system and project planning for the component registry should include careful monitoring of the rule-making process and the overall tank car construction and retrofitting trends.

II. Scope and Project Objectives

This scope of the study is to identify the issues associated with adding tank car valves to the industry’s component registry system managed by Railinc and to engage industry experts to understand the issues surrounding the:

- Number and types of tank car valves, together with logical groupings, if applicable
Tank Car Valve Roadmap Study

- Definitions of standard locations for valves (top, bottom, number, etc.)
- Manufacturers of tank car valves
- Key data requirements to add tank car valves to CEPM
- Principle processes involved in this initiative

After gathering these facts, develop recommendations on an outline one-to-three year time frame for project implementation. Finally, create an overall business case for the project, including costs to the major parties affected.

III. Background on Tank Car Rail Traffic

Growth in Crude Oil Traffic by Rail

A 2013 report produced by the American Association of Railroads stated:

Small amounts of crude oil have long been transported by rail, but since 2009 the increase in rail crude oil movements has been enormous. As recently as 2008, U.S. Class I railroads (including the U.S. Class I subsidiaries of Canadian railroads) originated just 9,500 carloads of crude oil. By 2011, carloads originated were up to nearly 66,000, and in 2012 they surged to nearly 234,000. In the first three quarters of 2013, Class I railroads originated 299,652 carloads of crude oil, 96 percent higher than the 152,676 carloads originated in the first three quarters of 2012. Based on the first nine months of the year, crude oil originations in 2013 will probably total around 400,000 carloads. Crude oil accounted for 1.4 percent of total Class I originated carloads in 2013 through September, up from just 0.03 percent in 2008.1

This surge in crude-oil-by-rail traffic might be a permanent fixture of the overall energy picture for North America. A trade publication associated with the valve industry noted recently:

The tank car’s promise as a method of transport for oil is not perceived to be short-lived, either. Some people have speculated that once new pipelines are built, the tank cars will go away. But the industry has two strong points in its favor. First, the cars can go anywhere there are rails, while a pipeline’s location is fixed. This is important because, if a loading opportunity occurs 200 miles away in two to three years, it is easy to move the loading point. Pipelines underneath six feet of earth don’t move too easily.

Second, the transport of crude oil from Canadian tar sands offers additional opportunities for tank car transport. The bitumen from which the Alberta tar sands is composed is so thick that, in order to get it to flow through a pipeline, it must be diluted with distillate. The flow is then 72% bitumen and 28% diluent, which makes the efficiency of the pipeline just over 70%. Using ordinary tank cars requires a mix of 83% bitumen to 17% diluent for loading and offloading. Also, the 83% mixture is carried in

---

1 Association of American Railroads, “Moving Crude Oil by Rail”, December, 2013, page 3
standard tank cars built with steam-heating coils (and more valves, by the way), which allow the bitumen to be unloaded with relative ease. Raw 100% bitumen can even be carried in tank cars; however, the contents must be heated to 200 degrees to get non-diluted contents to flow out of the car.

One transportation economist has stated that rail-shipping this heavy, sour mixture to Gulf Coast refineries, which are well-equipped to handle sour crude, presents a savings of three dollars a barrel over the pipeline route. Another advantage over pipelines is that the tank cars are available right now, while the Keystone XL pipeline and others may remain political prisoners for years.2

Safety Issues

With respect to the safety of crude-oil-by-rail traffic, the AAR report noted:

Railroads have an excellent crude oil safety record — better, in fact, than pipelines in recent years. Based on data from the U.S. Department of Transportation’s Pipeline and Hazardous Materials Safety Administration [PHMSA], the “spill rate” for U.S. railroads from 2002-2012 was an estimated 2.2 gallons per million crude oil ton-miles generated. The comparable spill rate for pipelines is nearly three times the rail rate at approximately 6.3 gallons per million ton-miles.

Pipelines carry — and spill — much more crude oil than railroads do. From 2002-2012, an estimated 19.9 million gallons (474,000 barrels) of crude oil were spilled in pipeline incidents, compared with an estimated 95,000 gallons (2,300 barrels) of crude oil spilled in rail incidents over the same period. The rail figure is less than 1 percent of the pipeline figure.

From 2002-2012, there were 148 incidents involving releases of crude oil from railroads, of which 109 involved releases of less than five gallons. Railroads are required to report spills of any size, including very small spills. By contrast, in most cases pipelines only have to report spills of at least five gallons. Just 39 of the 148 railroad incidents had releases of more than five gallons. By contrast, pipelines reported 1,785 spills of at least five gallons from 2002-2012, more than 45 times the number of rail incidents.3

There are three cautions to bear in mind in connection with the admirable historical safety record cited in the AAR report:

- Crude oil traffic for the eleven-year time frame is likely less than the crude-oil traffic for 2013 alone. This ramping up of carload volume, together with new traffic patterns, and

---

3 "Moving Crude Oil by Rail", pages 6-7.
emergence of large crude-oil unit trains may generate risks and exposures different than the historical pattern.

- This ramp-up in traffic is reflected by the trend in the number of crude oil rail incidents reported in the PHMSA incident reporting system for crude oil incidents, through September 27, 2014.4

<table>
<thead>
<tr>
<th>Year</th>
<th># Incidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014 (9 months only)</td>
<td>113</td>
</tr>
<tr>
<td>2013</td>
<td>117</td>
</tr>
<tr>
<td>2012</td>
<td>88</td>
</tr>
<tr>
<td>2011</td>
<td>33</td>
</tr>
<tr>
<td>2010</td>
<td>9</td>
</tr>
</tbody>
</table>

- The catastrophic train derailment and fire at Lac-Mégantic, Quebec, Canada, involving 72 tank cars carrying nearly 2.2 million gallons (US) of crude oil from the Bakken formation in North Dakota significantly changed the perception and narrative surrounding oil-by-rail. This accident and fire destroyed 30 buildings in the town, and killed forty-seven people. Since Lac-Mégantic there have been two incidents in the US (Aliceville, AL and Casselton, ND) involving a total of 46 tank cars with 1.1 million gallons (US) of crude oil spilled. While accidents like these are rare, they have drawn attention to the surge in oil-by-rail unit train traffic, and the increased public risk there from.

IV. Tank Cars and Tank Car Components

Tank Car and Tank Car Types

As noted below there are approximately 360,000 active tank cars in service in the North American rail system. There are many types of tank cars, designed to carry a wide variety of commodities. Different commodities require different tank car construction materials, and external components. Still, “[t]here are three types of tank car designs: low pressure, high pressure and cryogenic. These can be further differentiated as insulated and non-insulated types.”5

- “Nonpressure tank cars (also called general service or low-pressure tank cars) are used to transport a wide variety of regulated (hazardous materials/dangerous goods) as well as nonregulated commodities.

---


5 Johnson, Greg, op. cit.
Classes DOT-111 and 115, and AAR-206 and 211 are nonpressure tank cars used to transport both regulated (hazardous materials/dangerous goods) and nonregulated commodities. The most common nonpressure tank cars in use today are Class DOT-111 and Class AAR-211.  

“Up to 80% of the Canadian fleet and 69% of U.S. rail tank cars are DOT-111 type.”

- **Pressure Tank Cars** – “Classes DOT-105, 109, 112, 114, and 120 are pressure tank cars used to transport liquefied compressed gases, poison/toxic inhalation hazard (PIH/THI) materials, reactive materials, and/or corrosive materials requiring the additional protection afforded by a stronger car.”

Pressure tank cars are constructed of different materials, and to different construction standards than non-pressure tank cars. Further “[u]nlike nonpressure tank cars, which may be loaded or unloaded using an open system, pressure tank cars are loaded and unloaded using a closed system; i.e., the tank is not opened to the atmosphere during the process. The manway cover or pressure plate is removed only for maintenance purposes at a tank car repair facility.”

- **Cryogenic Liquid Tank Cars** – These specialized cars, which fall into “[c]lasses DOT-113 and AAR-204 tank cars are designed as a vacuum-insulated inner container (tank) enclosed within an outer shell (tank, not jacket) and referred to as an outer jacket by the DOT to transport cryogenic liquids. (Refrigerated liquefied gases having a boiling point colder than minus 130 F at atmospheric pressure; e.g., liquid hydrogen, ethylene, oxygen, nitrogen and argon.)”

**Heterogeneity of Tank Car Fixtures and Fittings**

The phrase “tank car fixtures and fittings” suggests similarity where none actually exists. These are rather complicated pieces of equipment, some with moving parts, designed to work in unforgiving environments. They are not easily grouped. General-service fittings may include:

- Bottom outlets
- Internal or external heater coil systems
- Top valves and fittings

---

7 Wikipedia article “DOT-111 tank car”, retrieved August 1, 2014.
8 *Field Guide*, page 47
9 *Field Guide*, page 48
10 *Field Guide*, page 65
11 All fixtures and fittings named in this section come from the training video “Tank Car Loading and Unloading” produced by the Renewable Fuels Association, and available online here: [https://www.youtube.com/watch?v=1PzNbQIvgDw](https://www.youtube.com/watch?v=1PzNbQIvgDw)
Tank Car Valve Roadmap Study

- Top-operated bottom outlets
- Man-way
- Pressure relief devices, including safety valves and safety vents

Examples of top valves and fittings include:

- Liquid valve
- Vapor valve
- Vacuum relief valve
- Safety valve or safety vent with a rupture disk

On pressure tank cars fittings may include:

- Liquid and vapor valves
- Gauging devices
- Sample lines
- Thermometer well
- Safety valves
- Regulating valves

Even with the variety of types (and sizes) of tank cars, the many different commodities carried therein, and the variety of available fittings and fixtures, fittings and fixtures can be divided into four broad categories:

- Inlet/outlet valves
- Pressure relief devices
- Manways
- Heating systems, gauging devices, and all other devices.

**Tank Car Valves**

Each tank car has at least two valves—an inlet/outlet valve and a pressure relief valve (PRV). These valves are located either on the top center of the car or, less frequently, on the bottom center.

The need for a basic inlet/outlet valve is obvious; the fluid needs to be contained after filling the car. The relief valve is necessary because, like any other vessel filled with fluid, over-pressurization can occur if the fluid expands because of temperature changes. Sometimes a vacuum relief valve is needed to keep the tank from imploding as it is emptied. While relief valves are most common for this use, rupture discs or rupture pins are also sometimes employed.\(^{12}\)

\(^{12}\) Johnson, Greg, op. cit. Emphasis added.
Heating Systems

Many tank cars are supplied with heating coils that allow the temperature of the tank to be raised before unloading to make the removal of viscous/semi-solid materials much easier. These coils are usually heated via steam at the unloading site, and these cars require additional inlet and outlet valves to control the steam flow.\(^\text{13}\)

Manways

Most nonpressure cars have a low-profile manway nozzle on top of the tank, equipped with a gasketed hinged and bolted manway cover. The cover is opened for loading/unloading or for access into the tank for maintenance. Other styles of manway covers (such as those on sulfuric or hydrochloric acid tank cars) are semipermanently attached to the manway nozzle and are equipped with a small gasketed hinged and bolted fill hole with a cover that is opened for loading or unloading.\(^\text{14}\)

Loading and Unloading of Tank Cars

Because of the very wide array of commodities carried in tank cars (petroleum and petroleum distillates, cryogenic liquids, various acids) and the varying viscosity of those commodities, there are different systems and devices for unloading tank cars. Broadly simplifying, however, tank cars are unloaded via:

- Gravity-based systems through simple bottom outlet valves\(^\text{15}\), and
- Eduction-based system, where the liquid commodity is forced out of the tank through a top-mounted valve by injecting air through a separate valve, also top-mounted.)

Placement of Tank Car Valves

The complexity created by the combination of different tank car types, commodities, and valves is obviated by somewhat standardized placement of the valves. “On nonpressure and pressure tank cars, the PRDs are located on the top of the tank; on cryogenic liquid tank cars, the PRDs are located in closed compartments or cabinets containing the loading and unloading equipment, typically mounted on the sides or on one end of the car.”\(^\text{16}\)

\(^{13}\) Johnson, Greg, op. cit. Emphasis added.

\(^{14}\) Field Guide, page 28

\(^{15}\) This system is generally used with non-viscous products, and requires the manway to be opened to allow air into the tank car as the commodity is drained through the bottom outlet valve. See additional comments on commodity viscosity above in section III, “Background on Tank Car Rail Traffic.”

“On the other hand, some [n]onpressure single-unit tank cars may be divided into compartments by inserting ellipsoidal heads into the tank shell (heads must be concave to the lading of each compartment) or by joining separately constructed tanks to make a single car structure. Each compartment will have its own loading/unloading fittings and PRD.”

**Summary of Tank Car Fittings and Fixtures**

In summary, so far as tank car fittings and fixtures are concerned there really is only very general **standardization in the sense that all tank cars have some sort of pressure relief device, one or more devices to facilitate commodity loading and unloading, and a manway.** Other devices (heating, gauging, and other fixtures) are optional based on the commodity moved and owner preference.

The location of all these devices (probably with the exception of the manway) is not uniform across all tank cars. However, the complexity of the type, number, and placement of these fittings and fixtures masks a certain amount of underlying operational simplicity. Tank cars, especially tank car trains, are mostly privately owned, or leased by private users. The looming example is the traffic from the Bakken fields in North Dakota to refineries on the Gulf Coast, and other destinations. The configuration of the cars employed in these routes will be consistent, week in and week out. Similarly, a tank car or cars used to transport various hazardous and cryogenic material (like liquid nitrogen) regularly moves from the plant making the commodity, to the plant or plants where it is used in other chemical or industrial processes. The specific tank cars (together with the attached valves and fixtures) become familiar to the workers on both ends of the transportation route. They know and understand the inlet/outlet equipment (valves) and the commonly used PRDs, which simplifies inspection and maintenance.

**Tank Car Fixtures and the Component Registry**

Virtually every tank car fitting and fixture could hypothetically be of some concern, because valves, manways, and even sample lines and are potential sources of leaks. But viewing potential safety issues through the lens of the component registry suggests the following project priority:

1. **Pressure relief devices**, which have the most direct impact on safety
2. **Outlet valves** and related equipment (i.e., induction/eduction valves taken together)
3. **Manways and all other fittings and fixtures** (tentative, requiring further study)

*In keeping with the stated scope and objectives of this study, the main focus from hereon will be on tank car pressure relief devices (PRDs); specifically focused on reclosable pressure relief valves (PRVs), which should constitute “Phase 1” of this*

---

17 *Field Guide*, page 31
proposed project. Data and processes related to other types of PRDs should be developed with experience in the course of fully implementing “Phase 1.”

(Some additional comments on project timing for outlet valves and other devices will be offered in Section X, “Recommendations”, below.)

V. Pressure Relief Devices

Pressure relief devices are one of the key safety components on tank cars. To illustrate the variety of pressure relief devices (PRDs), some extended citations from the AAR Field Guide to Tank Cars (hereafter cited as Field Guide) follow.

PRDs are fittings designed to relieve the internal pressure within a tank car above a specified value that may result from abnormal conditions or from normal pressure increases during transportation (pressure relief device is synonymous with safety relief device). Conditions that may cause a PRD to function include the exposure of the tank car to fire, hydrostatic pressure created within a tank overloaded by volume, chemical (exothermic) reaction of the lading in the tank that builds up pressure (such as polymerization), and/or an over-speed impact that results in a pressure spike due to the surge action of the liquid.

A type of a PRD (a regulating valve) may be used on certain tank cars to intentionally vent vapor during transportation. Such venting is normal in transportation. In addition to devices that relieve internal pressure, nonpressure tank cars may be equipped with a device to prevent a vacuum from forming within the tank.

In general, there are two categories of PRDs: (1) reclosing devices, such as pressure relief valves (PRVs), and (2) nonreclosing devices, such as safety vents, also called rupture disc devices.\(^{18}\)

The Field Guide describes the technical details of these two broad categories of types of devices.

Pressure relief valves (PRVs) are spring-loaded, reclosing PRDs designed to open at a set pressure to relieve excessive pressure within the tank. They then automatically reclose after normal conditions are restored. A tank car may be equipped with multiple PRVs to provide the necessary flow capacity for the commodity.\(^{19}\)

With respect to nonreclosable devices the Field Guide to Tank Cars has this:

Safety vents (rupture disc devices/nonreclosing PRDs) are equipped with a rupture (or frangible) disc designed to burst at a certain pressure to relieve pressure. Once the disc bursts, the safety vent remains open until the disc is replaced.

Rupture discs are made from plastic/composite materials or a metal body (usually stainless steel) incorporating an elastomeric-type membrane. Safety vents, instead of PRVs, are typically used on tank cars transporting corrosive materials (such as sulfuric acid) and other materials that may have properties that would be detrimental to the components of a PRV.

Safety vents are also used on tank cars transporting nonregulated commodities, such as corn syrup and clay slurry, and in combination with other PRDs on tank cars transporting cryogenic liquids, such as ethylene, argon and oxygen.\(^{20}\)

There are also some combination devices used on tank cars carrying certain hazardous commodities:

**Combination PRDs** incorporate a nonreclosing device, such as a breaking pin or rupture disc, in series with a spring-loaded reclosing pressure relief valve. The PRV must be outboard of the nonreclosing device (breaking pin or rupture disc). The breaking pin or rupture disc must be designed to fail at a pressure higher than that of the spring-loaded portion of the device. Thus, if internal pressure causes the pin or disc to fail, the spring-loaded portion will open.

Combination PRDs are typically used on high hazard PIH/TH materials, such as chlorine. Combination PRDs utilizing a rupture disc are required to be equipped with an indicator device to detect any accumulation of pressure between the disc and the spring-loaded valve. The device must be a needle valve, try cock, or telltale indicator, which must remain closed during transportation.\(^{21}\)

Other types of PRDs include:

**Regulating (regulator) valves** (called a pressure control device for cryogenic liquid tank cars) are required on pressure tank cars transporting carbon dioxide and nitrous oxide, and cryogenic liquid tank cars transporting liquefied argon, nitrogen, or oxygen. These spring-loaded PRDs, with start-to-discharge pressures lower than the other PRDs (a pressure relief valve and a safety vent), are intended to vent vapor during transportation to maintain internal pressure (through auto-refrigeration) below that of other PRDs.\(^{22}\)

**Vacuum-relief valves** (also called vacuum breakers) are applied to some nonpressure tank cars to admit air into the tank to prevent excessive internal vacuum that may result


\(^{21}\) Ibid.

\(^{22}\) *Field Guide*, page 15.
in a collapse (implosion) of the tank. This danger exists during closed-system unloading operations using pumps, where the tank is not vented to allow air to enter or, in extreme cases, where an empty tank is subjected to wide temperature variations (hot to cold); e.g., steaming or steam-cleaning a tank car.²³

**Breather vents** (also called continuous vents) are devices equipped with a permeable disc, such as pumice stone or a plastic-type membrane. Breather vents are typically applied to nonpressure tank cars transporting hydrogen peroxide solutions to prevent pressure buildup within the tank by allowing the venting of oxygen, which is generated as the material naturally decomposes.²⁴

To emphasize the overall complexity, a single manufacturer (Jamesbury) lists five different types of bottom outlet valves, five different types of top loading & unloading valves, and five different types of “AAR approved standard valves”, all exclusive of sizing. Midland Manufacturing offers more than thirty different pressure relief valves for tank cars, and many other pressure relief and bottom outlet devices.²⁵

**Physical Shape and Appearance (reference Appendix II for diagrams)**

Despite the operational variety of the various types of PRDs, there is perhaps surprising commonality in their physical appearance. **Diagrams I and 2** in **Appendix II** illustrate examples of pressure relief valves made by Midland Manufacturing and McKenzie Valve & Machining, respectively. To the untrained eye, these devices are quite similar in general appearance, even having a similar number of parts (18 versus 19).

**Diagram 3** depicts Kelso Manufacturing’s PRV offering. This device is simpler than the first two (having only eleven parts). Still, the internal parts are roughly similar to the first two examples, although Kelso has designed this device with a steel cover, to which is attached a metal plate with identification information.

**Diagram 4** illustrates one of Midland Manufacturing’s rupture disc devices. Simpler in design than PRV’s, this device is nonetheless similar in external appearance to Kelso Manufacturing’s PRV device in **Diagram 3**.

**Diagrams 5 and 6** illustrate vacuum relief devices built by Midland Manufacturing, and McKenzie Valve & Machining, respectively. Both are similar in appearance (externally), although the McKenzie offering has fewer than half of the parts of the Midland design. Both of these models have metal caps.

**VI. Tracking Pressure Relief Devices**

²³ Ibid.
²⁴ Ibid.
²⁵ See Appendix III for a partial list of tank car valve and related parts manufacturers.
Serialization

In order to effectively register and associate any component with a specific rail car, it’s somewhere between helpful and vital to have a serial number for the component. Consulting with the manufacturers, of all the potential tank car fittings and fixtures only the pressure relief valves and the bottom outlet valves generally have manufacturers’ serial numbers. And generally, these devices have been serialized for at least twenty years\textsuperscript{26}. This time frame is important, since, as noted in Table 2 below, approximately 71% of the active tank car fleet was built in the last twenty years.

These serial numbers (along with other data) are generally inscribed on an ID plate or tag which is attached to the valve. Diagram 8 in Appendix II illustrates the plate used by Midland Manufacturing. This plate contains the serial number of the valve, the model number, the date of manufacture and other pertinent information. Consistent with the processes currently in place with the component registry, the serial number would be used to register tank car valves, which would then be associated with the tank car initial and number (car ID).

One additional insight from the diagrams in Appendix II. The pressure relief devices illustrated (which are representative of the population of such devices) contain between approximately ten and twenty individual parts. While there might be a theoretical case for tracking individual PRD components in the component registry, the number and small size of these components make this impractical. The PRD as a whole is really the lowest practical level of granularity at this time, and for the foreseeable future.

VII. Tank Car Fleet Demographics

As of approximately September 1, 2014, the active North American railcar fleet totaled approximately 361,000\textsuperscript{27} cars:

\begin{table}[h]
\centering
\begin{tabular}{|c|c|}
\hline
\textbf{Status} & \textbf{# of Tank Cars} \\
\hline
Active & 360,802 \\
Inactive & 2,237 \\
Preregistered & 18,884 \\
Total & 381,923 \\
\hline
\end{tabular}
\caption{Table 1: Total NA Tank Car Fleet}\textsuperscript{28}
\end{table}

\textsuperscript{26} The older manufacturers have been serializing valves for many years. Some of the more recent entrants into the industry have only recently been serializing their products. But this is offset by the fact that as recent entrants, their footprint on the existing tank car fleet is small.

\textsuperscript{27} Because of the rapid expansion of the North American tank car fleet this number is by definition outdated almost immediately. But the overall and relative percentages owned by the leasing companies should probably hold.

\textsuperscript{28} Data taken from Umler on Friday, 29/Aug/2014, and includes. (Includes preregistered cars.)

Draft Date / Time: 04/06/15; 1:25 PM  
Page 14
Tank Car Valve Roadmap Study

Tank Car Ownership

The twelve largest leasing companies (some of which are, in turn, owned by the major manufacturers) collectively own 73% of the North American tank car fleet.

<table>
<thead>
<tr>
<th>Company</th>
<th># of Tank Cars</th>
<th>% of Tank Car Fleet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Union Tank Car(^{30})</td>
<td>94,200</td>
<td></td>
</tr>
<tr>
<td>GATX</td>
<td>61,200</td>
<td></td>
</tr>
<tr>
<td>First Union</td>
<td>4,400</td>
<td></td>
</tr>
<tr>
<td>CIT</td>
<td>15,700</td>
<td></td>
</tr>
<tr>
<td>AR Leasing</td>
<td>17,700</td>
<td></td>
</tr>
<tr>
<td>Trinity</td>
<td>44,800</td>
<td></td>
</tr>
<tr>
<td>Greenbrier</td>
<td>1,300</td>
<td></td>
</tr>
<tr>
<td>GE Rail Services</td>
<td>25,500</td>
<td></td>
</tr>
<tr>
<td>SMBC Rail Services</td>
<td>6,100</td>
<td></td>
</tr>
<tr>
<td>Southwest Rail Industries</td>
<td>1,700</td>
<td></td>
</tr>
<tr>
<td>Trinity Chemical Leasing</td>
<td>2,900</td>
<td></td>
</tr>
<tr>
<td>Transportation Equipment Inc.</td>
<td>1,800</td>
<td></td>
</tr>
<tr>
<td></td>
<td>277,300</td>
<td>73%</td>
</tr>
<tr>
<td>All other owners(^{31})</td>
<td>104,700</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td>382,000</td>
<td></td>
</tr>
</tbody>
</table>

Table 2

Tank Car Fleet Ownership\(^{29}\)

Tank Car Age Demographics

Tank cars are certified to operate for, with that limit extended by appropriate refurbishments. However, as shown in Table 3, approximately 71% of the fleet is twenty years old or newer.

(The rest of this page left intentionally blank)

---

\(^{29}\) Rounded numbers and includes preregistered cars.

\(^{30}\) Includes Procor and BNSF tank cars

\(^{31}\) Other large owners include oil and chemical companies, who run tank car traffic between specific points in their supply- and distribution-networks.
### Table 3
Active Tank Car Fleet Age

<table>
<thead>
<tr>
<th>Year Built</th>
<th>Tank Car #s</th>
<th>% of Total Active Fleet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backlog</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal '95 to '14</td>
<td>234,698</td>
<td>70.69%</td>
</tr>
<tr>
<td>Prior to 1995</td>
<td>105,752</td>
<td>29.31</td>
</tr>
<tr>
<td>Total Active</td>
<td>360,802</td>
<td>100%</td>
</tr>
</tbody>
</table>

Driven by surging oil-by-rail traffic, demand for new tank car construction is strong and expected to remain so for the foreseeable future. Precise numbers across all tank car builders are difficult to assemble, but recent industry reports indicate a tank car construction backlog of 52,600 units.\(^{33}\) Other reports indicate that the current backlog will translate into above average new-build deliveries several years into the future:

---

\(^{32}\) As of August 29, 2014

Table 4
Estimated Tank Car Construction

<table>
<thead>
<tr>
<th>Year</th>
<th>New Builds</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>5,000</td>
</tr>
<tr>
<td>2015</td>
<td>20,000</td>
</tr>
<tr>
<td>2016</td>
<td>17,000</td>
</tr>
<tr>
<td>2017</td>
<td>16,000</td>
</tr>
<tr>
<td>2018</td>
<td>16,500</td>
</tr>
<tr>
<td>2019</td>
<td>17,000</td>
</tr>
<tr>
<td>2020</td>
<td>17,000</td>
</tr>
<tr>
<td></td>
<td>108,500</td>
</tr>
</tbody>
</table>

At the same time, the “the rail industry recently urged federal regulators to toughen existing standards for new tank cars and require that the approximately 92,000 existing tank cars used to transport flammable liquids, including crude oil, be retrofitted with advanced safety-enhancing technologies or, if not upgraded, phased out.”

Much more recently, the US Department of Transportation proposed new rules which essentially build on the AAR suggestions. If these new rules are adopted, “[w]ithin two years, older "DOT 111" type tank cars would be phased out under the rule for transporting group I flammable liquids, including most Bakken crude, unless the cars are retrofitted to comply with new design standards.”

These “older DOT 111 type tank cars” are essentially the same cars addressed by the earlier AAR proposal. There is some industry discussion about how many of the 92,000 cars will ultimately need to be retired or retrofitted or repurposed. This is because 14,000 of the 92,000 tank cars have been constructed to a more recent (and more rigorous) industry standard. There are three construction standard options listed in the proposed rule-making notice, to take effect for all tank cars constructed after October 1, 2015, with existing tank cars not meeting that proposed standard to be retired by October 1, 2017.

---

34 Given recent developments in tank car regulation the estimates in this table likely significantly understates actual construction after 2014.
36 Association of American Railroads, “Moving Crude Oil by Rail”, December, 2013, page 1
38 Some of the older tank cars may be “repurposed” to haul other commodities deemed less risky than crude oil. These repurposed cars may then be outside the scope of “Phase 1” of the proposed Umler expansion project.
39 American Association of Railroads factsheet “Railroad Tank Cars.”
40 Federal Register, vol. 79, no. 148, August 1, 2014, pages 45018 to 45019. The comment period for this proposed rule ends September 30, 2014.
For purposes of planning the proposed project to add tank car valves to the component registry, the expected churn in the fleet resulting from the combination retrofitted, retired, and newly constructed tank cars can be outlined in the following table:

<table>
<thead>
<tr>
<th></th>
<th># of Cars</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank cars to be retrofitted:</td>
<td>92,000</td>
<td>19%</td>
</tr>
<tr>
<td>“Continuing” tank cars⁴¹:</td>
<td>290,000</td>
<td>59%</td>
</tr>
<tr>
<td>Tank car fleet as of 1/Sept/2014</td>
<td>382,000</td>
<td>-</td>
</tr>
<tr>
<td>New construction 2014-2015 (est.)</td>
<td>25,000</td>
<td>5%</td>
</tr>
<tr>
<td>New construction 2016-20 (est.)</td>
<td>83,500</td>
<td>17%</td>
</tr>
<tr>
<td>Tank car fleet as of 31/Dec/2020 (est.):</td>
<td>490,500</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 5 assumes (for simplicity of analysis) a minor three-month delay in the new proposed tank car construction rules, and also assumes zero actual retirements of the existing older tank cars (i.e., all of those older tank cars will be retrofitted.) Under those simplifying assumptions some 36% of the estimated 2020 yearend tank car fleet would be built to the new standard. To the extent that some of the 92,000 older tank cars were retired, that percentage would increase.

VIII. Process Analysis

This section outlines the challenges to incorporating tank car PRDs into the component registry. Registering tank car PRDs requires a multi-prong approach, requiring agreement, cooperation and effort from the fleet owners, tank car builders, valve manufacturers, and repair facilities. However, should this project be approved and move forward the work required would not be dramatically different than the process to capture couplers, bolsters or wheel sets in component registry system.

Existing tank cars

As noted in Table 1 of approximately September 1, 2014, there were approximately North American 382,000 tank cars in the Umler database (361,000 active). Each tank car has a certificate of construction (form AAR 4-2), which references drawing numbers for the various key systems and components of the thereon, and with which the builder certifies that the car meets the relevant regulatory standard. While the form includes the individual reporting marks and car numbers for each tank car⁴² the certification applies to, the document does not capture every detail of construction (specifically valve serial numbers) for every car. But the component registry needs exactly that level of car-by-car detail.

⁴¹ Includes inactive and pre-registered cars.
⁴² A single certificate of construction can apply to a group of identically constructed tank cars.
There are two ways to capture valve serial numbers on existing tank cars:

- **Fleet owners’ asset management files** – The asset files of some of the largest tank car owners (i.e., leasing companies) contain valve serial numbers by tank car. These could be captured in a CSV file and uploaded to Umler component registry to backfill a portion of the existing tank car fleet. As shown in Table 2, twelve fleet owners collectively own 73% of the North American tank car fleet. (The six largest collectively own 60% of the fleet.) Obtaining valve serial number detail by tank car reporting mark and car number is a promising approach. Based on selected interviews with representatives of a sample of these leasing companies valve serial numbers for between 10% and 20% of the tank car fleet could be captured and backfilled to Umler via this approach.

- **Recertification / repair** – Every rail car needs periodic miscellaneous repairs (brakes, lines, etc.) In addition, tank cars need to be recertified periodically (every ten years?). Finally, there are up to 92,000 older tank cars that will need retrofitting by approximately the end of 2017. Each trip to a certified repair shop represents an opportunity to capture serial number information for the component registry. However, for the repair shops to do this work new processes may have to be developed and communicated.

**New Tank Cars**

As noted above, the focus of this road map study is confined to a proposed “Phase 1” limited to reclosing PRVs installed on tank cars built or retrofitted to the new DOT 117 standard. These are the valves currently with manufacturer’s serial numbers. The tank car builders would associate these PRV serial numbers with specific tank cars as they do with wheel sets and other components currently included in the industry’s component tracking system.

There is a large construction backlog at the tank car manufacturers which is expected to continue into the foreseeable future. As shown in Table 4 and Table 5 a significant percentage of this construction will occur after 2015. Developing processes and systems to capture tank car valve data at the manufacturer (as now occurs with couplers, bolsters, etc.) will capture at least 17% of the estimated 2020 fleet.

Given recent events (proposed regulatory actions, never-ending unrest in the Middle East, and continued North American exploration and fracking) these estimates of tank car construction

---

43 It’s possible that some manufacturers might have this data as well, but this has not been confirmed in the course of this road map study.

44 Some of these cars may be retired or “repurposed”, i.e., used for less volatile commodities. For phase 1 of this proposed project focusing on the new DOT 117 standard has the most general agreement among the various industry stakeholders.

45 The new processes would also need to include the ability to assign new serial numbers to rebuilt valves, or valves taken from inventory (including labeling such valves via bar code or other methods), and associating those valves with a specific tank car.
could be significantly understated. *The earlier this proposed project launches, the quicker the compliance percentage will rise, simply in the normal course of tank car construction and refit.*

**Repair Shops**

A significant amount of valve inventory exists in the universe of repair shops, some of which are small businesses. Capturing data for this inventory (i.e., “field registration”) in the first phase of this proposed project is not recommended. It seems likely that most of the retrofitting to the new DOT 117 standard will be done not in the small repair shops, but at the large manufacturers and similar organizations. But the phase 1 systems development process for this project will establish the systems infrastructure to capture valve data going forward. Additionally, the time and experience of adding valve data for retrofitted cars will refine the processes for capturing valve data during the recertification process. Therefore, this study does not envision mass field registration of valve inventory at this time. Rather, after the systems infrastructure is established in the component registry, valves would be registered and associated with specific tank cars as cars are recertified.

**IX. The Business Case – Costs & Benefits**

Traditionally, capital projects fall into one of three categories:

- Projects that create new value through additional revenue or lower cost
- Projects that are required to defend market share (i.e., service or product enhancements) or maintain existing processes
- Projects that are mandated by regulation or safety

The current proposed project aligns most closely with the third category in this simplified capital budgeting schema (although not mandated by any government regulatory body.) It’s often difficult (sometimes impossible) to develop satisfying cost-benefit analyses with positive ROIs for such projects.

That said, this project should be viewed through the lens of the current political and regulatory environments.

**Political Environment**

Since the Lac-Mégantic disaster intense scrutiny has been applied to the rail industry in the press and by parties not necessarily supportive of the rail industry in general, or oil-by-rail in particular. Some of the parties that have weighed in should give the industry pause.
In a recent piece ominously titled “It Could Happen Here: The Exploding Threat of Crude by Rail in California”, Diane Bailey, writing for the National Resources Defense Council (described on its website as “the nation’s most effective environmental action group”) has the following fevered opening:

Soda cans on wheels. That’s what some call the dangerous rail tank cars that have suddenly become ubiquitous across the American landscape. In the rush to transport land-locked unconventional new crude oil sources, old rail lines running through communities across America are now rattling with thousands of cars filled with crude oil. Neither the cars nor the railroads were built for this purpose. Worse, federal regulators have few safeguards in place to protect communities and the environment from accidents, spills and explosions resulting from the race to move millions of barrels of crude by rail. . . . More crude oil was transported by rail in North America in 2013 than in the past five years combined. Millions of Californians live near crude-by-rail routes and could face extreme safety risks. . . . As oil companies profit, communities bear the cost.46

In calmer tones with a perhaps more ominous audience (the American Bar Association section of public utility, communications and transportation law) a piece titled “Rail Transportation of Oil and Tank Car Design” appeared in the summer 2014 edition of *Infrastructure*:

In May 2014, two agencies in the United States Department of Transportation (USDOT)—the Pipeline and Hazardous Materials Administration (PHMSA) and the Federal Railroad Administration (FRA)—issued a safety advisory that, among other things, made recommendations regarding the rail cars used to transport crude oil produced from the Bakken formation in North Dakota. Generally, they “recommend[ed] that offerors and carriers of Bakken crude oil by rail select and only use the tank car designs with the highest level of integrity reasonably available within their fleet.”1 More specifically, they “advise[d] offerors and carriers of Bakken crude oil to avoid the use of older, legacy DOT Specification 111 or CTC 111 tank cars for the shipment of such oil to the extent reasonably practicable.”47

This has reference to assertions that Bakken crude oil is more volatile and dangerous than other types of crude oil, and therefore should be transported with more care and in safer tank cars:

The worries about basic railroad safety are compounded by concerns over the unique composition of Bakken shale oil. Independent tests obtained by Earth Island Journal suggest that the North Dakota light crude is especially flammable, perhaps because it is being produced at such a breakneck pace that drilling companies aren’t following

---

standard industry practices to separate out volatile gases. Each day millions of gallons of highly combustible oil are moving through major metropolitan areas – yet local residents and public officials are often unaware of the danger, and many first responders are unprepared for a disaster like the one that occurred in Quebec.

“I live in fear of waking up to a bunch of text messages and emails because there’s been a 100-car explosion in Chicago and 300,000 people are vaporized,” says Scott Smith, a researcher at the nonprofit group Water Defense and the inventor of Opflex, a foam sponge that absorbs oil and was used in the Gulf Coast after the BP oil spill. “Unfortunately, that is a very real possibility if something’s not done.”

Regulatory Environment

The notion that Bakken oil is more dangerous than other crude oil is fiercely disputed by the oil industry:

“The best science and data do not support recent speculation that crude oil from the Bakken presents greater than normal transportation risks,” API Pres. Jack N. Gerard said. “Multiple studies have shown that Bakken crude is similar to other crudes. DOT needs to get this right and make sure that its regulations are grounded in facts and sound science, not speculation.”

But for now, the USDOT is acting as if the notion is true:

DOT’s Pipeline and Hazardous Materials Safety Administration simultaneously released a report summarizing the analysis of data it collected with the Federal Railroad Administration of Bakken crude data the agencies gathered from August 2013 to May 2014. The data show Bakken crude tends to be more volatile and flammable than crude produced elsewhere, PHMSA said.

Comments on [proposed regulations] will be accepted for 60 days, DOT said. “Given the urgency of the safety issues addressed in these proposals, PHMSA does not intend to extend the comment period,” it said.

The cost-benefit analysis in the proposed regulations offers insight into the current thought process of the regulators:

50 Ibid.
The 20-year estimated costs exceed midpoint estimated benefits for each of these regulation packages in amounts ranging from $650 million to $3.4 billion. In percentage terms, the estimated costs exceed the midpoint of estimated benefits by between 25% and 236%.

Costs (and Benefits) of the Proposed Umler Expansion Project

Total project costs fall into four categories:

<table>
<thead>
<tr>
<th>Cost / Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Railinc costs of systems development, passed to the tank car owners</td>
<td>In terms of the actual Umler component registry expansion, the costs are straightforward. Development costs (creating the tables, definitions, etc.) are estimated at approximately $200k to $300k (rough order of magnitude). This translates into a per-car cost for the tank car owners of 14 to 20 cents over four years.</td>
</tr>
<tr>
<td>Cost to the tank car manufacturers and fleet owners to assist Railinc backfilling data (where available) into the component registry</td>
<td>To the extent this data exists it mostly resides in the asset management systems of the fleet owners. (The manufacturers have valve data in their records, but these are not easily searchable.) Therefore, the cost will fall mostly on the fleet owners, which would be modest for those with sufficient detail in their asset management systems.</td>
</tr>
<tr>
<td>Cost / Description</td>
<td>Comments</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cost to the tank car manufacturers to load valve data into the component registry for new construction, and car retrofit work</td>
<td>For newly constructed tank cars this would be a modest process change, since they are already associating components to newly built cars. For tank car retrofit work, the incremental process cost would be modest (especially compared with the cost of the retrofit.)</td>
</tr>
<tr>
<td>Cost to the repair shops to load valve data into the component registry during maintenance &amp; repair work</td>
<td>There are three components to repair-shop costs: First, the cost to develop and capture processes to accommodate valve data entry into the component registry. This cost is part of the development cost noted above, and borne by the tank car owners. Second, the potential effort to register valves in inventory, some of which (old inventory) may not be serialized. But as noted above, the consensus of those involved in this roadmap study is that there is little short-term value in registering existing inventory. Rather, registration and association should occur simultaneously as inventory is installed on tank cars for repair or recertification. Third, the process cost going forward of entering data (associating components to cars) as work is done on existing cars. The labor cost for this work is modest, and would be passed onto the tank car owners as part of the overall repair cost. There may be additional costs associated with creating component IDs for inventory as used, but those processes will likely not be fully developed until after the initial phase of this proposed project.</td>
</tr>
</tbody>
</table>

In sum, the sense from the valve manufacturers interviewed is that current production is already serialized, and the incremental process costs, while real, would not be prohibitive. Most of the costs would ultimately fall to the fleet owners, although a very modest portion of what is in effect a complete recapitalization of the entire tank car fleet. Development costs are modest compared with these recapitalization costs. **But given the scale of proposed new construction and retrofit the best course may be to simply capture data on a going-forward basis (which will quickly cover the majority of the tank car fleet), and ignore unregistered valves in inventory.**

Hard dollar benefits are difficult, possibly impossible to estimate. As noted above, the proposed project most closely resembles projects mandated by safety or regulatory concerns.
Tank Car Valve Roadmap Study

Some efficiencies are likely should a recall become necessary, but hard data on historical recalls is neither readily available nor eagerly shared by the manufacturers.

On the other hand, in this regulatory environment where cost-benefit analysis is upside-down, ideal (i.e., rational) capital planning might not apply. Expanding the component registry to include tank car valves is in the interest of the industry as a reasonable step to monitor the overall safety of the tank car fleet. (And, which has the added benefit of modestly countering the mistaken notion that the industry is indifferent to tank car safety.)

X. Recommendations

The recommendations resulting from this road map study are in two categories: timing recommendations, and project design and process recommendations, as follows:

Timing Recommendations

1) The project should proceed in two\(^{52}\) phases. The first phase should incorporate reclosing pressure relief valves into the component registry, and focus on tank cars built or retrofitted to the new DOT 117 standard. The second phase should incorporate other PRDs, along with bottom outlet and other outlet devices.

2) The project should be initiated as early as possible, and as near as possible to the effective date of the proposed regulations on new tank car construction, (currently October 1, 2015.) This would maximize the data capture opportunity of loading the component registry in the normal course of new construction, and reduce data backfill requirements. An earlier date would also favorably coordinate with the looming retrofitting of older tank cars, which under the proposed rules must be upgraded, retired, or repurposed\(^{53}\) before October 1, 2017\(^{54}\). Capturing data during the retrofit process is likely easier than trying to obtain non-electronic backfill data.

3) Capture valve data from new construction and retrofit work while simultaneously working to obtain backfill data, where it is easily available. Establish codes and processes to capture valve data as existing tank cars are repaired or retrofitted. Defer any registration of valve inventory at repair shops.

\(^{52}\) An alternate approach would be to capture all valves for new construction and retrofitting, and designing processes later to capture those devices for the continuing fleet in the recertification and repair processes.

\(^{53}\) The repurposing dates vary depending on the commodity transported.

\(^{54}\) The 2015 and 2017 dates are from Federal Register, vol. 79, no. 148, August 1, 2014, page 45018. However, the Associated Press recently reported that the "oil and railroad industries are urging federal regulators to allow them as long as seven years to upgrade existing tank cars that transport highly volatile crude oil . . ." Lowry, Joan, “Oil, Rail Industries Want 7 Years to Fix Tank Cars”, September 30, 2014, http://abcnews.go.com/Politics/wireStory/oil-rail-industries-years-fix-tank-cars-25867671. As of this writing it is not known if this request will be approved in the course of the rule-making process.
Project Design & Process Recommendations

1) As noted above “[e]ach tank car has at least two valves—an inlet/outlet valve and a pressure relief valve (PRV)” but also “some [n]onpressure single-unit tank cars may be divided into compartments . . . [e}ach compartment [having] its own loading/unloading fittings and PRD.”

It seems reasonable for the design to anticipate the possibility of several valves per tank car. A reasonable approach would be to allow up to six valves, with each valve having a narrow number of valve types, e.g., pressure relief valve, vacuum relief valve, eduction valve, bottom outlet valve, etc. (Probably not more than 10 designated types.) In this way the design could anticipate capturing all valves on all cars, while the short-term process focused on capturing the data for the pressure relief valves on the new or retrofitted DOT 117 tank cars.

2) Given the rapid rate of tank car construction (likely to continue for the foreseeable future) priority should be given to establishing agreement, processes and procedures with the tank car builders to capture PRV data in Umler (along with data for couplers, wheel sets, etc.)

3) Some of the manufacturers have announced retrofit55 efforts for the older cars. Simultaneously with developing processes and procedures to capture PRD data for new cars, develop similar processes and procedures with the manufacturers56 (and any other organizations that might participate) to capture similar PRD data as older cars are retrofitted.

4) For the existing fleet, work to backfill the component registry cost effectively:

   a) Work with fleet owners to access electronic PRD data to backfill the component registry the extent such data is easily available. (There may be some overlap between this recommendation and gathering data from retrofitted cars.)

   b) For fleets with less detailed asset management systems encourage work to gather what data is available cost-effectively. (Some fleet owners may have asset management enhancement efforts underway or planned.) Establish repair process and codes to capture PRD data during periodic 10-year recertifications, making component registry updates a routine part of the recertification process.


56 How extensive the actual effort at retrofitting older tank cars is unknown at present. How many manufacturers and other organizations might be involved, how quickly that work would be done, cost, etc. But because of the scale of work involved for each retrofitted tank car it’s likely that the effort will center around the manufacturers.
Summarized Project Timeline

The following is a high-level outline of the steps necessary to implement the recommendations herein. This is not a detailed project work plan. Actual implementation will require more detailed planning; this is simply an overview, and based on the assumption that the October 1, 2015 for new design construction will hold.

- **2015 – Jan to April**
  - Obtain recommendation from Tank Car Committee to move forward with adding PRDs to the component registry
  - Closely monitor the rule-making process, especially the effective dates for new tank car standards, and use of older tank cars
  - Monitor the rule-making process for changes in requirements, dates, etc.

- **2015 – May to October**
  - Formal project proposal submitted through the industry project selection process. This process is managed by the Railinc Project Selection Working Committee (RPSWC).
  - Complete project business case to include with project submission

- **2016 – January**
  - Define industry TAG to lead the project
  - Kick-off project (define registration, association and required rule or job code changes
  - Launch PRD process for new construction and retrofit activities
  - Define repair shop processes for recertifications, etc.
  - Begin discussions with fleet owners to obtain backfill data from asset management systems, where such data is available.
  - Work processes to backfill PRD data, to the extent such data is easily available from fleet owners.

- **2017-2018**
  - Phase in mandatory rule changes to capture PRV associations to tank cars.
  - Launch repair shop processes for recertifications, etc.
APPENDIX I
Interviews Conducted

1. Chairman of the AAR Tank Car Task Group and Director, Maintenance & Reliability Engineering, GATX
2. Director, Tank Car/Hazmat Safety, Association of American Railroads (AAR)
3. Director of Technology, Railinc
4. Implementation Specialist, GBW Information Technology
5. MM @ GBRX
6. Project Manager, GBW Services
7. General Manager, Maintenance & Repair Billing, Greenbrier Management Services
8. QA Director, ULTX Manufacturing
9. Senior Director, Maintenance Planning & Control, Trinity Industry Leasing Company
10. Manager, Mechanical Records, GATX
11. Manager, Fleet Compliance & Reliability, GATX
12. Director – Engineering & Compliance, American Railcar Leasing
13. Chief Operating Officer, Kelso Technologies, Inc.
14. Global Director of Rail Transportation Business Unit, Midland Manufacturing

\(^{57}\) Represents the titles of those consulted during the course of this roadmap study. Communication was by phone and email, some with multiple contacts and discussions.
APPENDIX II
Illustrations of various tank car valves

Diagram 1 is a representation of Midland Manufacturing’s pressure relief valve model #PRV A-1075 to A-1450. These devices contain eighteen different parts, are available in twelve different pressure settings, and come in stainless steel, or stainless trim models. Midland has dozens of PRV offerings, and generally Midland’s PRV designs are uncovered.

Diagram 2 is a representation of McKenzie’s 75 psi safety relief valve. This device has 19 different parts. Like the Midland Manufacturing example in Diagram 1, this device is uncovered.

---

58 All diagrams in this section are taken from publically available material on the websites of Midland Manufacturing and Kelso Technology. These manufacturers were selected solely because their websites offered technical diagrams to illustrate the points made in this study.
APPENDIX II (con’t)

Diagram 3 is a representation of the Kelso Technologies’ pressure relief valve, model JS75 and JS75S. This device contains 11 different parts, and in contrast to other designs from other valve manufacturers, most of Kelso’s PRV’s have a cover to which a plate containing (among other data) the serial number is attached.

Diagram 4 is a representation one of Midland Manufacturing’s rupture disc devices, with sixteen component parts. Midland designs these devices with covers, which are attached to the base with a chain.
APPENDIX II (con’t)

Diagram 5 is a representation of one of Midland Manufacturing’s vacuum relief devices, with seventeen component parts. There is no cover, but the valve has a cylindrical, stainless steel body over the top of the device.

Diagram 6 – McKenzie Valve & Machining’s vacuum relief device, containing eight different parts.
Finally, a single example of a bottom outlet device:

In contrast to the PRVs above, **Diagram 7** is a representation of one of Midland Manufacturing’s bottom outlet valves. This device is, of course, designed for a completely different purpose than a PRD, and at least in terms of the number of component parts (thirty-seven) is more complex.

**Diagram 8** is the engineering drawing of the Midland Manufacturing name plate. This plate is affixed to all Midland tank car valves. On PRDs this is affixed to the body of the valve. Kelso Industries attaches its plate to the cover of its tank car valves. All tank car PRDs are serialized in some similar form or fashion.
APPENDIX III
Partial List of Major Valve Manufacturers
(Not intended as a comprehensive listing)

1. **Midland Manufacturing** - Midland is part of the Dover Corporation, a NYSE company based in Illinois. Midland’s PRV offerings can be found on their website here: http://www.midlandmfg.com/products/general-purpose-car/pressure-relief-valve. In addition to PRVs, Midland manufacturers bottom outlet devices, gauging equipment, and other tank car accessories.

2. **Jamesbury** is owned by Metso, a Helsinki, Finland-based company whose shares are traded in the US on NASDAQ. See the portion of the Metso website devoted to Jamesbury tank car valves at: http://www.metso.com/Automation/valve_prod2.nsf/WebWID/WTB-090519-22575-95F7C?OpenDocument#.U_z0duOwlfh. Dennis Foley, TBD

3. **McKenzie Valve & Machining, LLC** – McKenzie is a private manufacturer owned by Union Tank Car. Based in Tennessee. McKenzie “started producing the UTLX brand of valves and tank car components in 1997. The original intent was . . . to supply railroad components to Union Tank Car[.] . . . Since that time . . . McKenzie Valve has increased its customer base outside of those facilities.”59 Their offerings, including bottom outlet equipment, safety relief valves, and related equipment are found on their website here: http://www.mckenzievalve.com/mvpages/products.htm.


5. **Kelso Technologies** – Kelso is a relative new, smaller player in the tank car fixtures and fittings industry. The company’s emphasis is on new technology to make tank cars safer. Its products include bottom outlet valves, pressure relief valves, vacuum relief valves, and man ways. It’s product offerings are here: http://www.kelsotech.com/products.

6. **Salco Products** – Salco Products designs, manufactures a variety of plastic and metal products used in railcars generally, and tank cars in particular. Tank car products include various fittings, PRDs and bottom outlet valves. http://www.salcoproducts.com/page/home

---

59 See the brief history of McKenzie on their website here: http://www.mckenzievalve.com/mvpages/history.htm.