Looking Ahead at Clean Air Issues’ Potential Impact on Railroads

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Abstract

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One of the least known and understood environmental regulations for the rail industry is the Clean Air Act (CAA). The railroads have dealt with it on an “as need” basis. Many believe the air quality issues for railroads are the locomotive emissions. Much emphasis is placed on locomotives because they are the primary generators of hazardous air pollutants (HAPs) for the rail industry. The rail industry agreement with the United States Environmental Protection Agency requires that new locomotives in 2007 emit only one third the air pollutants compared to a locomotive manufactured in 1990. The rail industry consumes approximately 3,500,000,000 gallons of diesel fuel annually. But there are many other sources that are less recognized that must be understood and addressed to stay in compliance with air regulations.

Some of the other sources of air pollutants from railroad operations are: diesel engines in work equipment and gang trucks; visible dust emissions from constructions sites; new source air permits for new and upgraded boiler systems; diesel powered pile drivers; ballast unloading operations and storage tank off gases during expansion and filing events. Depending on the air quality in your operational area of the country, you and your railroad operations may be subject to permitting and compliance issues under the CAA. This paper will identify the sources, regulatory issues and present several options for future compliance with the CAA.
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The debate about air quality, emissions of greenhouse gases and atmospheric warming is ongoing. As the population of earth increase the demands for energy, food and other commodities and services also increases. The general, scientific consensus is that human activities are contributing HAPs to the atmosphere. Global warming is occurring whether by a natural climatic cycle or by human contribution is under study. The debate and most difficult question is how to protect the earth's atmosphere while protecting and improving the quality of life around the world.

To start the process of looking for future trends on how air quality issues will affect the rail industry, there has to be some understanding of what is currently happening and what are the future requirements going to be. From the energy crisis of the 1970s to the first environmental regulation requiring air pollution control devices on automobiles and exhaust stacks, change follows need. The affects of smog in metropolitan areas and the affects on forests from acid rain in the northeastern sector of the U.S. are indicators of decreasing air quality and its adverse affects on the environment.

The most recent observations of concern, even with the use of air scubbers on smoke stacks and catalytic converters on automobiles, are the emissions from power plants, manufacturing facilities, petroleum refineries and internal combustion engine. These sources produce nitrogen oxides (NO\textsubscript{X}), carbon dioxide (CO\textsubscript{2}), Carbon Monoxide (CO), Sulfur Oxides (SO\textsubscript{X}), Hydrocarbon (HC) and Particulate Matter (PM). NO\textsubscript{X}, SO\textsubscript{X} and HC are known to be contributor to the production of lower atmosphere ozone. When ozone, CO and/or PM build up in the air,
usually over large metropolitan and some unique geographical areas (example mountain valleys),
the quality of respirable air decreases and starts affecting the health of the residents.

Incomplete combustion of petroleum products, wood, coals and other carbon containing
compounds product CO and PM and a variety of other off gases depending on chemical makeup
of the fuel source. PM is measured in microns (millionth of a meter \(1 \times 10^{-6}\) PM-10 would refer
to particulate size that is 10 microns in diameter. This particle is considered respirable (small
enough to become lodged in lung tissue by OSHA and USEPA. California has determined PM
from diesel exhaust in the PM-2.5 range is a human carcinogen.

When an area is identified with these conditions it is known as a "Non-attainment Area" for air
quality. The USEPA requires the state to develop a strategy to bring the quantity of the area’s
concentration of air pollutants back into acceptable levels. The state, in turn, will ask the
affected area to develop a plan to reduce its generation of air pollutants. Most communities look
at converting their mass transit bases and municipal fleet from diesel to natural gas to reduce the
emissions of CO, NO\(_X\), SO\(_X\) and HC. But these steps only go so far. The pollutants contributed
by municipalities are very small percentage of the overall problem.

The state must develop a "State Implementation Plan" (SIP). Part of the SIP will look at
industrial contributions by sectors. According to USEPA research, railroad operations contribute
approximately 4.6% of the total tons of air pollutants as emissions across the country. This is a
large enough percentage for regulators to take notice. Even though locomotive emissions are the majority of the percentage, these emissions are federally regulated and preempted from state authority, all SIPs to date have made additional demands for contribution of reduction to the railroad's operation. The remaining areas available to the states are work equipment, intermodal operations and company vehicles.

The rail industry negotiated with the USEPA for federal regulatory control of locomotive emissions in order to standardize the emission requirements. The potential of states and communities setting different standards across the country would have overburdened the industry. The reduction of emissions from locomotives is set forth in an agreement between USEPA, locomotive manufacturers and railroads. By the end of 2007 all manufactures and remanufactures locomotives with build dates of 1973 and newer will have reduced emissions to one third as manufactures based on brake horsepower hours. Today, there are low to medium horsepower locomotives that have greatly reduced emissions. Several railroads have committed to using these units as local and yard switching power in non-attainment areas like Los Angeles and Houston.

The emissions that must be totalized are dependent on the type of non-attainment of air quality in the area. There are three categories: ozone, carbon monoxide and particulate matter measuring ten microns or smaller which is known as PM-10. The level of regulated HAPs discharge is dependent on the ambient air quality of the area. There are four non-attainment classifications and requirements for facilities that discharge regulated quantities of HAPs in tons per year (TYP). The classifications and air permit thresholds are:
### Classification vs. Regulated Quantities

<table>
<thead>
<tr>
<th>Classification</th>
<th>Regulated Quantities</th>
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<tbody>
<tr>
<td>Marginal / Moderate</td>
<td>&gt; 100 TYP of VOC and NO(_X)</td>
</tr>
<tr>
<td>Serious</td>
<td>50 - 100 TYP of VOC and NO(_X)</td>
</tr>
<tr>
<td>Severe</td>
<td>25 - 50 TYP of VOC and NO(_X)</td>
</tr>
<tr>
<td>Extreme</td>
<td>10 - 25 TYP of VOC and NO(_X)</td>
</tr>
</tbody>
</table>

To calculate your facility’s annual emissions of ozone contributors, Volatile Organic Carbon (VOC), Nitrogen Oxides (NO\(_X\)) and an inventory of PM –10, you must define the extent of the facilities and identify activities that could produce these pollutants. Inventories need to include boilers, tank and vat emissions, solvent and cleaner usage, paint and coating activities, fueling facilities, stationery engines, mobile equipment with 50 horsepower or greater engines, backup generators and even aerosol can propellant. If the total potential TYP of the facility exceeds the threshold amount for various non-attainment areas, your facility will need an air permit, which requires monthly and annual reporting of emissions.

The next largest source for air emissions, after locomotives, is from railroad fixed facilities. Fixed facilities are the locomotive and car maintenance shops, work equipment maintenance area and material storage areas. Every facility is required to look at all of the activities that generate HAPs and calculate, in TYP, the maximum potential to emit or discharge. Included in the inventory are HAPs from boilers or heating units, evaporating solvents from parts cleaners, paints and coatings and volatiles from fueling operations and storage tanks, to name a few.
To calculate the maximum potential to emit HAPs, consider the use of a paint gun. The calculation is made using the assumption that the gun is operated using the highest HAPs coating material you use. The gun is operated at its highest output or throughput and this is occurring everyday of the year for the full duration of all shifts that "could" use it. So if you have a paint booth in a shop that operates around-the-clock (3 shifts). So the gun would be held wide open 24 hours a day for 365 days a year. Add up all of these TPY maximum potential emissions of each operation or piece of equipment. If your operations could contribute or has the potential to produce “significant” emissions, as defined in 40 CFR 52.21(b)(23)(I), your facility requires an air permit under Title V of the Clean Air Act (CAA). The HAPs and rate of emissions most likely to affect a rail facility are:

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Emission Rate (TPY)</th>
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<tbody>
<tr>
<td>Carbon monoxide</td>
<td>100</td>
</tr>
<tr>
<td>Nitrogen oxides</td>
<td>40</td>
</tr>
<tr>
<td>Sulfur oxides</td>
<td>40</td>
</tr>
<tr>
<td>PM</td>
<td>25</td>
</tr>
<tr>
<td>PM – 10</td>
<td>15</td>
</tr>
<tr>
<td>Ozone (as VOCs)</td>
<td>40</td>
</tr>
</tbody>
</table>

There are three basic types of air permits: Operating, Synthetic Minor and Construction. The Operating Permit is required for any facility that has the potential to emit HAPs at levels that meet or exceeds the significant emissions listed. A variation to the Operating Permit is the Synthetic Minor Permit. The Synthetic Minor is for facilities that have the potential to emit HAPs at the permitting level but the facility can prove, that by controlling the operations, it will
emit below the permitting levels. The information gathering and the preparation of the permit applications can take a year or more. For permitting a new air source, the agency has up to 18 months to review the application, at which time the permit may be denied. Start the permitting process as early in the planning stages as possible. Understand the timelines of the process so no surprises or unexpected delays and expenditures occur.

The Construction Permit has been required by the CAA for construction of new sources and retrofits or upgrades to existing air emission equipment that commenced after June 9, 1989. The permit can be regulated by USEPA, states with authorized programs and even counties and municipalities. If any air emitting equipment change is being considered, be sure to understand the air permitting requirements and timelines involved. Failure to obtain a construction air permit or operate a significant air source without a permit can subject you to penalties of not less than $10,000 per day per violation.

Another technology, which will affect rail operations, is the development of alternative fuels to high sulfur diesel fuel. Alternate fuels for controlling air emissions and improving air quality will have its own set of unique challenges. The first is the problem of current diesel engines used in Maintenance of Way work equipment, intermodal hostler trucks and locomotives. This off road equipment was designed to operate on diesel fuel containing 5,000 ppm sulfur. The presents of sulfur in diesel fuel affects two operational design areas for the internal combustion engine. First as an ignition retarder and second as a fuel stabilizer providing some lubrication characteristics between piston and cylinder wall.
Low sulfur (15 ppm) diesel fuel will require existing diesel engines to be tuned with retardation of 2-4 degrees. Additional cylinder wear is expected, meaning shorter operating life between overhauls or early retirement of engines. The wear is anticipated due to loss of sulfur-metal anodizing at the high internal temperatures of combustion of the diesel engine. This affect may cause manufacturers to re-formulate the cylinder metal alloy to counter the speculated wear and control heat expansion and contraction.

The refining of low sulfur diesel fuel will create other logistical problems for the refiners. Removal of approximately one half- percent of the total volume as elementary sulfur, which is currently sold as part of the diesel product. This means for every billion gallons of off-road diesel at 5,000 ppm sulfur being reduced to 15 ppm sulfur will generate approximately 4,985,000 gallons of elementary sulfur. This sulfur must be managed, marketed or disposed. Obviously this will drive the cost of diesel higher.

Another aspect to alternate fuels is the total elimination of NO\textsubscript{X}, SO\textsubscript{X} and PM emissions from train operations. California is looking at requiring re-electrification of railroads in certain areas and air districts. In other non-attainment areas such as Denver, Colorado, Dallas/Ft. Worth and Houston-Galveston, Texas, any company with ten or more fleet vehicles that operate exclusively within the non-attainment area must have, at a minimum, 10\% - 20\% of their vehicles rated as low or no emitters of NO\textsubscript{X}, SO\textsubscript{X} and PM.

The requirements for fleet vehicle emissions reduction is based on vehicle weight. So you may be required to operate a gang truck, mechanics van and several crew hauling vehicles that use
low emissions fuel or are rated as low HAPs emitters. The current alternative fuels in use are liquefied natural gas, propane and ethanol. Another alternative is the use of electric powered vehicles or vehicles known as “Hybrids” which combine a fuel powered generator with high efficiency storage batteries for power.

The final area of concern to be addressed is the use of off-road diesel engines. California has determined that diesel PM-2.5 is a human carcinogen. Other states, like Wisconsin, are considering similar action. Work equipment diesel engines will be in the same class as construction equipment like excavators, bulldozers and dump trucks. In the past, these engines had little to no emission standards and requirements. Federal guidelines are being proposed to require emissions controls and particulate traps on all off-road engines. There is some debate over retrofitting the existing diesel engines with emission controlling equipment at the time of replacement or overhaul.

Of greater concern are the proposals to regulate the operating times of off road engines in non-attainment air quality areas. For example, in the eight county Houston-Galveston, Texas non-attainment air shed, one proposal is for the restriction of all off-road diesel engines not being allowed to operate from 6:00 am to 12:00 noon. The ramifications of these requirements can only be speculated.

Consider all of the highway, housing, commercial development, railroad maintenance and airport construction projects that could not begin work until afternoon. No movement of containers and trailers at intermodal and transportation hub centers until afternoon. No local switching, no car
classification and no crane or lift equipment operating until afternoon. The ramifications would be staggering, let alone the implications to the affect on interstate commerce.

To reduce emissions from off-road sources will require a cooperative effort between the railroads, work equipment manufacturers and the engine manufacturers. Discussions need to start between these groups to research design, produce engines and equipment to dramatically reduce HAPs emissions. The railroad's role is to drive the air issues and requirements that are being established by the regulations to the equipment manufacturers and suppliers. They, in turn, must make demands on their component suppliers to provide more energy efficient and lower emitting equipment. The engine manufacturers must certify their engines as low emitter so everyone can get credit for their role in reducing HAPs and being an environmentally friendly company.

With the increasing concerns of air quality across North America and around the world, the rail industry must be proactive in air emissions control. Every community in which we operate is affected by the transportation of goods and services provided by railroads, as well as the emissions to the atmosphere from rail operations. Railroads, on the ton miles per gallon of diesel fuel, are the most environmentally friendly mode of ground transportation. New controls of air emissions will be challenging to achieve but these challenges will continue the development of more energy efficient equipment that will reduce emissions while increasing rail service efficiencies for our customers.