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FM 186-2 PROGRAM EVALUATION

Environmental Chemical Solutions

This report is designed to give the reader an overall picture of the impact and the benefits of the ECS FM 186-2 Spill Response Program. The goal of the FM 186-2 Program is the reduction of non-point source pollution by utilizing the most environmentally correct procedures and incorporating the health and safety requirements into the spill response action.

The FM186-2 Program Evaluation

Purpose:

To; discuss the FM 186-2 Program developed by Environmental Chemical Solutions ("ECS") to respond to large and small gasoline and diesel spills at public fueling facilities (PFF).

To; describe the FM 186-2 technology and the environmental advantages of the Program discussing such factors as waste classification, solid waste disposal, VOC suppression, storm water runoff, employee health, and public safety.

To; describe some of the Federal and State (California) statutory and regulatory requirements applicable to the program, as well as the ethical responsibilities of the regulated community to protect both employees and the people residing in the communities in which they do business.

It is every business's responsibility to give equal consideration to health, safety and the environment.

Regulators and the Regulated Community

Laws to protect people and the environment are enacted by state and federal legislators. Many of the environmental laws are deliberate in mandating the use of a best available technology (BAT) or to the maximum extent practical (MEP). Regulators require industry to implement advancing methods to protect, rehabilitate and enhance environmental quality, and to prevent and control pollution of the land, air and waters.

Regulations designed to implement the environmental laws passed by the legislature are promulgated by regulatory agencies. In addition, codes, such as fire, building, and electrical, were developed by professional associations and adopted, in part or in whole, by state or local agencies. Regulators work with the regulated community to promote, through educational programs and enforcement actions, adherence to these laws.

It is a difficult task at best for the regulated community to adhere to the large number of regulations that either cross references multiple other statutes or codes (both federal and state) or from other agencies that have overlapping jurisdiction because of some other facet of their operation.

It is an equally difficult task for regulators, partly because of the voluminous number of industries they regulate and partly because many have different compliance requirements. This, coupled with the varying levels of understanding of the host of regulations on each of the industries, compounds the difficulty of their task.

But, at all times, the regulated community is required to comply with all health and safety statutes, environmental laws, fire codes, and any other regulations specific to their location and business.

Ultimately, it is a herculean task for all stakeholders to work together, as a complete community, to attain and maintain the goals established by the legislators.

Spill Response at Public Fueling Facilities (PFF)

By law, the PFF is required to respond to and mitigate those spills he deems he can handle, or for larger uncontrollable spills, to call for emergency response, and take proper public safety precautions.

Spilled fuel presents an initial health and safety danger from explosion and fire, and environmentally threatens air and water quality.

Even with best management practices in place, spills occur. Many of the spills generated at a typical PFF are caused by the fueling actions of the general public.

Topping off the tank is one of the most common reasons for fuel spills at a PFF. According to a report by the California Air Pollution Officers Association (CAPOA), over 66% of all spills (drips) at the average PFF are about 2 mls in size and an average of .5 pounds of fuel is spilled for each 1000 gallons pumped. While small drips from over fueling are quite small in size, if today the average major PFF pumped 100,000 gallons of throughput each month, and averaged 8 gallons of fuel per auto, the typical PFF would service about12,500 automobiles monthly spilling an average of .5 pounds of fuel for each 1000 gallons pumped. That equates to over 6 gallons of fuel spilled at each PFF each month.

Today's PFF's typically incorporate convenience stores (C Stores) at their fueling operations. While these C stores are critical to the PFF's financial operations, it slows down the spill response capabilities of the station's attendant(s).

The attendant's first priority likely would be to secure the store and then respond to the spill. This would mean that many small drips, overfills and small spills either go unnoticed, or are considered too small to require a response.

Many drips and overfills evaporate quickly and leave behind residual contamination. The remaining hydrocarbon contamination can then be transported by stormwater systems to rivers and other water bodies. Methods for cleaning up the multiple of small spills have basically consisted of doing nothing, using granular material such as kitty litter and allowing the material to blow away, or disposing of it, often without following required storage and disposal requirements.

In addition to small spills where residual contamination presents the main concern, bigger, but not large spills threaten public safety or can directly impact storm drain collection systems. A quick efficient response is essential to help control such spills addressing vapor exposures and to keep them from entering storm water systems or a water body. Many facilities are ill prepared to respond capably to such spills, and others do not have appropriate spill control apparatus.

A third type of spill is a large spill and can consist of spills that are large enough to require an emergency response from the fire department. Facilities are required to provide basic employee training to shut down the pumps and dial 911, but lack public safety training or equipment for these types of spills.

The design of PFF's can also affect the environmental impact of spills and releases. Many older PFF's are poorly designed by placing storm drains adjacent to driveways, by locating drain runoffs near dispensing islands, or by directing storm water from the property to the street.

Based on the *California Hazardous Waste Manifest Report* for 2002, 2004, 2005 and 2012, consistently, only about 30% of the PFF's manifested their spill cleanup waste in a hazardous waste drum and sent it to the hazardous waste transfer station. The majority most likely put the spill cleanup material directly into the trash or simply allowed the spill to be evaporated and then washed away by the rain. A review of several counties found no evidence that indicates any conditionally exempt small quantity generator (PFF) took their spill cleanup waste to the HHW Program.

The FM186-2 Program

The FM 186-2 Program came about because of a need for a complete yet simple program to respond to the large number of incidental spills at public fueling facilities (PFF) primarily caused by the refueling of vehicles.

The FM 186-2 Program's complete start-up kit includes equipment and protocols to effectively address the multitude of small spills, drips and leaks that occur at public fueling facilities (PFF), and also the equipment and protocol to address the large spill, should one occur.
The FM186-2 Program offers a variety of training materials including onsite, digital, VHS or computer-based training that is available to all employees. Facilities are contacted regularly to verify that spill response equipment is maintained at recommended levels and training is current. At that time any spill support questions are answered with particular attention given to any large spill responses that may have occurred.

What Constitutes a Large Spill?
It was difficult to establish the parameters of a large spill. Many industries define large and small spills quite differently. Working with CUPAs from Northern California along with industry personnel and local fire departments, an agreed upon definition was developed to simply identify a large spill as:
"A spill that is not easily contained"
The ECS Program uses this definition in defining a large and small spill.

In the FM 186-2 Program, if it becomes necessary to utilize the small four foot booms that are included with the red Emergency Spill Bag provided by ECS to contain a spill, the spill is considered to be a "large" spill.

The actual spill volume that constitutes a large spill will differ at each site based upon facility design factors such as the slope of the forecourt and the placement of the storm drains. A relatively small spill that travels towards the property line could be handled as a large spill. Additionally, some corporate accounts set diameter size of the spill to establish a "large" spill, such as a spill about the size of the footprint of a car.

As discussed below in the section entitled "Regulations", it is the responsibility of the person creating the waste material (typically the service station) to determine if the waste is hazardous waste. The FM 186-2 Program recommends that all spill clean up materials used in response to a large spill should be handled as hazardous waste.

Spill clean up materials resulting from large spills should be collected into the kit's hydrocarbon containment bags, labeled and removed by licensed hazardous waste haulers to a permitted hazardous waste treatment or disposal facility unless the conditions are met that allow the PFF to dispose of the waste at an authorized Household Hazardous Waste facility.

The FM 186-2 Program groups all other spills as small spills that can be handled in accordance with the section "regulations" below.

FM 186-2 Technology

The base chemical formulation in the FM 186-2 Program was derived from the 1968 formulation by Dr. William McNeely for the U.S. Navy on a product for responding to fuel oil spills created by Naval fueling operations in and around San Diego Bay.
Today, these chemistries created by Dr. McNeely are used internationally for immediate response to large hydrocarbon spills both on land and sea. These formulations include enhancing the biodegradation of hydrocarbon contaminated soils, VOC vapor suppression, groundwater cleanup and various industrial cleaning applications.

In 1995 ECS developed a comprehensive program that would train employees to safely respond to large spills as well as effectively mitigate the multitude of small to medium sized spills using technology that built upon Dr. McNeely's work.

FM 186-2 is a liquid solution that when properly applied, separates and micro-solubilizes the fuel into a water active spherical micelle. A micelle is an aggregate of like molecules that form an outer shell surrounding an inner core of opposite but like molecules. The water attracting outer shell is in contact with the environment while the oil attracting inner shell captures the hydrocarbon molecule(s). The FM 186-2 Program utilizes sorbent pads (wipers) to absorb the treated fuel/FM 186-2 complex.

The FM 186-2 spill response method utilizes distinctive surfactants in an active scrubbing that diminishes stormwater runoff from residual contamination. This action goes much further than kitty litter and other granular cleanup material to meet the requirement in section 402(p) of the Clean Water Act to implement measures to reduce the discharge of pollutants "to the maximum extent practical".

FM 186-2 is a scientifically constructed aqueous blend of readily biodegradable* surfactants and solubilizing agents. The main surfactant components incorporated into the FM 186-2 formulation have been studied in university and regulatory research, and are today being utilized in many environmental applications.

Water is a prime component of the FM 186-2 chemistry. It gives the micelle configuration the ability to separate the hydrocarbon molecules into the surrounding water bearing solution, creating microsolubilized particles.

During proper application, several actions occur. First, the hydrophilic portion of the micelle "takes in" the hydrocarbon, surrounding it within a water-laden "shell."
The result of this action suppresses the volatizing of the fuel. The effect is a long lasting stabilized solution that will not support combustion.

It should be noted that even after the water portion of the FM 186-2 solution has evaporated, the micelle configurations remain stable, retaining and preventing the microsolubilized particles from re-coalescing. The FM/hydrocarbon complex enhances the biodegradation of the hydrocarbon by increasing the hydrocarbon's bioavailability.

The FM 186-2 surfactants solubilize to the sub-micron level. At this level, the surface area available for biodegradation is greatly magnified. Initially, it was assumed that the surfactants first must break down before biodegradation can occur. In a study from Princeton University, it was revealed that with certain surfactant formulations, the bacteria eat on the target contaminant without having to first degrade the micelle itself. This greatly enhances the biodegradation of both the contaminant and the surfactant by bacteria already found in the environment.

Impact Evaluation

FM Spill Response Historical Data

By utilizing usage data collected on FM 186-2 users, we can identify and track the spill response activities in the PFF's utilizing the FM 186-2 program.

- The review involved 2300 stations nationwide that have been using the FM 186-2 Program for over one year (2005).
- The average station used 2.25 gallons of FM 186-2 solution per month. (based on reorders)
- The prescribed application ratio is 1: 1.
- Therefore for purposes of this report, we can calculate that the average gasoline station on the FM 186-2 Program responded to 2.25 gallons of spilled fuel per month.

Spill Size

It has been reported that 4 mls of gasoline dropped from 30 inches (the average height of the gas tank fill port on an automobile), encompasses an area of 4 to 6 square inches.

Let us assume the average amount of spilled fuel that an attendant will respond to is 100 mls, or approximately 1/3 of a cup. This sized spill would create a footprint large enough to expect a response action. As there are 8,516 mls in 2.25 gallons, and based on 100 mls as larger enough to notice, the average service station in 2005 would have responded to potentially 85 spill events per month. Or, if we apply the report's conclusion that 66% of the spills are too small to respond to, active spill response drops to only 28 spills per month with an average sized spill being about 300 mls. That would equate to just over a cup of fuel spilled per response. Either way, the 85 spills smaller spills or the larger 28 spills would equate to the 2.25 gallons of FM 186-2 used per month in the FM Review.

Using the high (85) or low (28) number of spill responses per month, the ongoing exposures to hazardous vapor decreases as the FM 186 suppresses the VOC release minimizing exposure to constituents like benzene.
Using the number of agreed upon monthly responses, we create a base formula for calculating the positive potential impact of the FM 186-2 Program.

Primary Impact: Air Quality

Human exposure to hazardous vapor is a dominant concern in both regulatory and industry today. When a spill occurs, fuel begins to evaporate immediately. Inhalation exposure to gasoline is a particular concern because of relatively high levels of benzene in gasoline vapor, and the extremely high evaporation rate of gasoline.

Station attendants can be acutely exposed to this vapor in two major ways – when responding to the spill, and when adding the used spill cleanup material to a storage drum. During spill cleanup actions, station attendants are exposed to hydrocarbon vapors, including benzene that is produced when the gasoline becomes exposed to air. Station attendants are again exposed to such vapors when placing the saturated cleanup material in the hazardous waste drum. Volatile organic compounds build up in storage drums during the day and collect within the drum headspace. Every time an attendant removes a storage drum lid and adds additional waste to the drum, the employee is potentially exposed to uncontrolled amounts of vapor. If the calculations concerning spill size and spill responses discussed above are accepted, and if we use the low amount of spill response (28) by each station, and each station responds in a similar fashion, the hazardous waste drums used by the station to store the waste cleanup material would be opened at least 28 times each month.

Thus, the VOC that has accumulated within the spill cleanup waste drum is released to the atmosphere almost every day, thus potentially re-exposing the attendant repeatedly to the same continual hazard.

Use of a granular material to adsorb the fuel spill does little to reduce vapor release either during the spill cleanup activities or during the storage of the used granular material. The FM Program is designed to address these employee exposure issues and eliminate or drastically reduce these re-exposures.

Secondary Impact: Storm Water Runoff

One of the major issues facing the United States today is storm water runoff. Runoff from service stations, parking lots and streets severely impact our waterways as these areas are highly recognized as “Hot Spots” for non point source pollution. Non-point source pollution is one of the most difficult pollution sources to control effectively. The federal Clean Water Act and its implementing regulations require implementation of measures to reduce the discharge of pollutants “to the maximum extent practical (MEP)”.

The “kitty litter” approach to a fuel spill leaves a residue of the heavier chain hydrocarbons after the cleanup process has been completed. This is evident by the rainbows that become quite pronounced in storm water runoff from these Hot Spots.
These rainbows contribute substantially to stormwater pollution. This area of non-point source pollution has been the target of much regulatory discussion. Many absorbents currently in use leave behind residual oils from spill clean up activities that continue to contribute to pollution long after the initial response action had been completed.

Many communities rely on sand or grit interceptors to contain these releases. While it is difficult to calculate the

volume of hydrocarbon that can be measured in the rainbowing effect, it has been reported that these BMP's alone are typically not effective.

The FM 186-2 Program addresses the secondary impact of the spill by reducing the residual hydrocarbon during the cleaning action. While sand and grit filters are excellent secondary BMP's for stormwater runoff, active spill response cleanup using the FM 186-2 program reduces or eliminates the volume of residual hydrocarbons that enter the stormwater system at its inception.

Regulations

U.S. Environmental Protection Agency (EPA) and many various states have adopted permit exclusions that address the immediate responses to spills.

These regulations can be found in 40 CFR 264.1(g)(8)(i)(C), 40 CFR 265.1(c)(11) and 40 CFR 270.1(c)(3)(C).

These exclusions provide that a person engaged in treatment or containment activities during an immediate response to a spill is not required to obtain a treatment, storage or disposal permit. However, this exemption does not apply after the immediate response is over. Thus, while the initial cleanup action is covered by an exemption, storage and disposal of the resulting waste cleanup materials is not exempted and may be subject to hazardous waste management requirements if the waste is a hazardous waste. The comparable California exemption is found at Title 22, California Code of Regulations, Sections 66264.1(8)(A)(3)), 66265.1(e)(11), and 66270.1(c)(3)(A)(3).

These exclusions provide that an immediate response to a spill is exempt from the requirement to obtain a treatment, storage, or disposal permit. Additionally, similar exemptions can be found in Pennsylvania's 25 Code Section 2644.1, 265a.1,and 270a.1, while New Jersey's exemptions are found in NJAC section 7:26G-8.1, NJAC Section 7:26G-9.1 and NJAC Section7:26G-12.1. Similar exemptions are also found in Virginia, Maryland, Delaware and Texas among other States.

Under federal and state regulations, a waste is considered to be hazardous waste if it is (or contains) a listed hazardous waste, or if it exhibits one or more of the characteristics of a hazardous waste. There are four hazardous waste characteristics: ignitability, corrosivity, reactivity, and toxicity. Each of the four characteristics is defined in regulation. See, for example, federal regulations at 40 CFR Section 262.21, 261.22, 262.23, and 262.24. Some states, such as California, characterize more waste as hazardous than do the federal regulations. If the waste is not (or does not contain) a listed hazardous waste, and if it does not exhibit one or more characteristics of a hazardous waste, it is not classified as a hazardous waste and does not have to be managed as a hazardous waste.

Federal regulations at 40 CFR 262.11 provide that it is up to the person that generates the waste (usually the individual service station) to determine if the waste is a hazardous waste. Most all States typically have similar regulations. See for example California regulations in Title 22, California Code of Regulations Section 66262.11.

The regulations provide that the person generating the waste must evaluate whether the waste is a hazardous waste by determining if the waste is (or contains) a listed hazardous waste, and if it is not listed, to determine if it exhibits one or more of the hazardous waste characteristics by either analyzing the waste using a specific test method, or by applying knowledge of the hazardous characteristics of the waste in light of the materials or the processes used.

Analytical results of the cleanup materials that utilized the FM 186-2 indicate that the resulting spill cleanup materials do not exhibit any characteristic of a hazardous waste and are available in the "Waste Analytical" report from ECS.

Petroleum waste is a presumptive hazardous waste. Users/generators are responsible for proper waste characterization and disposal.

Facilities that use the FM 186-2 Program should conduct their own testing to determine whether or not treated spills utilizing the FM 186-2 cleanup materials are hazardous waste.

What about TPH?

Environmental Chemical Solutions conducted two studies to follow the TPH to its final destruction. These two reviews were conducted under simulated landfill conditions and followed the biodegradation of the benzene and the TPH for both gasoline and diesel under anaerobic (no oxygen) conditions. Review of the studies is available in the *Landfill Degradation Reports* in the packet or available from ECS.

Conclusion

It is difficult to quantify the total effect of the FM 186-2 Program. However, if we accept as groundwork, the figures established in this report, it can be determined that the 2300 stations identified in this report who are using the FM 186-2 Program nationally, responding to the lower figure of 28 spills per month, together, projected the following:

Annually, the FM 186-2 Program potentially impacted the following:

1. Reduced over 772,000 employee exposures to concentrated benzene and VOC releases monthly, (including re-opening hazardous waste drums).
2. Minimized storm water contamination from over 60,000 gasoline spills at Public Fueling Operations annually.
3. Helped reduce the release from over an estimated 40,000 pounds of volatile organics discharged and rereleased into the atmosphere from small spills caused by public refueling.
4. Contributed a total of less than 90 cubic meters of total secured landfill space nationally.

ECS continues to research and quantify our Program's environmental impact. We are continually striving to improve our training methods and technology. We believe that our Programs are environmentally sound and incorporate the multitude of requirements established by law and with the spirit in which they were written.

Public Fueling Operations should be prepared to respond to fuel spills with both the proper training and equipment. They should also be able to properly respond to an emergency and be able to take appropriate steps to protect the public. They should know the spill and spill treatment process, and dispose of the clean up materials accordingly.

They should maintain appropriate recordkeeping including all required documentation. The FM 186-2 Program comes complete with training logs, protocols, training placards, videos, CD ROMs, VHS tapes, and Internet to access a wide range of training and support material.
In addition, regulatory agencies have access to their own section of the ECS site for learning how to monitor the PFF's usage of the FM Program, what to look for, what to ask, and other pertinent information.

Ultimately, it is up to the generator to determine the proper classification and disposal of their waste. The FM 186-2 Program supplies a treatment process during the immediate response to a spill that offers the generator options when responding to and disposing of waste generated by public refueling at a retail gasoline operation.

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Waste Accumulation Title 22, California Code of Regulations, Section 66262.34 et seq.

Ignitable Waste
Title 22, California Code of Regulations, Section 66264.17
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VOC Emissions
Local Air Pollution Control District Rules

Worker Protection Title 8, California Code of Regulations, Section 5192

Spill Training
Title 8, California Code of Regulations, Section 5192(e)

New Technology
Title 8, California Code of Regulations, Section 5192(o)

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