The Ice Storm of 2008 and Emergency Response Coordination Throughout Western and Central Massachusetts

Chapter 22

THE ICE STORM OF 2008 AND EMERGENCY RESPONSE COORDINATION THROUGHOUT WESTERN AND CENTRAL MASSACHUSETTS

Jason J. Barroso[1§], Sarah A. Rocklin[2], Kenneth J. Gendron, P.G., LSP[3]
[1]*Environmental Scientist, Tighe & Bond, 53 Southampton Road, Westfield, MA 01085,* [2] *Environmental Scientist, Tighe & Bond, 53 Southampton Road, Westfield, MA 01085*, [3] *Senior Hydrogeologist, Tighe & Bond, 446 Main Street, Worcester, MA 01608*

ABSTRACT

On December 11, 2008, an ice storm devastated the Northeast causing critical damage to the utility infrastructure leaving over a million residents without power. Storm damage throughout the region was mostly related to fallen trees, power lines and utility poles. The storm made national headlines and prompted public officials to declare a state of emergency in Massachusetts, New Hampshire, New York, Vermont and Maine. This case study will focus on the emergency response efforts in Massachusetts related to the cleanup of environmental impacts caused by the release of transformer oil (mineral oil dielectric fluid) contained within utility pole mounted transformers. Mineral oil dielectric fluid (MODF) is a highly refined mineral oil which is stable at high temperature and has excellent insulating properties. However, MODF does pose environmental risks and, as a result, is regulated under the Massachusetts Contingency Plan (MCP, 310 CMR 40.0000). Additionally, polychlorinated biphenyls (PCBs) were routinely used in oil-filled transformers well into the 1970's. Massachusetts regulations require the notification and remediation of MODF releases to the environment. Reportable quantities, governing reporting requirements, and cleanup standards for MODF releases have been established based on the PCB content of the transformer oil. The widespread nature of the storm damage caused a logistical nightmare when coordinating emergency response activities. With over 100 reported releases of MODF, release sites were continually reevaluated to determine which posed the greatest threat to the environment, human health and public safety. Prioritization of release sites was accomplished only after careful consideration of various factors, including the

§ Jason J. Barroso, Environmental Scientist, Tighe & Bond, 53 Southampton Road, Westfield, MA, 01085, Tel: 413-562-1600, Fax: 413-568-9764, Email: JJBarroso@tighebond.com

PCB concentration of the transformer oil, impacted environmental receptors (wetlands, surface water, private water supplies, etc.) and the accessibility of each release site. In fact, accessibility may have proven to be the most crucial of factors when prioritizing cleanups, since many releases were not immediately discovered.

Keywords: Ice Storm, Emergency Response, Transformer Oil, MODF, PCB

1. INTRODUCTION

On December 11, 2008, an ice storm devastated the Northeast causing critical damage to the utility infrastructure, leaving up to a million residents without power in Massachusetts alone. The storm event affected over 30 cities and towns in central and western Massachusetts where heavy ice accumulations caused innumerable fallen trees, power lines and utility poles. Residents were left without critical utility services for days. In many of the hill towns, lack of electricity also meant lack of running water and/or lack of heat. The ice storm may have dissipated the following day but the aftermath was felt for days, weeks and even months by some.

In addition to leaving residents without power, the Ice Storm of 2008 also left utility companies scrambling to not only restore services but also to manage the environmental impacts related to fallen, ruptured and otherwise compromised transformers and their related contents. While the "little gray cans" hanging from utility poles rarely receive a second glance by passers-by, these transformers are oil-filled and pose varying degrees of risk associated with their hazardous contents. Mineral Oil Dielectric Fluid (MODF) is routinely used in transformers and also regulated as a hazardous material under Massachusetts regulations.

As Western Massachusetts Electric Company (WMECO) and National Grid's environmental consultants, Tighe & Bond, Inc. managed the assessment, remediation and ultimate site closure of 112 MODF releases associated with downed pole-mounted transformers throughout Berkshire, Hampshire, Hampden, Franklin, Worcester and Middlesex counties. While the ice storm may have dissipated on December 12, reports of ruptured transformers continued through January 12, 2009. With a continuously growing list of MODF releases, release sites were continually evaluated to determine which posed the greatest threat to the environment, human health and public safety.

1.1 MODF Usage and Regulation

Mineral oil dielectric fluid (MODF) is a byproduct of petroleum distillation. MODF is often used in oil-filled electrical transformers due to its stability at high

temperatures and excellent insulating properties. The most commonly used liquid in a transformer is a mineral oil known as transformer oil that has a continuous operating temperature rating of 105º C, a flashpoint of 150º C, and fire point of 180º C (Dorf 1997). A good grade transformer oil has a breakdown strength of 86.6 kV/cm (220 kV/in), that is far higher than the breakdown strength of air, which is 9.4 kV/cm (25 kV/in) (Dorf 1997). MODF is regulated under the Massachusetts Contingency Plan (MCP, 310 CMR 40.0000) and as a result, releases of MODF to the environment require assessment and/or remediation. Additionally, polychlorinated biphenyls (PCBs) were routinely used in oil-filled transformers well into the 1970's. As a result, releases of MODF to the environment may require action under state and federal regulations.

1.1.1 MODF Regulation under the MCP

The MCP establishes requirements for the notification, assessment, alternatives evaluation and remediation of releases of oil or hazardous materials to the environment. Notification requirements are based upon contaminant concentrations (Reportable Concentrations) or quantities released (Reportable Quantities). Reportable Concentrations (RCs) and Reportable Quantities (RQs) are established at 310 CMR 40.0300 of the MCP and are listed at 310 CMR 40.1600, the Massachusetts Oil and Hazardous Materials List. If a contaminant is detected in soil or groundwater at a concentration greater than its associated RC, by definition this detection constitutes a reportable release to the environment. If the quantity of oil or hazardous material released to the environment within a 24 hour period exceeds the associated RQ, by definition the incident constitutes a reportable release.

The MCP establishes a RQ of 25 gallons for MODF containing a PCB concentration less than 2 parts-per-million (ppm). Additionally, 310 CMR 40.0352 establishes RQs for materials containing PCB concentrations less than 500 ppm as well as materials containing PCB concentrations greater than 500 ppm. The RQ for MODF containing a PCB concentration greater than 2 ppm but less than 500 ppm is 10 gallons and the RQ for MODF containing a PCB concentration greater than 500 ppm is one gallon. Table 1 below identifies the number of releases in each PCB category.

Table 1. PCB Concentrations of Release Sites

PCB Content of MODF	Number of Release Sites
Less than 2 ppm PCB	78
Between 2 ppm and 500 ppm PCB	32
Greater than 500 ppm PCBs	2

The MCP establishes RCs for both soil and groundwater and each media is given two RC categories: RCS-1 and RCS-2 for soil and RCGW-1 and RCGW-2 for groundwater. RCS-1 applies to all soil samples collected within 500 feet of a residential dwelling, residentially zoned property, school, playground, recreational area or within the boundaries of a groundwater resource area categorized as RCGW-1. RCS-2 applies to all soil samples not obtained from an RCS-1 area. RCGW-1 applies to all groundwater samples collected within a current or potential drinking water source area. RCGW-2 applies to all groundwater samples that are not collected from a RCGW-1 area.

RCs associated with MODF are those which regulate the relevant constituents associated with MODF. For the purposes of assessment or remediation of MODF releases, the Massachusetts DEP Extractable Petroleum Hydrocarbon (EPH) analysis is used to characterize MODF impacts to surrounding media (soil, groundwater). EPH analysis quantifies concentrations of hydrocarbons that fall within the ranges of C_9-C_{18} Aliphatics, C_{19}-C_{36} Aliphatics and C_{11}-C_{22} Aromatics. Table 2 below identifies the RCs associated with EPH analysis.

Table 2. MCP Reportable Concentrations

EPH (mg/kg)	**GW1 (mg/l)**	**GW2 (mg/l)**	**S1 (mg/kg)**	**S2 (mg/kg)**
C_9-C_{18} Aliphatics	0.7	5	1,000	3,000
C_{19}-C_{36} Aliphatics	14	50	3,000	5,000
C_{11}-C_{22} Aromatics	0.2	5	1,000	3,000

Once a release is determined to be reportable, assessment and remediation of that release must be conducted in accordance with the applicable provisions of the MCP.

1.1.2 MODF Regulation under the EPA

MODF has been known to contain PCBs and as a result, MODF is to some extent regulated by the Environmental Protection Agency (EPA) under the Toxic Substances Control Act (TSCA). Title 40 of the Code of Federal Regulations (CFR) regulates PCBs under Part 761. Title 40 CFR Part 761 requires that a release to surface water, vegetable gardens, farm land or grazing land of any quantity of PCB material, with a concentration greater than 50 ppm, be reported

to the EPA within 24 hours. Additionally, releases of a material with a PCB concentration between 50 and 499 ppm, must be reported to the EPA within 24 hours if the quantity released exceeds 2,700 gallons and releases of a material with a PCB concentration of 500 ppm or greater must be reported to the EPA if the quantity released exceeds 270 gallons.

2. CASE STUDIES

During the Ice Storm, several scenarios evolved for the 112 spill sites that were reported. Several reports of a transformer down revealed no loss in fluid. Several revealed total loss of a transformer's contents, while still many others revealed lost volumes between these two extremes. In addition, any one (or more) of several different media types (soil, surface water, sediment, etc.) were impacted at a given release site. The sections below describe typical release scenarios and media impacted by the releases as well as describing response actions required to establish compliance with the MCP.

Table 3. Environmental Media Impacted by Release

Media Impacted	**Number of Release Sites**
No Actual Release	33
Pavement/Snow/Ice	3
Soil	69
Wetland	3
Surface Water	4

2.1. No Actual Release

In this scenario, a downed transformer was observed to be intact with no loss of oil from the unit. As an example, U.P. No. 4, located on Carr Street in Westminster, Massachusetts met this criterion. Upon arrival at the reported release site, the transformer was observed to lying on its side in a snow bank. Upon further inspection, the unit was observed to be intact, failures were not identified in the bushings, the knock-outs or the main seal. The transformer was righted, photographed and removed from the "required cleanup" list and subsequently picked up by either National Grid/WMECo crews or their environmental contractor crews for disposal. In this scenario, Tighe & Bond was responsible for developing a summary report of the critical elements of the event and documenting the exemption from reporting under the MCP.

2.2. Release to Pavement/Snow/Ice

A release of MODF to pavement, snow or ice was the least complex of reportable scenarios, requiring minimal remedial actions. In this scenario, a downed transformer released a portion of its contents to snow/ice and pavement in the vicinity of the damaged utility pole. An example for this scenario is a release on East Hoosac Street in Adams, Massachusetts. National Grid and Tighe & Bond mobilized to the site and discovered a 15-kVA transformer at the edge of the roadway. Subsequent laboratory analysis of the transformer oil confirmed that the transformer contained less than 1 ppm, which is considered non-PCB, in accordance with Environmental Protection Agency (EPA) CFR Part 761.3 and Massachusetts DEP (310 CMR 40.0000) regulations. Approximately 15 gallons MODF had flowed in a northeasterly direction down the sloped asphalt road. In addition, automobile traffic had spread the oil along a 98 foot long × 21 foot wide section of road. Response actions associated with this release scenario involved the deployment of oil absorbent materials to contain the release as well as the collection and offsite disposal of spent oil absorbent material. Additionally MODF-impacted snow, ice required removal and offsite disposal. Following the implementation of initial response actions, the asphalt roadway was found to be free of significant cracks and as such confirmatory sampling of subsurface soils was not required. Response actions resulted in post remediation conditions which would be consistent with those required for a Class A-1 Response Action Outcome (RAO) scenario under the MCP, however the volume of the release did not constitute a reportable condition under the MCP. As a result, Tighe & Bond developed a Non-Reportable Summary Report to document the event and response actions associated with the release.

2.3. Release to Soil

In this scenario, a downed transformer (or damaged and still attached to a utility pole) released some or all of its contents to soils in and around the vicinity of the UP. An example for this scenario (the most common scenario for the Ice Storm cleanups) includes a release at 62 Main Street in Orange, Massachusetts. A 50-kVA transformer was dislodged from its mount on U.P. No. 7 and fell to the ground. Upon impact with the ground surface, the transformer released all of its 19 gallons of PCB-MODF to the soil. After conducting a visual survey of the release area, Tighe & Bond personnel and National Grid's environmental contractor mobilized to the site to excavate soil, conduct confirmatory soil sampling and field-screening activities and render the site ready for restoration. Upon receipt of acceptable analytical data for the site, Tighe & Bond coordinated with National Grid's landscape contractor to have the site restored to its original condition for the property owner. Tighe & Bond was responsible for notification

and reporting requirements including a Class A-2 Response Action Outcome (RAO) Statement to fulfill National Grid's obligations under the MCP.

2.4. Release to Wetlands

In this scenario a downed transformer (or damaged and still attached) released some or all of its contents to soil, pavement or snow/ice and ultimately impacted an adjacent wetland system. The release associated with U.P. No. 23/122 on Old North Road in Worthington, Massachusetts was one such release. Heavy ice accumulation caused U.P No. 23/122 to break, rupturing the attached transformer, resulting in the release of approximately 12 gallons of MODF to the driveway at 1081 Old North Road, the asphalt road surface and the adjacent stormwater culvert, which ultimately discharges to a wetland area across Old North Road. Laboratory analytical data confirmed the MODF exhibited a PCB concentration of less than 2 ppm. Initial visual inspection of the release area indicated that the release had impacted three separate areas in the vicinity of U.P. 23/122, an area approximately 10 feet long by 5 feet wide, which included a stormwater drainage culvert adjacent to the point of impact; a wetland area approximately 55 feet long by 15 feet wide downgradient of the stormwater drainage culvert; and an area approximately 160 feet long by 10 feet wide adjacent to Old North Road. The vertical extent of contamination varied from surficial impacts to one foot below surface grade. Oil absorbent materials were deployed to the roadway surface to capture remaining MODF impacts and oil-absorbent booms were deployed at locations downgradient of the stormwater drainage culvert to contain visible MODF impacts to stormwater run-off. Response actions included the excavation of impacted media (soil, snow and ice) for offsite disposal as well as confirmatory sampling of soil and stormwater run-off within the release area.

Despite impacts to an adjacent wetland system, surface water and sediment were not impacted by this release. Standing water within wetland system at the time of the release was a function of the stormwater management system in the area and in the absence of a storm event, surface water was not present within the release area. This distinction carries with it varying compliance requirements. While stormwater sampling was conducted and compared to the Recommended Surface Water Quality Guidelines, pursuant to DEP Policy WSC-02-411, soil samples collected from within the impacted wetlands did not classify as sediment. While someone initially responding to a release may classify media being sampled as sediment based on the presence of what appears to be surface water; an important distinction needs to be made between stormwater run-off and surface water to determine whether the impacted media was soil or sediment.

The MCP defines sediment as "detrital and inorganic or organic matter situated on the bottom of lakes, ponds, streams, rivers, the ocean, or other surface water bodies". The MCP further defines surface water as "all waters other than groundwater within the jurisdiction of the Commonwealth, including, without limitation, rivers, streams, lakes, ponds, springs, impoundments, estuaries, wetlands, coastal waters and vernal pools. The release area is at times heavily influenced by the local stormwater drainage system. In the absence of a storm event, the soils are not located on the bottom of a surface water body. Tighe & Bond personnel conducted numerous site reconnaissance visits over the course of approximately three months and documented that the impacted wetlands did not contain surface waters. As a result, soil samples collected from the impacted wetland were classified as soil rather than sediment.

This release required the submittal of an Immediate Response Action (IRA) Plan, prior to the submittal of a RAO Statement to allow for adequate documentation related to classification of impacted media as soil rather than sediment.

2.5. Release to Surface Water

In this scenario, a sudden release occurred on Orpin Road in Peru, Massachusetts when ice buildup damaged power lines and broke a utility pole causing a pole-mounted transformer to fall, resulting in a release of 16 gallons of non-PCB MODF to soil, surface water and sediment. The released MODF flowed through a drainage swale/culvert, into a stream and discharged to a wetland. Initial visual inspection of the release area indicated that the release had impacted two separate areas in the vicinity of the utility pole, which would require remediation. Impacted areas included an area of soil which included a stormwater drainage culvert adjacent to the point of impact and a forested wetland area located downgraident of the surface water drainage culvert outfall. Response actions included the excavation of MODF-impacted soil, field-screening activities, confirmatory sampling (soil, surface water and sediment) and the recovery of 2,500 gallons of impacted surface water from the drainage culvert outfall area.

Observations made during subsequent site reconnaissance visits confirmed the presence of surface waters within the wetlands area. As a result, sediment samples were compared to available DEP sediment screening criteria for PCBs. In the absence of available sediment screening criteria for extractable petroleum hydrocarbons (EPH), a Stage I Environmental Screening was conducted to evaluate "readily apparent harm" and "potentially significant exposures". No visible impacts to surface water, sediment or adjacent soils and no signs of stressed vegetation or wildlife were observed during subsequent site

reconnaissance visits. Upon receipt of acceptable analytical data for the site, Tighe & Bond completed and submitted the appropriate reporting documentation (Class A-2 RAO)to DEP to complete site closure.

3. PRIORITIZATION OF RELEASES

Once the scale of ice storm devastation became known, it was obvious that a large number of transformer releases had occurred and would require cleanup. Tighe & Bond personnel worked closely with National Grid and WMECo personnel to determine reported release locations, gleaning over whatever details could be gathered from the reports and investigating each reported spill location. As reports of releases were received from National Grid and WMECo, Tighe & Bond located and visited each location to determine the severity of the release, if a reportable condition existed, what response actions would be required for each location and the sensitivity of the release site, in order to triage the site accordingly. In many cases, cleanup crews would be re-routed while on their way to a spill location if, for example, a more severe release was identified, or if roadways proved impassible due to downed lines, poles, trees or other obstructions. All told, the triaging portion of the cleanup took approximately 3 weeks to obtain the reports, visit each site and categorize each release for cleanup, reporting to DEP, etc. The cleanups, restoration and reporting was completed by the end of April 2009 for the 100 plus spills that were identified, remediated, documented and closed out between the day of the ice storm and the completion of the last cleanup which occurred on April 6, 2009.

In addition to responding to spill reports, Tighe & Bond was also provided with a list of transformers which had been retrieved and returned to area work centers prior to implementation of response actions. After cross-checking the list of retrieved transformer locations with the spill cleanup locations and locations which had been documented to not constitute a release, Tighe & Bond personnel visited the remainder of the retrieved transformer locations to assess whether a release had occured. Where spills could be identified, the sites were triaged; cleanups were completed, and closed. It should be noted that every spill site identified has been closed via either the submittal of a Non-Reportable Release Summary Report to National Grid/WMECo or submittal to DEP of a RAO Statement.

4. CONCLUSION

The Ice Storm of 2008 left in its path a wake of destruction that not only damaged property and critical infrastructure but also resulted in various environmental risks. Along with the obvious strains associated with repairing critical infrastructure, National Grid and WMECo demonstrated the utmost concern for remediating environmental impacts resulting from the ice storm. Support crews were mobilized from out of state to assist with infrastructure repair as well as environmental response and remediation activities progressed with a "whatever it takes to get the job done right" approach. In retrospect, one could easily envision a scenario in which impacts to the environment could have persisted for much longer causing significant deterioration of resource areas, had the responsible parties (National Grid and WMECo) not placed such a great deal of emphasis on the importance of comprehensive environmental response actions.

In Massachusetts, the Ice Storm of 2008 involved an unprecedented number of releases over a short period of time and dispersed over a large geographical area, with varying environmental impacts. At times environmental response activities may have seemed ad hoc, but the situation required the continual adaptation of response strategies to best minimize risk associated with such expansive and varied environmental impacts. It is uncertain whether Massachusetts will ever experience a similar storm event causing such widespread environmental impacts. However should this scenario repeat itself, or should a similar event occur, there is at least one lesson that can be learned from the Ice Storm of 2008. The ability to adapt is the most critical component of a successful emergency response effort.

5. REFERENCES

Dorf, Richard C. 1997. The Electrical Engineering Handbook, Second Edition. Boca Raton: CRC Press, LLC.