# PRE-INVESTIGATION EVALUATION OF CORRECTIVE MEASURES TECHNOLOGIES

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## 1.0 INTRODUCTION

In May 1996, the New York State Department of Environmental Conservation (NYSDEC) issued a Part 373 Permit Hazardous Waste Operating Permit for the General Electric (GE) Buffalo Service Center. This permit allows storage of hazardous wastes containing volatile organics, metals and polychlorinated biphenyls (PCBs) at the facility, which is located at 170 Millens Road in Tonawanda, New York, 14223.

As part of the issued Part 373 Permit, GE is required to conduct a Corrective Measures Study of the following 8 Solid Waste Management Units (SWMUs) and or Areas of Concern (AOCs) at the Buffalo Service Center:

- RCRA Hazardous Waste Storage Area,
- PCB Storage Area,
- PCB Work Area,
- Oil/Water Separators,
- Rail Spur,
- Floor Drains,
- Sewers, and
- Rinse Water Tank.

The purpose of this report is to conduct a preliminary screening of potential remedial technologies which could be used at the GE Buffalo Service Center. The preliminary screening is also conducted to identify any additional data needs (e.g. physical characteristics of the soil or treatability data) to be collected to assist in the evaluation and selection of a final corrective measure or measures for the facility.

The initial screening was conducted for technical implementability. This initial screening process eliminated those remedial technologies which are unproven or not expected to achieve an acceptable level of performance. Remedial technologies which could be extremely difficult to implement were also discarded. The technologies with the greatest potential for applicability to the Site characteristics and constituents of concern have been retained and will be evaluated further.

This report has been prepared to satisfy the requirements of Module III, E.5.(e) Task II of the issued Part 373 Permit requiring the preliminary screening of technologies available for corrective measures at the facility.

## 2.0 *SUMMARY OF CONTAMINATED MEDIA*

Previous sampling events at the GE Buffalo Service Center were summarized in the Current Conditions Report, dated 31 July 1996. The Current Conditions Report detailed information about each of the SWMUs and AOCs, the previous uses of the units, materials which were managed in the area and any remedial activities which were conducted to date. A description of the underlying geology and hydrogeology at the facility are also included in the Current Conditions Report.

The information presented in the Current Conditions Report was used to determine potential migration pathways, media of concern and potential receptors for the SWMUs and AOCs. The following migration pathways were noted for the GE Buffalo Service Center:

- Surface and Subsurface Soils, both native and backfill material, containing elevated concentrations of volatile organics and PCBs;
- Perched water, as could occur in fill areas, containing elevated concentrations of PCBs; and
- Sediment in surface waters and storm water runoff, containing elevated concentrations of PCBs.

The remedial technologies which are included for initial screening have been selected to address contamination within the migration pathways.

## 3.0 IDENTIFICATION OF APPLICABLE REMEDIAL TECHNOLOGIES

This section reviews the technologies which can be used to contain, remove, or treat the soil, perched water and sediment at the Site. Specifically, the technologies selected are those which are available for containing and remediating soils contaminated with volatile organic compounds and polychlorinated biphenyls.

## 3.1 NO ACTION

The **No Action** alternative was considered for comparison purposes. This would involve leaving the Site in its current condition, without any remediation of contaminated soils or sediments. No removal activities would be conducted for those areas which currently contain contaminated media, nor would any barriers be placed around those units which could affect receptors. Since this alternative does not include any remedial activities, no additional, Site-specific data or testing needs to be performed.

## 3.2 INSTITUTIONAL ACTIONS

**Institutional actions** involve access restrictions for any units which contain contaminated material. This technology could involve deed restrictions, posting signs and/or fencing-off of contaminated areas. There is no removal of contaminated media. By limiting access through legal and physical methods, this technology can be used for protection of human health. There is no additional data collection needed to determine the suitability of this alternative.

## 3.3 SURFACE CAPPING

**Capping** techniques utilize materials such as synthetic membranes, asphalt, concrete, clay, bentonite, and soil. In general, capping is performed when extensive subsurface contamination at a site precludes excavation and removal of wastes because of potential hazards and/or excessive costs. The materials mentioned above are used in single and multi-layered cap designs.

Capping and also be used to reduce surface water infiltration in areas where soil contamination is present in subsurface areas. This use of the technology limits the potential for release of further contamination to receptors.

## 3.4 SURFACE CONTROLS

**Diversion/collection**, grading, and soil erosion controls limit infiltration and erosion by providing continuous surface grades, diversion ditches, and collection ditches to limit the ponding of surface water. Using these techniques can also be used to lessen surface water infiltration and reduce the introduction of contamination to potential receptors.

## 3.5 DUST CONTROLS

**Dust controls** play an important role during implementation of soil remediation, though the technology is very simple and easy to implement. Typical long term dust control measures include revegetation and capping. Interim dust control measures can consist of temporary covers in non-active areas and watering of soil and surfaces during excavation/removal activities..

## 3.6 *EXCAVATION AND REMOVAL*

**Excavation and removal** of soils and wastes is used extensively in the remediation of hazardous waste sites. This technology includes excavating, loading and transporting soil and waste material off-site or to an on-site location for treatment or disposal. Generally, the excavated areas are backfilled with clean fill and graded. This technology usually involves the use of conventional heavy construction equipment with special procedures for worker safety and containment of contamination during excavation and transport.

## 3.7 *ON-SITE DISPOSAL*

**On-site disposal** of soil involves the on-site construction of a new landfill or upgrading an existing landfill. This technology could include consolidation of soil to a specific area of the site followed by capping and containment technologies. This new construction or upgrading would be completed in general accordance with NYSDEC Part 360 regulations. Part 360 requirements include, among other specifications, a composite capping system and long-term monitoring.

## 3.8 *OFF-SITE DISPOSAL*

**Off-site disposal** of contaminated soil/waste involves the hauling of excavated soil/waste to a commercial sanitary or hazardous waste landfill, as appropriate, for disposal. This technique requires sampling of the waste material to confirm waste classification and obtain off-site disposal facility approval to ship. The specific analytical requirements are determined by the off-site disposal facilities selected.

## 3.9 *PRETREATMENT (DEWATERING AND SOLID SEPARATION)*

On-site or off-site treatment of contaminated soils may require **pretreatment** such as dewatering and solids separation. Dewatering processes include centrifuge technologies, gravity thickening, and filtration. The water generated during dewatering generally contains hazardous constituents, which would require additional treatment and could be treated together with ground water, if any. Solid separation methods include screens and sieves (i.e. filtration), spiral classifiers, cyclones and hydroclone, and settling basins.

## 3.10 *THERMAL TREATMENT*

**Thermal treatment**, including incineration, can be used to destroy organic contaminants. The most common incineration technologies include liquid injection, rotary kiln, multiple hearth, fluidized bed, pyrolysis.

**Low temperature thermal soil aeration** or desorption heats soil to temperatures where the organic constituents are volatilized and removed from the material. The air emissions from the process are then treated to remove the organic constituents. The off-gases from the air emissions treatment unit are then cooled and scrubbed of particulate matter before being emitted into the atmosphere. This technology is capable of removing volatile and semi-volatile organic compounds (including PCBs at concentrations of less than 50 ppm).

**Incineration** involves the combustion (oxidation) of materials. Combustion of solids involves a series of repeated steps because initial burning causes the material near the media (soil particle) surface to burn, with secondary burning oxidizing the residual solid structure. As the initial ash layer drops off, fresh untreated solid is exposed and the process repeated. Therefore, the size of the soil particles affects the number of times this sequence must be repeated. Residue and ash handling systems are used to manage bottom ash from the combustion chamber, fly ash from the air pollution control equipment, the small quantities of particulates from the stack and scrubber water.

Typical incineration systems for waste destruction include rotary kiln, fluidized bed, and infrared systems. Rotary kiln incinerators are able to burn a wide variety of wastes. Primary chamber temperatures are between 1400 and 2200°F, and secondary chamber temperatures between 1600 and 2200°F. Residence times for solids range from 20 to 40 minutes. Air pollution control equipment for these units include absorbers for the acid gases, and scrubbers, baghouses, or electric precipitators (ESP) for the particulates. Rotary kilns may be operated either co-currently or counter-currently. In co-current units, soil and gases flow in the same direction. In counter-current units, the soil and gases flow in opposite directions to increase the proportion of heat transferred and therefore the material processing rate. Counter-current systems encounter two main disadvantages, including (1) they are prone to slagging, and (2) destruction efficiencies for gases in the primary combustion chamber are lower than in co-current systems.

Infrared incinerators operate the primary chamber between 1450 and 1600°F, and the secondary chamber between 1800 and 2000°F. These systems involve reduced off-gas treatment compared to other systems since combustion in the primary feed chamber is powered by electricity. Residence times for solids range from 15 to 30 minutes. Air pollution control equipment is similar to that used for the rotary kiln.

Fluidized bed incinerators may be used for combustion of sludges, tars, and granular materials. Temperatures are maintained between 1200 and 1800°F and solids residence times range from seconds to hours. The "combustion chamber" consists of a bed of very hot inert granules, such as sand. This bed, which provides rapid and thorough heat transfer to the injected fuel and waste, is kept in constant turbulent motion by the injection of air to the bottom of the bed. Wastes are rapidly injected in the bed. The biggest constraint of this incinerator is its limited capacity and range of applicable waste types (e.g. materials with low ash fusion temperatures are undesirable). The main advantage is that it provides superior heat transfer and mixing capabilities. Air pollution controls include lime addition within the bed for acid gases, and cyclones, baghouses, and ESPs for particulates.

**Thermal desorption** heats solids sufficiently to volatilize, not oxidize, the organic contaminants. This allows the volatile and semi-volatile contaminants to be physically separated from the media (soil). Excavated materials are transferred to the desorber chamber. Contaminants volatilize into the gas stream, which is processed to remove the contaminants and particulates. Depending upon the type and concentration of organics and other factors, the gas stream may be treated on-site, collected on activated carbon, or recovered in condensation equipment. Particulates are removed using typical equipment including cyclones, scrubbers, or baghouses.

## 3.11 *CHEMICAL TREATMENT*

Generally, certain organic contaminants can be immobilized, chemically extracted, or detoxified using chemical treatment.

**Soil washing** extracts contaminants from soil matrices using an extracting solution. This technology mechanically mixes, washes, and rinses the soil to separate contaminants in one of two ways: contaminants can be dissolved or suspended in the wash fluid or contaminants can be concentrated into a smaller volume of soil by simple particle size sorting/separation. By separating fine clay and silt particles from larger sand and gravel, the volume of soil to be further treated can be reduced. The washing fluid may be composed of water, organic solvents, chelating agents, surfactants, acids or bases, depending on the contaminant to be removed. The waste types that can be removed include heavy metals (e.g., lead, zinc), halogenated solvents (e.g., TCE, trichloroethane), aromatics (e.g., benzene, toluene, phenol), gasoline, fuel oils and PCBs.

**Solvent extraction** is similar to soil washing in that a fluid is mixed with the soil to precipitate release of the contaminants to the solvent. For organics, the washing solvent is mixed with the contaminated media, and the organic contaminant dissolves into the solvent. The fluid is transferred to a separator, where contaminants are separated from the solvent by temperature or pressure change, and the solvent is recycled. The concentrated contaminants are then removed from the separator.

**Chemical detoxification** techniques include neutralization, hydrolysis, oxidation/reduction, enzymatic degradation, and installation of permeable treatment beds. This operation involves the use of chemicals to destroy, degrade, or reduce the toxicity of contaminants. Chemical dehalogenation technologies for PCBs employ chemical reactions to remove the halogen atoms (chlorine from PCBs) from the molecule. One representative process is base-catalyzed decomposition (BCD), which uses sodium hydroxide, sodium bicarbonate, or aliphatic hydrocarbons to provide hydrogen.

## 3.12 *IMMOBILIZATION AND PHYSICAL TREATMENT*

A number of methods are currently being developed which involve physical manipulation of the soil in order to immobilize or detoxify waste constituents. These technologies include immobilization, solidification/stabilization, encapsulation, and volatilization.

**Immobilization** methods, which include precipitation, chelation, and polymerization, are designed to bind contaminants and render them less mobile, limit leaching of the contaminants from the soil matrix, and limit contaminant movement from the areas of contamination.

**Solidification/stabilization** involves mixing the wastes directly with a solidifying agent (e.g. Portland cement, flyash, and lime). The solidification/stabilization process produces a monolith with structural integrity or a crumbly solid. The contaminants do not necessarily interact chemically with the solidification agent, but are mechanically fixed within the solidified matrix. Solidification/stabilization methods usually involve the addition of chemicals in order to limit the solubility or mobility of waste constituents. This technology is well suited for solidifying soils containing heavy metals, organics (generally no more than 20% by volume), and solidified plastic. However, some constituents and soil characteristics may interfere with the use of cement-based methods, such as fine particles, silt, clay, and lignite. The advantages of cement-based methods include their low cost and the use of readily available mixing equipment.

**Encapsulation** methods physically microencapsulate wastes by sealing them in an organic binder or resin. These methods can be used for both organic and inorganic waste constituents.

**Volatilization** can be accomplished through thermal treatment or mechanical aeration. The direct heat rotary dryer is a proven thermal treatment unit and has been used for many years by the asphalt industry. This unit is best suited for use with free flowing granular solids. Section 3.10, Thermal Treatment, provides a discussion of thermal technologies.

## 3.13 *IN-SITU TREATMENT*

In-situ treatment, an alternative to waste excavation and removal, entails in-place treatment of the soil through the use of chemical or biological agents or physical manipulations which degrade, remove, or immobilize contaminants. In-situ treatment processes include bioremediation, heating, soil flushing, and vitrification.

**Bioremediation** is a technique for treating zones of soil contamination by microbial degradation. The technology involves enhancing the natural biodegradation process by injecting nutrients, oxygen, and cultured bacterial strains or by introduction of genetically engineered microbes. Bioremediation can provide substantial reduction in organic contaminant levels in soils, without the cost of soil excavation in situations where in-situ treatment is applicable. The technique is well suited for soil contaminated with petroleum by-products. A number of site-specific factors, such as site geology, soil characteristics, and aquifer characteristics, are critical in evaluating the implementability of this technology.

**In-situ heating** destroys or removes organic contaminants in the subsurface through thermal decomposition, vaporization, and distillation. Methods of in-situ heating are steam injection and radio frequency heating.

**In-situ soil vapor extraction** is a process to remove the volatile organic compounds from the soil by allowing the vaporized volatiles to vent. This venting is either done passively, through wells placed in the contaminated soil, or actively, through the use of vacuum pumps attached to the wells. Contaminants contained in the vented gas can be discharged to the atmosphere or captured for treatment, as appropriate.

**In-situ soil flushing** is a process applied to in-place soils using a ground water extraction/reinjection system. In-situ soil flushing consists of injecting a solvent or surfactant solution to enhance the contaminant solubility, resulting in an increased recovery of contaminants in the leachate or ground water. The system would include extraction wells and a wastewater treatment system.

## 4.0 SUMMARY

A total of 13 remedial techniques were pre-screened for applicability in remediating the presence of PCB and volatile organic contamination in surface and subsurface soils, perched water and sediments. All of these technologies will be retained for further evaluation upon final delineation of the areas to be remediated. No additional samples will be collected for pre-screening evaluation of the remedial technologies at this time.