Enhancing Public Safety in Boston:
A Computerized System to Inventory and Track Underground Storage Tanks

An Interactive Qualifying Project
submitted to the Faculty
of the
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Table of Contents

Table of Figures

Abstract

This project developed an updatable, computerized record-keeping system to help the Boston Fire Department's Special Hazards Division to keep track of Underground Storage Tanks (USTs). This new system, which replaces the current paper-based recording process will help prevent or reduce accidents involving USTs.

1 Introduction

Underground Storage Tanks (USTs) are large containers usually made of steel that can hold up to tens of thousands of gallons of material such as gasoline, oil, water, and hazardous chemicals. They are most commonly found at gas stations and businesses that have a back-up power generator. Along with the large capacity, there are large risks associated with the USTs.

There are inherent safety concerns in the location of storage tanks. Above-ground tanks carry with them the threat of leakage and explosion. On February 15, 1919 in Boston, an above-ground tank that contained 2.5 million gallons of molasses exploded, sweeping away people, horses, elevated train trestles, cars, and even houses as it tore a path through Quincy Market and into the harbor. Twenty-one people were killed, hundreds were injured, and over a million dollars worth of damage was caused. [1]

By placing storage tanks underground, the risk of thousands of gallons of hazardous material being suddenly released into the environment is minimized, but tanks are still susceptible to slow leaks. An additional danger that comes with storing tanks underground is the impossibility of visual inspection. Leak detection systems are required on newer tanks, but they can not detect rust or other structural defects. Despite the use of leak detection systems and many other efforts to enforce proper use and maintenance, there are occasional situations with USTs that require emergency response. These situations are detected most commonly by a complaint from a neighboring location of strong odors, caused by fumes from a leaking tank. In the past year, there have been multiple incidents involving USTs in the United States that have lead to major contamination and health threats. [2]

Fuel, even in small quantities, can pollute a subsurface environment for years. If a leak in a fuel tank goes untreated, the surrounding area will become polluted. This can lead to the contamination of the public drinking water supply. [3] Problems may also occur during the tank removal process. For example, during the removal of a tank in San Francisco, fumes entered the Pacific Bell corporate office

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[1] Silverman, Stephen. "History's Stickiest Disaster," Useless Information.
<http://members.tripod.com/~earthdude1/molasses/molasses.html>

[2] Carol D. Leonnig, "Gas Leak Monitor Failed at SE Service Station; Mayor Criticizes Company's Treatment of Displaced Families," The Washington Post, 10 August 2001, sec. METRO, p. B02.

[3] Journal Sentinel wire reports, "MTBE found in wells throughout California," Milwaukee Journal Sentinel, 28 August 2001, sec. NEWS, p. 07A.

via the ventilation system. As a result, nine people were sent to the hospital, and hundreds of people had to be evacuated from the building. [4]

In tanks that contain gasoline or other toxic materials, especially materials that evaporate into fumes, even a small leak can cause health problems. A leak indicates a structural flaw, which can quickly lead to total rupturing of the tank and loss of the contents at the expense of the environment, life and property in the area. It can take years and substantial capital to rid the environment of spilled materials.

The Boston Fire Department (BFD) is the first line of emergency response in the case of a tank accident in Boston. The BFD currently maintains clerical paper records for licenses and permits for all known storage tanks. This project group will use this information and create a searchable database that will improve the efficiency of record keeping. The database will be maintainable and will create a simple way to view upcoming permit expirations. The database will also include a map of the locations of all the tanks, including layers where there are schools, hospitals, construction, and other potential danger areas near a tank. Our database will help ease the BFD into electronic record-keeping. The database will contain information for all sites in District 6, which includes South Boston and Dorchester. The BFD will then decide whether it is beneficial to bring someone in to finish populating the database for more permanent use.

In order to streamline the UST permitting process, we will be observing the BFD's current system of data entry for new and modified tanks, and we will review the operating procedures for tank installation and removal. The inspectors who oversee the process and complete the paperwork when the process is completed will be the focus of this review, because the implementation of our project will affect them most directly. We will also offer suggestions for changes that we believe might improve the efficiency of the BFD's storage tank emergency response. These suggestions may include changes in the application process, and any other changes that will better protect against UST accidents.

The chapters that follow provide background information, the methods by which we hope to accomplish our objectives, and our expected results and analysis.

[4] Bay Area Report, "SAN RAMON; Pacific Bell fume leak sends 9 to hospital," The San Francisco Chronicle, 14 August 2001, sec. NEWS, p. A12.

The Underground Storage Tank (UST) permitting process is complicated because it involves three levels of government: federal, state, and municipal. All regulations must include, at minimum, the higher levels of law and include additional, more specific, regulations. The following sections include information on the structure and function of USTs, the regulations, permitting and licensing information, the Boston Fire Department (BFD), which is the municipal enforcer of UST regulations and our project sponsor, and South Boston, which is the area that this project group will be focusing on.

2.1 Underground Storage Tanks (USTs)

An Underground Storage Tank (UST) refers to any storage tank that is more then ten percent below the level of the surrounding grade [5]. USTs are used in private industry and by public agencies, most commonly for fuel storage. The majority of regulations governing USTs are intended to ensure that stored material is not released into the environment. The reason for this is two fold: first, most materials stored in USTs are hazardous; second a large release of any material, even if it is nontoxic, can cause problems.

2.1.1 Technical Description of USTs

UST systems are composed of the following sub systems, as shown in Figure 1:

- The tank: typically a double walled steel tank, or a single walled non-ferrous tank.
- The delivery system: the mechanism used to remove material from the tank and deliver it to the desired location. An example of a delivery system is a gas pump.
- The filling system: the mechanism used to deliver material to the UST from an outside supplier, frequently a hole in the ground at the top of the tank that a truck driver can connect a hose to.
- Plumbing systems: the pipes used to connect the UST to its filling and delivery system.
- The leak detection system: the systems placed in and around the UST and it's plumbing to detect leaks.

[5] "527 CMR: Board of Fire Prevention Regulation"

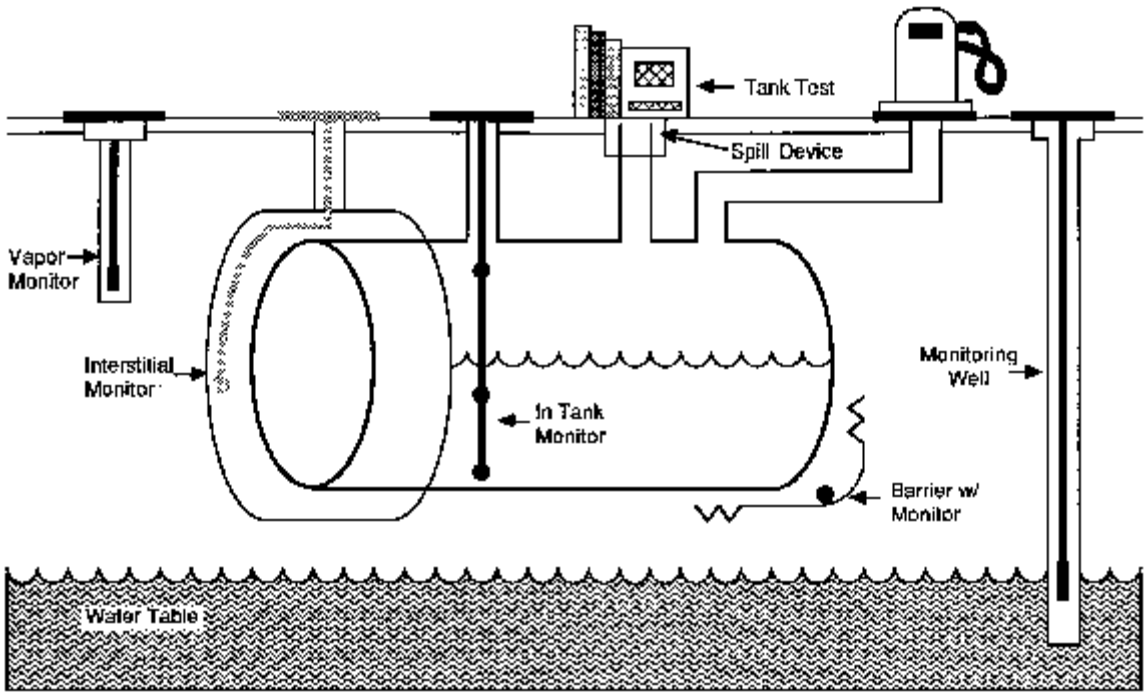


Figure 1: Drawing of a Typical UST System[6]

2.1.2 Regulation of USTs

The primary objective of the UST regulation policy is public safety. This is achieved though several regulatory requirements:

- Mechanical safety of USTs.
- Spill/leak prevention measures on all USTs.
- Spill/leak containment measures on all USTs.

To enforce these requirements an operation permit is required for all UST facilities, and regular inspections are required to maintain the operation permit. See Appendix B, UST Laws and Regulations for more complete descriptions.

The Federal Government, by way of the Environmental Protection Agency (EPA), establishes the minimum requirements for UST regulation programs. These requirements are not backed by implementation details; this is the responsibility of the state governments. The State Government details the implementation of the federal requirements, and any additional requirements it chooses to enforce. The State programs are implemented by the local governments and in the case of Boston this falls to the BFD.

[6] Ken Woodard http://www.cee.vt.edu/program_areas/environmental/teach/gwprimer/ustsdmkw/ustpage.html

Some of the additions made by the State of Massachusetts to the EPA guidelines include anti-corrosion measures that must be in place to ensure that the USTs maintain integrity. Spill and leak prevention and detection measures are required to ensure that materials stored in USTs do not escape into the environment. Below is an illustration of how material leaked from a UST can contaminate groundwater over a large area if the leak is not controlled.

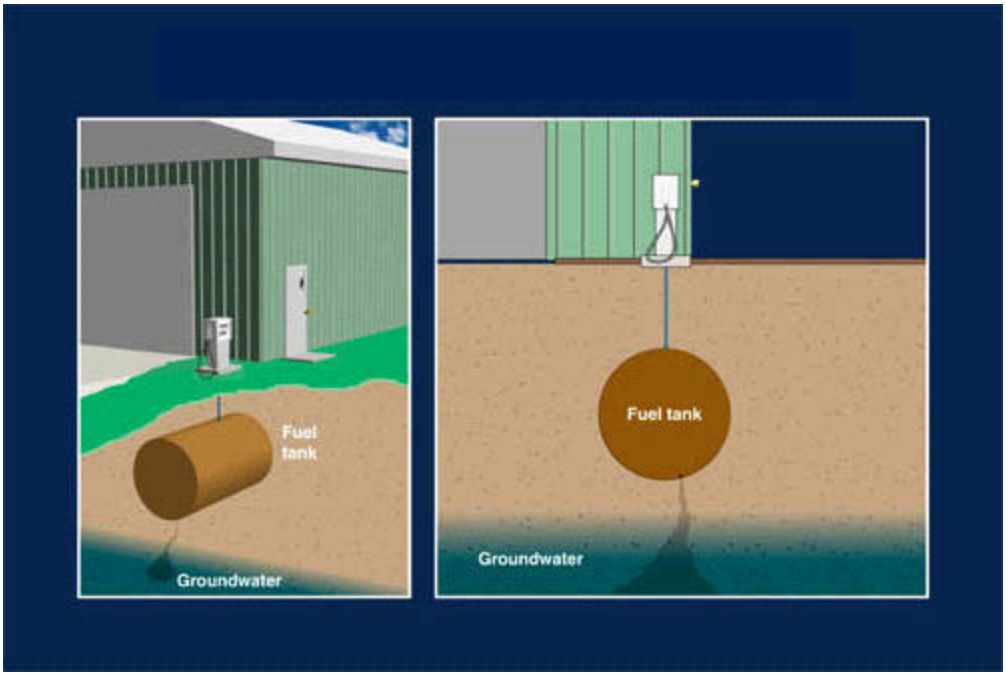


Figure 2: Leaking UST contaminating groundwater[7]

2.1.3 UST licensing and permitting processes

The local government, specifically the BFD for this project's scope, is responsible for issuing and renewing UST licenses and permits. The UST permitting process ensures that the appropriate regulatory organizations are aware of all UST projects that happen inside of their jurisdiction. The application process is used to issue the permits needed to operate a UST facility. By reviewing all applications for permits that are received, the regulatory organizations can ensure that only UST facilities that meet the regulatory requirements are issued operating permits.

[7] ECO-NOMIC, "Environmental Services" < http://www.eco-nomic.com/indexthn.htm>

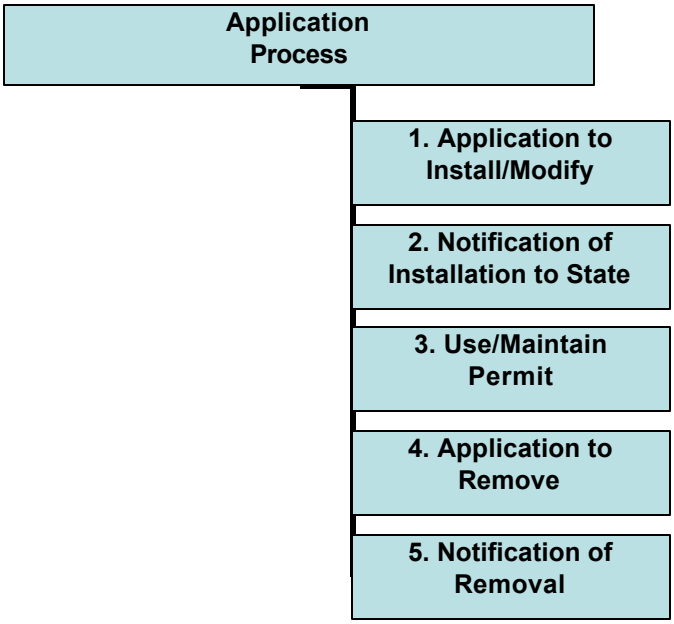


Figure 3: The UST application process as administered by the BFD

Depending on the amount of material stored on a site, a license or permit may be required from the City of Boston. A license is required for the storage of petroleum products in excess of 10,000 gallons. The license is obtained from the Inspectional Service Department, and expires yearly on April 30. The license application process involves determining abutters and public hearing and notice. The required fee is dependent upon the amount of material stored at the facility.

All sites are required to have a permit, one copy of which is in the UST folder at the BFD, and the original copy, which is to remain posted on site at all times . The permit is obtained from the Boston Fire Department Special Hazards Division. Permits must be renewed every 5 years and there is a variable fee structured for each permit. [8]

The process used to issue and renew UST permits in Boston is currently entirely paper-based, relying on a few employees to maintain the records. The permitting process is the area of the UST regulatory system that the project group will focus on. We will provide recommendations to the Boston Fire Department that will allow the BFD to streamline the process, making it easier for the fire department to regulate USTs.

[8] City of Boston, "Storage Tank Building Permitting and Licensing Requirements." < http://www.uos.harvard.edu/ehs/enviro/BostonTankPermitting.pdf>

The initial permit request for a new facility, or a modification to an existing facility, is filed with the State Fire Marshal. The application includes plans for the tanks that will be modified or installed, and a full site plan, indicating other structures or USTs already in place (see C2. Permit to Install/Modify a Tank"). The application and plans are reviewed by the Fire Marshal, to ensure that the proposed facility will meet the standards set forth in the legislation and regulation of USTs. This application is also sent to the local fire department, which maintains records of all the USTs inside its jurisdiction.

Once the design review is completed, and the proposed facility has been deemed acceptable by the Fire Marshal, building permits are issued and the construction process can begin. While the USTs and support systems are being installed, a representative from the local fire department is on the site to inspect the tank's subsystems as it is being installed (see C3. Permit to Maintain a Tank Facility"). This ensures that each step of the installation process is completed properly. Additionally, the site records in the hands of the fire department representative allow the fire department to maintain their own records of the site layout.

When the construction of the UST and its supporting systems, including material dispensing systems, leak detection systems, and filling systems, has been completed , the entire system is tested for its integrity to ensure that there are no faults. The system-wide testing is usually done by an outside engineering firm, hired by the company that is installing the UST (see Appendix C8. Tanknology Inspection Results"). Once the initial inspection and testing is finished, the UST facility is issued a "permit to operate" by the local fire department and by the State Fire Marshal. The State application is used to keep an inventory of all the USTs in the State, and the revenue generated from the application fee is used to pay for the cleanup of spills related to USTs.

For the lifetime of the UST, the owner is required to maintain current permits and licenses for all their USTs. To accomplish this, all material that passes through the tanks must be tracked. Lost material amounting to over 40 gallons a month must be reported to the local fire department as a leaking UST. Additionally, once every five years a test of the UST's leak detection systems is required, and the tank may be inspected at any time by the local fire department. For self-service gas stations, there is a yearly inspection requirement to ensure that all equipment is in working order. Permits for self-service stations must be renewed yearly and expire on June 30, coinciding with the end of the fiscal year. For bare steel tanks with cathodic protection, a professional testing firm must be contacted by the tank owners for inspection every three years. The results of those tests should then

be forwarded to the BFD. These regular inspections are necessary to detect leaks in the earliest stage possible and to prevent major disasters.

The current method for tracking the UST permits is to keep paper copies of all the existing permits and applications. The project group will work with the Boston Fire Department to computerize all the records of USTs that are maintained by the fire department. While the project group is working on computerizing the existing records, we will also analyze the process used to issue permits for USTs and suggest possible improvements to the process (See Appendix C for complete copies of all Permits and Applications).

2.2 Boston Fire Department

The Fire Prevention department of the Boston Fire Department (See Appendix D, Sponsor Information) monitors the installation and removal of USTs. In case of emergency, the Boston Fire Department (BFD) responds to the site. The BFD has a Special Hazards Division, which receives all UST permitting and application paperwork. While a UST is in operation, the certifications for the tank and its emergency systems must be renewed once every one to five years (for further detail, see 2.1.3 UST licensing and permitting processes). The variance in inspection times is based upon the accident record of the UST facility. Application renewals can be filed at the BFD headquarters.

When a spill or other incident involving a UST occurs, the first group to be notified is the local fire department, who ensures that the public is protected, specifically by evacuating people from the area contaminated by material in the UST. Once the public has been evacuated, the fire department can begin containing the spilled or leaked material. Once the immediate risk has been mitigated by the local fire department, the State Department of Environmental Protection (DEP) will become involved in the situation. The DEP's role in a UST spill is two fold; they are responsible for investigating the cause of the accident, and supervising the spill cleanup.

2.3 South Boston

The focus of this project will be the area of South Boston, which is District 6 of the Boston Fire Department. Although we will only be working in this area, the structure by which this project is accomplished will allow it to be recreated in other areas of the city if desired.

South Boston was annexed into the city of Boston in 1804 (see Figure 4). With the completion of the Old Colony Railroad, the population continued to grow. Immigration to South

Boston at that time was mainly Irish immigrants who became industrial workers in nearby factories. The result is most of the area being dense residential neighborhoods housing blue-collar workers.

As business expanded, landfills were created to increase land area as the railroad and shipping businesses allowed for high volume trafficking of lumber and foundry products. The bustling seaport went into decline after World War II when there was a change in the freighting and transportation technologies.[9] However, there has been a slow increase in maritime commercial uses recently with trucking and containerized shipping utilizing the piers.

Currently South Boston's commercial district is build around East and West Broadway and contains miles of waterfront. Most of the heavy industry that was in South Boston has moved out of the city into areas where real estate is cheaper. Investments by public agencies are revitalizing the port area. In addition, recent projects along the Fort Point Channel suggest a move toward the cultural, institutional, and commercial redevelopment of former railroad and industrial land. Many of these industrial and commercial locations will require USTs for operation, making South Boston a strong area to focus on for UST information.

[9] Michael A. Fischer and T. Luke Young, "Exploring South Boston's Seaport", <http://yerkes.mit.edu/11.525/1998/southboston/> (29 January 2002).

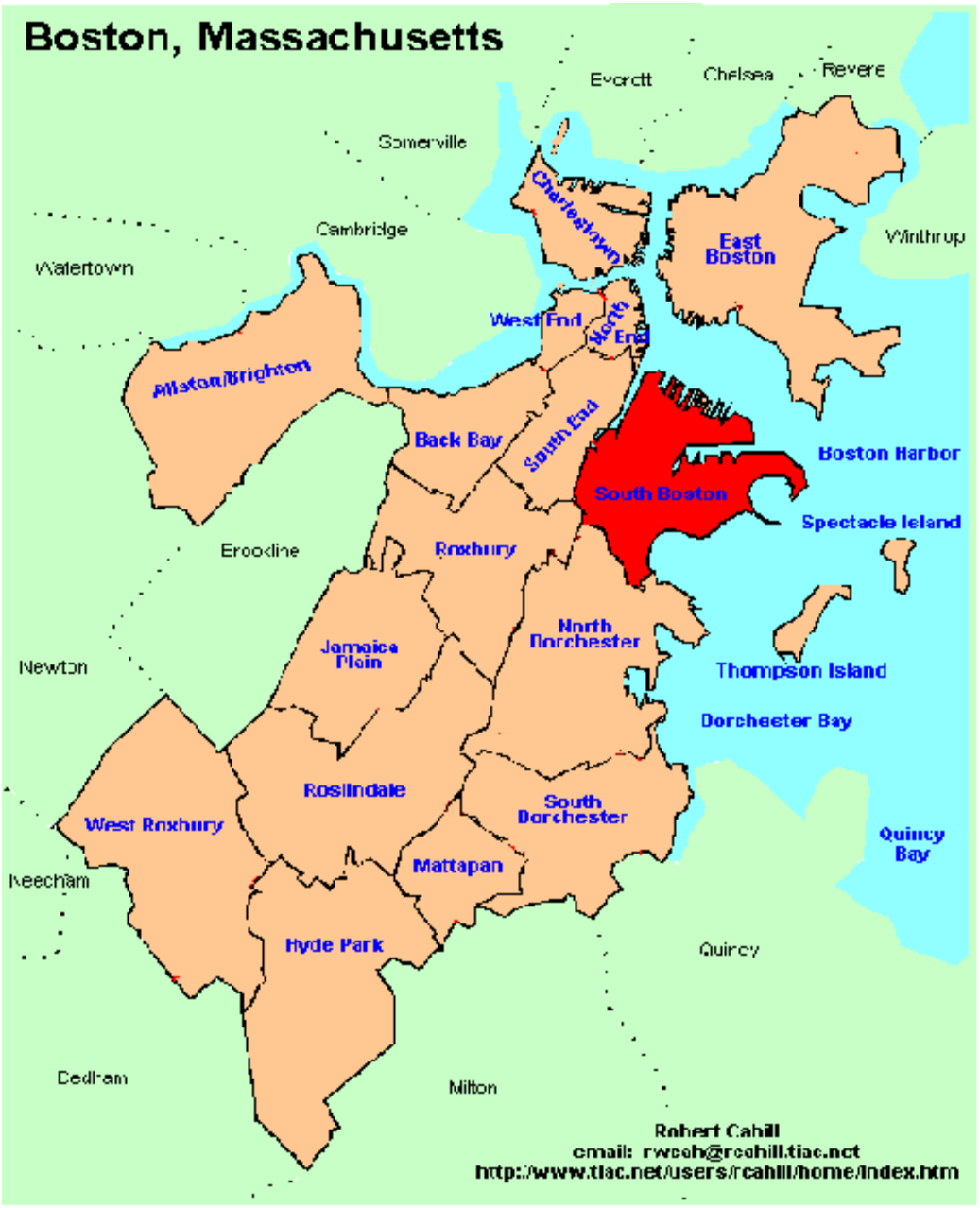


Figure 4: Map of Boston[10]

[10] Cahill, Robert. <http://www.tiac.net/users/cahill/home/index.htm>

3 Methodology

The main goal of this project is to improve public safety in the City of Boston. The project group will achieve this goal by assisting the BFD to improve its UST-related processes. The first step of these improvements will be accomplished by transferring the fire department's UST record-keeping processes from a paper-based system to a computerized system, beginning with District 6, which is South Boston. We will also review the current application and renewal processes and propose changes after a thorough analysis. We have broken the project into three objectives:

1) Streamline the UST Control Process used by the BFD
2) Analyze the Short-term Benefits of the Project
3) Analyze the Added Benefits of the Project

3.1 Streamlining the UST Control Process

The first step in streamlining the process used by the BFD to track and inventory USTs is to understand the process that is currently used. We will acquire knowledge of the BFD's current process by talking with personnel who work with the current system, and by observing the inspection process for the removal and installation of a tank.

Based on this understanding, the project group will generate a database system of UST information, which will be populated by the records kept by the BFD. Microsoft Access will be used to implement the database for this project. Many of the fields in the databases will reflect the same fields used on the application forms (see Appendix C). The main fields of focus include owner information, tank location, and material description, as shown in the sample database query in Figure 5. In addition to these fields, information for each tank on every site will be available, because often one site will have multiple tanks that can store different materials. We will add these fields to the database because it will give that information readily, whereas the current system would require that the file be pulled in order to find that information.

The database system is created from two databases, the first of which contains site information such as material usage and contamination data. The other database contains tank information, including tank volume and material. These databases are linked together by codes. We have designed a code for each site, including the district number, the street number, and part of the street name. This is the only code in the site information database. This code is also in the tank information database, linking

the two. In other words, if the site code is entered in a query, both site and tank information will be available. In the tank database there is an additional code which is unique for each tank. This code is the same as the site code with the addition of a suffix. The suffix is a number given to each tank on the site (for example: 1, 2, 3…). Searching for this code will show only the information for a specific tank.

Facility: BOB & JIM'S SERVICE STATION INC ID #14580		**Owner: BOB AND JIM'S SERVICE STATION**
Address: 102-110 DORCHESTER AVE SOUTH BOSTON, MA, 02127 **County:** SUFFOLK	**Phone:** (617) 268-5434 **Description:** Gas Station	**Address:** 110 DORCHESTER AVE SOUTH BOSTON, MA, 02127

ID	Serial Number	Above Ground	Capacity	Contents	Status	Use	Tank Material	Tank Type	Pipe Material	Pipe Type	Tank Leak Detection	Pipe Leak Detection
1		N	6000	Gasoline	In Use	MV	Cathodic	1 Wall	Reinforced	1 Wall	A	P
2		N	6000	Gasoline	In Use	MV	Cathodic	2 Walls	Reinforced	2 Walls	A	P
3		N	6000	Gasoline	In Use	MV	Cathodic	2 Walls	Reinforced	2 Walls	A	P
4		N	6000	Diesel	In Use	MV	Cathodic	2 Walls	Reinforced	2 Walls	A	P

Figure 5: Sample Database Query

This database will be integrated with a map layer that graphically displays the information in the database. The software that will be used is MapInfo, and tank locations will be determined by site maps, found in the folders containing tank information at the BFD. The resulting software will be a useful tool displaying the locations of USTs within the city of Boston. The maps will aid the fire department in locating a UST for inspection or emergency response. The site code will be used to identify the sites on the map layers, which will link the sites to the database. Tank codes will be contained in the symbols that designate the location of each tank on the site.

Complete UST information will be more easily retrieved by increasing the efficiency of the information retrieval process. Once we have used the data from the application forms to fill the database, we will then look to organizing the data in a useful and informative way to better aid the fire department. One way to simplify data retrieval and data entry is to create a form, as we have shown in Figure 6.

The increase in efficiency that is possible from our system will allow for a more complete analysis of current BFD procedure with USTs. Part of this process will be analyzing the public safety risk of a given UST, based on criteria to be determined by the group and the BFD. This analysis will be based on the information currently collected by the BFD, and information about the area surrounding the UST.

These improvements to the BFD's system, including the accessibility and organization of information and the visualizations made possible by the map system, also have one drawback. The drawback to this system is the inability to automatically add information to the maps. When a new tank or site is added to the database, someone must manually find the site address, add the site to the site layer by creating an object to visualize the site and connect it to the site, and connect it to the database to inherit the code. Then the tank must be added to the site on the tank layer, and the code must be linked to the database.

3.2 Short-term Benefit Analysis of the project

After the tank information is transferred into the database, the amount of time it takes to locate information on a specific tank will be greatly reduced. The time saved as a result of this system will allow the BFD to consider expanding the services it offers. The BFD will be able to view the newly presented data and perform an analysis of the benefits of the project with the understanding of how the information or structure can be useful in other areas of the fire department.

A large benefit of our project will be the fact that the database will be updatable. To simplify the updating process, there is a form that contains all the fields in the database, as shown in Figure 6. The person who is interested in adding tank information simply has to fill in the fields and submit the form, and that tank information is integrated. This system will allow much more efficient retrieval of the UST information. To locate a tank, any field on the form can be filled in and queried. If there are tanks that match that information, they will be displayed. This will make all tank information comprehensible to the BFD, allowing them to receive information quickly.

Despite the previously mentioned limitations on the map system, the maps are also updatable, and can be expanded to all of Boston. Other departments will then be able to add their own layers to fit their needs. This will benefit the Boston Fire Department by allowing departments such as the building division to create layers to visualize sites or buildings as they see fit.

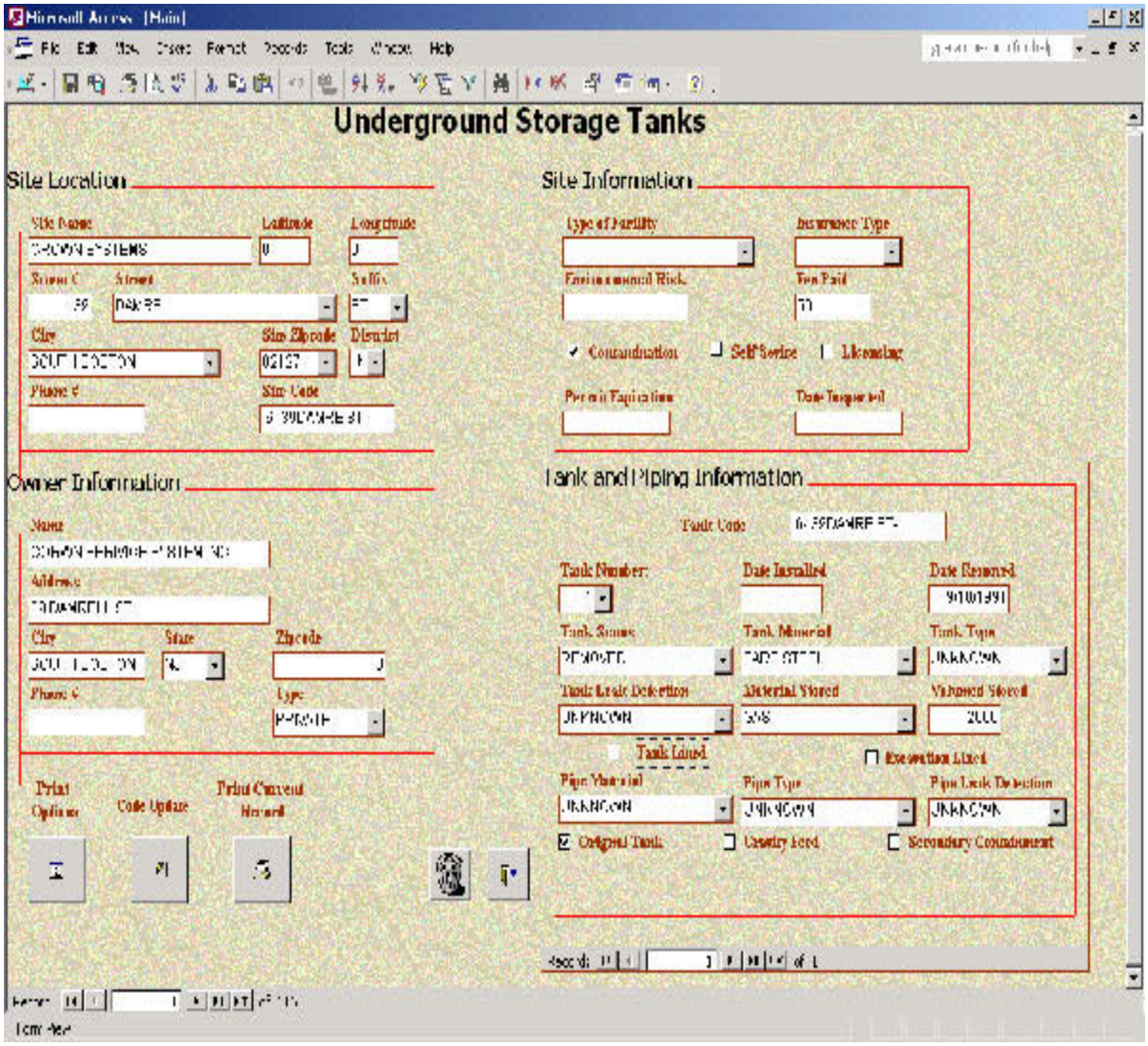


Figure 6: Query Form

The project group will assist the BFD in analyzing other areas of interest relating the data to their department. We will do this by considering scenarios in which UST information would be useful and interviewing those who would be affected by the integration of the database. The information we collect will help us make educated suggestions to the BFD of possible integration sites. Areas we presume will be affected by this information include blasting, excavation, construction, and emergency departments. Discussion of these areas and their function for our information will be explained further in Section 3.3, which focuses on future benefits of our project.

3.3 Analysis of Added Benefits of the Project

After implementing the information retrieval process, the project group will propose operational changes to improve the quality and area of service offered by the BFD in the future. We will analyze the current scope of the fire department's UST procedures and suggest operational changes that could be easily made using the new UST tracking system. The expansion of the BFD's operation will increase the monitoring of USTs in the city, and minimize the chance of accidents involving USTs.

Opportunities for inter-agency communication will include cooperation with environmental agencies in the City. This project will provide information on possible sources of contamination, and communication with the agencies for which contamination is a concern. This communication will be with agencies responsible for issuing building permits to determine not only if USTs are located on the proposed site, but if there are any USTs nearby. Organizations that may be interested in this data include the Brownfield's Redevelopment Authority and the Boston Landmarks Commission. If there is a property that either of those organizations is dealing with, they will be able to swiftly research areas with tanks before any work is done to the property. Another agency that may be interested in this project's results would be DIGSAFE. DIGSAFE maintains a registry of all buried utilities in the North Eastern US, and must be consulted before any excavation project.

Opportunities for intra-department communication include working with the section of the BFD responsible for issuing blasting and demolition permits. Simple access to all tank locations will help to ensure that blasting projects happening near UST facilities will follow the proper safety precautions. Another part of the fire department that will benefit from this would be the Emergency Response Center. If there is a UST near the site of a fire response, proper evacuation measures can be taken.

The expansions to the BFD's operation will be developed as a series of proposals and case studies to demonstrate the usefulness of the expansion. The proposals will be geared towards showing an increase in public safety for a minimal outlay of funds from the BFD, with the objective of showing an efficient path to increasing the effectiveness of the BFD's operation.

4 Results

There are two major results the project group will generate. The first is an updatable database and linked maps. The second result will be a proposal detailing operational expansions that can be made by the BFD, using the computerized system.

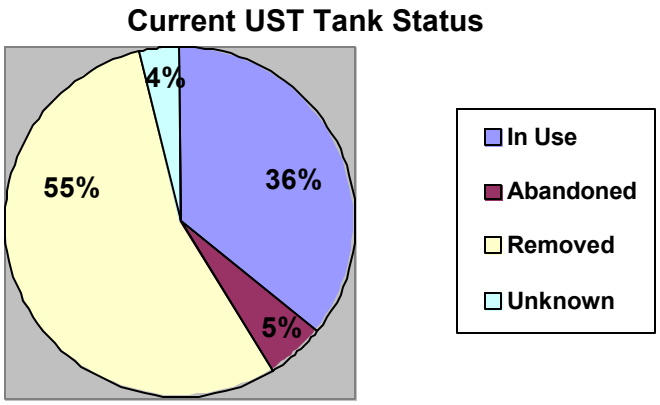


Figure 7: Percent Tank usage

Data collection showed the project group both how many sites were in District 6, and how many tanks were in the district. Figure 7 shows the percentage of tank usage. Many of the tanks that have been removed are due to the construction of the convention center in the area of C Street. During data collection for the database, which stores information on all 226 tanks in District 6 of the fire department, including South Boston and parts of Dorchester, we discovered that there are a number of tanks with expired permits and other incomplete records.

This number of incomplete records poses a risk to the public because without the permits and licenses the BFD does not know if the tanks are in use and if they are meeting safety standards. Currently the BFD's inspection process is based solely on when complaints come in on a certain site, and there is no enforcement process to determine if contamination was cleaned or ignored. Our project has created a tool that will allow the BFD to track UST history by storing not only permit and licensing expiration dates but also site contamination information.

Figure 8 shows the number of tanks removed by each year, based on the number of files in our database. The large number of tanks removed around 1998 was caused by the passage of a federal law that changed the requirements for USTs, and mandated all tanks must be in compliance with state

and federal laws by September of that year. If the tanks were not going to meet standards when inspected, they had to be removed, and newer tanks could then be installed.

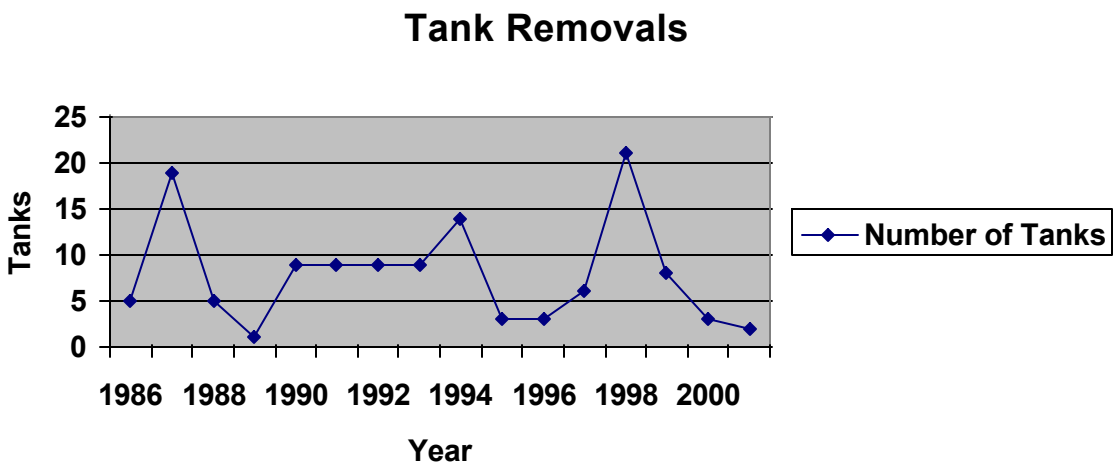


Figure 8: Tank removals by year

While the discovery of tank sites with out of date permits was expected, the number of sites that are not in compliance with the law came as a surprise to the project group. There are thirty-eight sites, 30% of the 123 sites in south Boston, containing tanks that do not have paperwork on their tanks, as shown in Figure 9.

	Missing Permits	Expired Permits	Missing FP-290	Incomplete FP-290	Miscellaneous Missing Information
Number of Sites	19	17	16	8	6

Figure 9: Incomplete Site Files

The FP-290 is the form required when tanks are installed or modified. This form should contain all information about the site, the owner, and the tanks. If this form is missing or incomplete, as it is for 24 sites currently, the BFD knows little or nothing about the tank or who to contact if a problem is reported. The permit is required upon the time of tank installation and should be renewed every five years. The permit can not be renewed unless the tank has had no discrepancies in its inventories, and its monitoring system is in working order.

Because of the incomplete forms, many of our results have an "unknown" field. This shows the importance of the FP-290 because without it, the task of analyzing the risks posed by each tank becomes nearly impossible. The majority of tanks have been recorded as being bare steel, and many of the steel tanks have been removed. Most of the tanks that have been installed more recently are made from fiberglass, as shown in Figure 10.

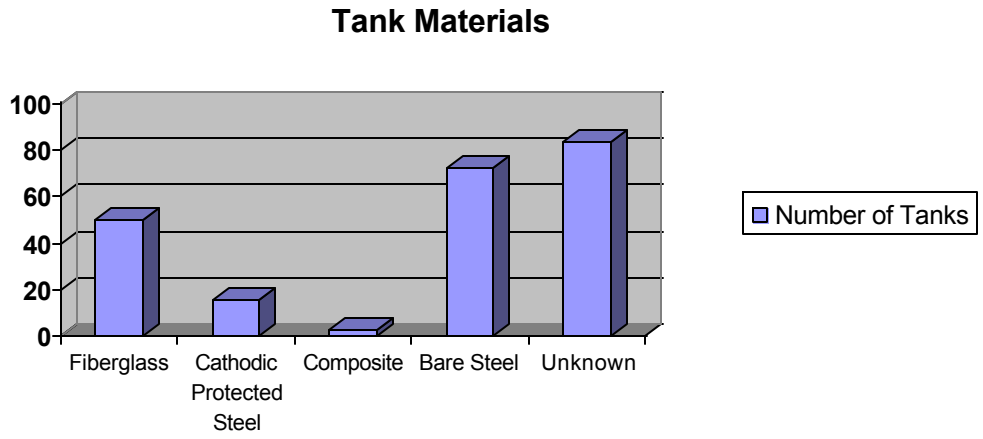


Figure 10: Tank Materials

The proposal for possible expansion for the BFD's UST program will be developed with an eye towards adding value to the system we have developed. By providing an array of options that will increase public safety and increasing the use the BFD will get from its computerized system, the project group will show the flexibility of the system we have produced.

Examples of possible areas that could benefit from our system include:

1. Communicating with other divisions of the BFD about USTs, such as linking blasting permit applications to local UST sites and linking fire alarm calls to the UST database
2. Becoming pro-active in site inspections of UST facilities and providing the ability to search all the UST records on file

These systems will be discussed further in our analysis section below, where we will show that our project will benefit the public by minimizing the chance of UST accident.

5 Analysis

In analyzing the results of this project, the project group will focus on two main areas: the direct risks posed by USTs to the public in the city of Boston, and the opportunities the BFD can explore to improve their UST program. The project group will use both qualitative and quantitative metrics in performing the analysis of the effectiveness of our results. The qualitative metrics the group will use relate to public safety. For the quantitative metrics used here, the group will focus on process efficiency. We will base our analysis of current operations on observations made by the project group, discussions with BFD personnel, and the system we have developed.

5.1 Operational Analysis

The current operation of the BFD Fire Prevention Division is hampered by a lack of both power and resources. This project will aid this situation by providing a tool to make more efficient use of the resources and staff that the BFD does have. This section will discuss some of the specific situations the project group encountered during our work with the BFD.

When a tank is removed from a site, three soil samples must be taken and analyzed. The test results are sent to both the fire department and the tank owners. If the results of the soil analysis show contamination, the tank owner must then contact the DEP to organize a clean-up effort. To ensure that the DEP receives notice of the contamination, the BFD also sends the information to the DEP. The tank owner is financially responsible for the clean-up, causing some owners to leave the state rather than paying an environmental clean-up company. The fees for not cleaning a contaminated site include a $10,000/day fine from the EPA plus a $2,000/day fine from the state of Massachusetts. These fines can only be levied by the superior court, specifically the housing court. However, this process is lengthy and rarely enforced, and we discovered many of the tank files contained notice of contamination but no notice of a clean-up process. This lack of clean up notification indicates a lack of communication between the EPA and the BFD as the former cleans up contaminated sites. If the fire department or the EPA had the power to levy fines, contaminated sites would be more quickly addressed and cleaned up. The current court process is rarely used due to lack of man-power on the part of the EPA and the BFD.

When a license is going to be renewed, site owners can decide to store more or less material than the year before. If the site owner chooses to store more material and install a new tank, the BFD

has an application that must be filled out prior to the installation. If the owner decides to store dramatically less and does not plan to continue using a given tank, the fee on their license gets reduced, and the tank must be removed from the ground. The only process in place currently to ensure that the BFD becomes aware of a tank that is no longer in use is a report by the site owner, or when an application to remove the tank is filed. This means that tank owners can stop using tanks and abandon them in place, often without taking the appropriate precautions first, and without the BFD becoming aware of the situation. Moreover, these tanks can easily be forgotten when property ownership changes hands or is abandoned.

A better tracking system on all tanks, which can be accomplished by enforcing up-to-date FP-290 forms, will allow a more thorough check when looking into a property. This will help agencies such as the BRA, which works to redevelop brownfields, which may contain abandoned tanks.

The BFD does not currently have a Standard Operating Procedure in place for handling UST related issues. We have created an SOP (Appendix E, Standard Operating Procedure) to increase efficiency in the process that the BFD currently has, including regular inspections and a manual on how to add or change information in the database. Additional information and suggestions for uses of the SOP are found in 6 Recommendations.

5.2 Implementation Analysis

Quantifying public safety is beyond the scope of this project, so any measure of public safety will be based on how the action or change affects public safety, by either increasing or decreasing public safety. There are three public safety scenarios that our project will focus on. The first scenario is the likelihood that a citizen is in the presence of a tank when a spill occurs. Our project will help minimize the occurrence of spills by assuring that all testing has been done to keep the inspections up to date, so the leak prevention systems will be in appropriate working order. The second public safety scenario is that our project will help to prevent leaks, which can pollute acres of land such as public parks or residential areas. Lastly, the awareness of inspection expiration dates and notification of tanks with prior leak problems will alert the BFD to potential danger areas.

Quantifying process efficiency is within the scope of this project. We will analyze the efficiency in at least two ways. First, we will time how long it takes to locate the information on a specific tank using the current process, and compare it with the projected amount of time to locate information on a specific tank using the database. We believe that it will take far less time to locate a specific tank using

our system. The second way to quantify the efficiency of our system is to measure the amount of time it takes to locate all tanks in a certain area. With the linked maps system our project will employ, it should take a great deal less time to locate tanks in certain areas, such as a block of streets, or a single street.

The expected time that will be available by using the computerized system is considerable, and we suggest that the BFD become more proactive in warning tank owners when their permits, licenses, or applications are expiring. This will give tank owners time to go through a thorough inspection process before applying for renewal. Also, the BFD can use the time to input status changes on the tanks into the database to keep it updated.

Our project may also assist other agencies in their work. Projects that involve blasting, construction, and excavation will be able to easily check and see if there is a tank in the area that they will be working. Although this is currently done, the electronic method will minimize the chance of a misplaced or lost file. Additionally the electronic system makes it much easier to search an area of the city for tanks because it will not require a street number by street number search thought the paper files.

6 Recommendations and Conclusions

These recommendations are based on the observation and analysis of the BFD's current operations. Although some of the following suggestions would require appropriate funding to be implemented, many of them are simply a reorganization of tasks using the current time and staff allotted to the Special Hazards Division.

This project has accomplished its mission of helping the Boston Fire Department to improve public safety by organizing the UST process and adding a computerized system for storing information. This computerized system allows information input and retrieval more quickly than through the currently implemented paper-based storage system. Implementation of the database will make day-to-day UST processes quicker and more complete. The project group has also presented a Standard Operating Procedure (SOP) (see Appendix E, Standard Operating Procedure**),** which will allow the BFD to have clear guidelines to refer to when questions about UST procedures come up.

One of the first issues the project group encountered was the lack of documentation at the BFD regarding UST-related processes. To supplement this documentation, we worked to determine how the BFD currently handles UST processes, and how our project would work with and improve the existing procedures. Our suggestions include reminders of upcoming permit expirations and enforcement of all aspects of an application, such as the FP-290, being completed before the application is accepted. The project group developed a document (see Appendix E, Standard Operating Procedure) containing the existing procedures used by the BFD, and added the procedures necessary to use the computerized system the project produced.

Adopting this SOP, or a modified version of it, would be valuable to the BFD for a number of reasons. Directly relating it to our project, the SOP provides a convenient reference for how the computerized UST system can be used, and describes some of the considerations that are required to maintain that system. In a more general sense, having an SOP makes the training of personnel easier, and provides a more uniform response from different staff members handling the same situation. This step-by-step manual (see Appendix F, Database Manual) for UST processes is also useful in the orientation of new staff, or outside consultants, such as this project group.

We also recommend that the BFD enforce an annual deadline for tank owners to test their tanks. The advised date for this to be done by would be June 30 th (the end of the city's fiscal year) of the year a permit is up for renewal because the BFD can withhold the renewal until tank testing results

have been produced. Testing for the integrity of certain parts of tank systems include testing every year on product line piping and tightness tests every three years on all piping. For steel tanks with cathodic protection, impressed current protection must be tested yearly, and sacrificial anode testing must be performed every three years. While there should also be regular maintenance on these systems, the BFD does not have the staff available for the enforcement of that process. We believe the best result will come from requiring testing results before permit renewals.

The main system developed by this project was a computerized system (using a database) to track and inventory USTs in the city of Boston. This system has only been implemented in South Boston (Fire District 6), but its adoption across the city would prove a valuable tool for the BFD. While the paper files (folders) on each site must be maintained for the period that the site is in existance due to State regulations, it is not necessary to use the paper records for routine operations. Using a computerized system will be both more convenient and more expedient then the use of a paper-based system. Due to its comprehensible search and data entry functions, the use of a computerized system should result in an increase in productivity, for personnel involved with UST related process.

While the benefits of the database system are apparent, this tool will not be available to the BFD until their systems are updated. We recommend that the software for Microsoft Office 2000 be purchased and put into use on resident computers. This will allow more tools in Microsoft Access, the program in which our database was written, to be accessible, allowing information to be presented more easily. The GIS mapping software is MapInfo and will also need to be installed in BFD systems for the UST mapping layers to be available for viewing. People who would need access to the programs include the Captains and Inspectors of USTs.

With the use of any data repository comes the necessity of maintaining the data stored to ensure that it is up to date. Although the maintenance of the database produced by the project is covered in the proposed SOP, periodic maintenance must be performed to remove out of date records. This will need to be done with a periodicity on the order of every five years. If the map system that the group developed is to be used in the future, it will also need to be maintained. This will probably require an outside professional with experience in the use of MapInfo, or a similar mapping tool.

Another department that is interested in the mapping aspect of our project is the Special Hazards Team that deals with Superfund Amendments and Reauthorization Act of 1986 (SARA) sites. Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA III) contains a list of

toxic chemicals and the quantities that are stored which can make a site exceptionally hazardous. The BFD has a team which has a HAZMAT truck containing a computer system. Their interest in MapInfo would involve taking our model of sites and tanks and applying it to sites which store SARA III chemicals for more effective tracking and emergency response. For the mapping system to be of full use, a professional trained in the use of the MapInfo program would have to be brought in to complete the maps for the entire city of Boston. While this is a large undertaking, we believe it would be thoroughly beneficial to the city. Once an entire map of the city is complete, any city group will be able to create a layer containing its information on the map, and make it available for viewing.

One of the greatest hindrances the BFD faces in enforcing UST related regulations is the amount of work required to enact any punitive measures against an offending UST operator. Currently, to enact punitive measures the BFD has to take each case before the housing court before measures can be taken. However, during the time delay caused by the court system, the tank owner can remedy the problem, or the initial steps may be taken to correct the problem, making the investment of resources in taking the case to court a waste of limited resources. For this reason the BFD should have the power to directly levee fines that can be appealed if the tank operator feels the situation is invalid.

By giving the BFD the power to directly impose punitive measures, the initial step of the process to force a tank operator to correct a problem becomes a much simpler issue, involving less time and fewer people involved in the situation. This power will allow the BFD to increase the enforcement of existing regulations, and ensure that UST operators are maintaining their facilities to the required standards.

With the ability to more efficiently enforce the existing regulations comes the need to increase the inspections being performed on all USTs in the city. While not all sites require regular inspection by law, all UST sites should be regularly inspected to ensure that the tanks and support equipment have not been damaged. By regularly inspecting all UST facilities, accidents can be prevented, therefore increasing public safety. A proactive enforcement strategy also benefits the BFD because there will be fewer emergency calls. Ultimately, reacting to emergency calls is more time and cost expensive then dedicating resources to inspections and other preventative measures.

7 Bibliography

Bay Area Report, "SAN RAMON; Pacific Bell fume leak sends 9 to hospital," The San Francisco Chronicle, 14 August 2001, sec. NEWS, p. A12.

Cahill, Robert. "Map of Boston." <http://www.tiac.net/users/cahill/home/index.htm>

Carol D. Leonnig, "Gas Leak Monitor Failed at SE Service Station; Mayor Criticizes Company's Treatment of Displaced Families," The Washington Post, 10 August 2001, sec. METRO, p. B02.

City of Boston, "Storage Tank Building Permitting and Licensing Requirements". <http://www.uos.harvard.edu/ehs/enviro/BostonTankPermitting.pdf>

"Code of Federal Regulations, US Code Title 40, Code of Federal Regulations", Part 282, <http://frwebgate.access.gpo.gov/cgi-bin/getcfr.cgi?TITLE=40&PART=282&SECTION=10&TYPE=TEXT> (20 September 2001)

"Code of Federal Regulations, US Code Title 40, Code of Federal Regulations", Section 280. <http://frwebgate.access.gpo.gov/cgi-bin/getcfr.cgi?TITLE=40&PART=280&SECTION=10&TYPE=TEXT> (1 July 2001)

Department of Fire Services, "527 CMR: Board of Fire Prevention Regulations," Section 9.00, <http://www.state.ma.us/dfs/cmr/cmridx.htm> (21 July 2000).

Department of Fire Services, "US Query Tool" < http://db.state.ma.us/Dfs/ustQueryPage.asp>

ECO-NOMIC, "Environmental Services" < http://www.eco-nomic.com/indexthn.htm>

General Laws of Massachusetts, "CHAPTER 21E: MASSACHUSETTS OIL AND HAZARDOUS MATERIAL RELEASE PREVENTION AND RESPONSE ACT," Section 5, Persons liable, <http://www.state.ma.us/legis/laws/mgl/21E-5.htm>

Journal Sentinel wire reports, "MTBE found in wells throughout California," Milwaukee Journal Sentinel, 28 August 2001, sec. NEWS, p. 07A.

Ken Woodard and David Moorefield, " Underground Storage Tanks" <http://www.cee.vt.edu/program_areas/environmental/teach/gwprimer/ustsdmkw/ustpage.html>

Silverman, Stephen. "Histories Stickiest Disaster, "Useless Information" <http://members.tripod.com/~earthdude1/molasses/molasses.html>

8 Executive Summary

This project was preformed in conjunction with the Boston Fire Department's Special Hazards Division (BFD) to improve its Underground Storage Tank (UST) control and inspection process. These improvements are geared towards increasing the efficiency of the BFD. The project group accomplished this by developing a proof of concept for a computerized system to maintain the records the BFD needs for its UST related operations.

The current system used by the BFD is based on paper records of all UST related information that the BFD has. These records are organized alphabetically by street address, without a master index of all sites in the city. This results in a system that is difficult to use for outside personnel, and will be difficult to train new staff to use.

The new system developed by the project group is a substantial step forward for the BFD, which has not had the staffing or the time to attempt a system like this before. With the adoption of this system, which uses a database and linked maps to display UST information, the BFD will be able to access data faster and more efficiently. The increase in efficiency comes from the ability to access multiple files with ease, allowing area searches to be preformed quickly and easily.

With this increase in available information, the BFD has the potential to increase its enforcement and inspection actions relating to USTs. Currently the enforcement of UST related regulations is lacking, due to the high demands required to take punitive action. The legislative streamlining of this process would aid the BFD greatly in its ability to pursue action against offending UST operators.

Due to state regulations, the BFD must maintain all records for UST sites for as long as the site is active. However, the paper records do not have to be used for routine operations, which is the role of the systems produced by this project. This project introduces some new technology to the BFD's personnel, its main objective being to increase the efficiency and effectiveness of the BFD.

Appendix A, Annotated Bibliography

A 1) Risks of USTs

All sources in this section were of equal use to the proposal, and used primarily in the Introduction to show the hazards of USTs.

Angela Rozas, "Underground gas tank leak to be tested; DEQ to check site on Roosevelt Blvd.," The Times-Picayune (New Orleans), 29 December 2001, secMETRO, p. 1.

Commentary: A leak of undetermined contamination extents caused a service station to close. Cleanup could take several years, as reported. This is a good article for showing the lasting problems caused by leakage.

Bay Area Report, "SAN RAMON; Pacific Bell fume leak sends 9 to hospital," The San Francisco Chronicle, 14 August 2001, sec. NEWS, p. A12.

Commentary: As a UST was being removed, fumes leaked into the Pacific Bell corporate headquarters building. The fumes got in through the building's ventilation system, and 17 people had symptoms of asphyxia. This article is useful to show hazards of tanks.

Carol D. Leonnig, "Gas Leak Monitor Failed at SE Service Station; Mayor Criticizes Company's Treatment of Displaced Families," The Washington Post, 10 August 2001, sec. METRO, p. B02.

Commentary: 1400 gallons of gas leaked from a service station, which caused 16 families to be evacuated. The electronic detection system had failed, which is why the leak went unnoticed. The station had not reported that 400 gallons had gone missing in the spring. This incident caused a mass review of all tanks in the D.C. area. Will Boston wait for something like this before it enforces standards?

Journal Sentinel, "Family settles lawsuit over leaking gas tanks," Milwaukee Journal Sentinel, 13 October 2001, sec. NEWS, p. 02B

Commentary: Tank leakage at a service station at 5511 S. 108 St. was traced back to 1976. Investigation began when a lawsuit that at some points involved 99 defendants was filed in Milwaukee County Circuit Court. This article shows the expense that leaks can cause.

Journal Sentinel wire reports, "MTBE found in wells throughout California," Milwaukee Journal Sentinel, 28 August 2001, sec. NEWS, p. 07A.

Commentary: MTBE is a gasoline additive that was found in 48 wells in public water systems, which caused a mass review of CA tanks. The results were that 1200 tanks threaten the drinking water supplies of Californians. MTBE will only be used until Dec. 2002, because it has been linked to cancer.

Silverman, Stephen. "History's Stickiest Disaster," Useless Information. <http://members.tripod.com/~earthdude1/molasses/molasses.html>

Commentary: Tells the story of the Boston Molasses flood of 1919, where 2.2 million gallons flooded the streets, killing 21, and turning the Harbor brown for weeks.

ECO-NOMIC, "Environmental Services" < http://www.eco-nomic.com/indexthn.htm>

Commentary: CAD drawing of a leaking UST. Shows leaking into groundwater.

A 2) Law and Regulation Sources

"527 CMR: Board of Fire Prevention Regulations", 18 January 2000
Section 9.00 Tanks and Containers

Commentary: Applications to the design, construction, installation, testing, and maintenance of tanks and containers. Section 9.05 concentrates on USTs. It contains the dimensions for tank construction, along with installation and testing requirements. VERY USEFUL

"527 CMR: Board of Fire Prevention Regulations", 12 March 1999, Section 14.00 Flammable and Combustible Liquids, Flammable Solids or Flammable Gases

Commentary: Handling, storage, and container requirements for above materials. Indicates that containers must be in accordance with NFPA standards. Includes fire control measures. Moderately useful

Department of Fire Services, "527 CMR: Board of Fire Prevention Regulations", <http://www.state.ma.us/dfs/cmr/cmridx.htm> (21 July 2000).
Section 5.00 Operation and Maintenance of Buildings or Other Structures… Keeping and Use of Gasoline or Other Motor Fuel

Commentary: Has more electrical requirements, heating, wiring, inventory requirements, delivery, and operation and maintenance standards. Useful for giving distances to where wiring, smoking, etc can take place in relation to tanks.

General Laws of Massachusetts, "CHAPTER 21E: MASSACHUSETTS OIL AND HAZARDOUS MATERIAL RELEASE PREVENTION AND RESPONSE ACT," Section 5, Persons liable , <http://www.state.ma.us/legis/laws/mgl/21E-5.htm>

Commentary: Very useful for the breakdown of who is in charge of what and who is held responsible in the case of an emergency. Also looking into Chapter 148, which are the laws on fire prevention.

Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup, "Underground Storage Tank", n.d., <http://www.state.ma.us/dep/>

Commentary: MA DEP regulations on contaminated sites due to UST. The site also contain polices for UST closer assessment. There is a lot of useful information

Massachusetts Department of Fire Services, Office of the State Fire Marshal, "Underground Storage Tank Program", n.d., <http://www.state.ma.us/dfs/ust/usthome.htm>

Commentary: Official State Fire Marshal's regulations and programs dealing with UST's. The site says that tanks needed to be upgraded to meet new standards by December 22, 1998. The site also contains a list of other departments involved with the program. There are links to many of the other sites listed above; it is a good site to branch off of.

National Fire Codes, "Flammable and Combustible liquids code", Vol. 2, NFPA, sec 30-1 to sec 30-78, 1996.

Commentary: Authored based on Boston, relates to storage and piping design and operations. Written more technically, the information will take a block of time to digest and apply to our project. Useful for this project

United States General Accounting office, "Report to Congressional Requesters.", Environmental protection., n.d., <http://purl.access.gpo.gov/GPO/LPS12479 >

Commentary: A report about the compliance of UST's to existing regulations and the risks this poses to the public. The authors state that EPA standards do not currently prevent hazards, and ask that a different approach be taken. Moderately useful

Annual Book of ASTM Standards, 2001, volume 11.04. ASTM Designation E1526-93 Standard practice for evaluation the performance off release evaluation systems for USTs.

Commentary: Gives specifics on evaluating safety systems for USTs. Source is great for certain procedures, but not general statistics or procedures. May be useful if we need any of the procedures described.

Annual Book of ASTM Standards, "Standard guide for performing evaluations of USTs for operation conformance with 40CFR part280 regulations", 2001, volume 11.04. ASTM Designation E1990-98.

Commentary: Same as above. May be useful later in the methodology, rather than in the background.

Briggs, A.A., Borehamwood fire research station, "Use of nitrogen-filled high expansion foam to protect a 500-tonne fuel tank "

Commentary: A specific case study of a fire suppression system for storage tanks. The book has not been thoroughly read because it has been misplaced in the library, but once we attain it, we will know how valuable a source it is.

"Code of Federal Regulations, US Code Title 40, Code of Federal Regulations", Section 280. n.d. <http://frwebgate.access.gpo.gov/cgi-bin/getcfr.cgi?TITLE=40&PART=280&SECTION=10&TYPE=TEXT> (1 July 2001)

Commentary: Technical standards and corrective action requirements for owners and operators of underground storage tanks. Includes exemptions to the standards. This information will be slightly useful, but not a lot of information.

"Code of Federal Regulations, US Code Title 40, Code of Federal Regulations" Section 281. n.d. <http://frwebgate.access.gpo.gov/cgi-bin/get cfr.cgi?TITLE=40&PART=281&SECTION=10&TYPE=TEXT> (20 September 2001)

Commentary: Similar to above. Approval of state underground storage tanks programs, not much information.

"Code of Federal Regulations, US Code Title 40, Code of Federal Regulations", Part 282, n.d. <http://frwebgate.access.gpo.gov/cgi-bin/get cfr.cgi?TITLE=40&PART=282&SECTION=10&TYPE=TEXT> 20 September 2001)

Commentary: Same as above, approval of underground storage tank programs, not much information.

Massachusetts Department of Revenue, "Regulations on USTs", n.d. <http://www.dor.state.ma.us/ust/ust_home.htm>

Commentary: Listing of Mass regulations and programs relating to USTs. Includes Grant requests, grant approvals, claims, compliance reports, meeting schedules, and eligibility. General info, but not a lot of specifics.

Mass State Building Code, "780 CMR: State Board of Building Regulations and Standards", Section 18.2 and 18.3 (28 February 1997)

Commentary: State regulations and specifications for storage tanks. Includes information relating to liquid handling, storage, and containment, tank protection, and ventilation. Does not go into specific detail for Under Ground Storage Tanks (USTs). This resource will not be very useful.

Occupational Safety and Health Administration (OSHA), "Application for Renewal and Expansion of Recognition". Federal Register # 63:69676-69683 (17 December 1998)

Commentary: Information about Intertek Testing Service Regulations. Useful information about requirements to get safety standards renewed. OSHA concentrates more on the employee safety aspect rather than the mechanics of the tanks.

Office of Hazardous Materials Safety, United States, Department of Transportation's Research and Special Programs Administration, "HAZMAT Safety," 22 January 2002

Commentary: Materials Safety information, useful for all the chemicals stored in USTs. This information will be used to show the dangers of neglecting tanks.

PI Associates Inc. "Handbook of underground storage tank safety and corrective Technology", Science Information Resource Center, 1988

Commentary: EPA sponsored study of technologies relating to USTs. That sums it up, really. More info will appear later, because we will probably use this source later, but we haven't referenced it yet.

"Standard Guide for Three methods of assessing buried steel tanks.", Annual Book of ASTM Standards, 2001, volume 03.02. ASTM Designation SG158-98.

Commentary: Marginally relevant to project, gives specifics for doing inspections. Not useful as of yet, but good to know it exists for later.

U.S. Environmental Protection Agency, Office of Underground Storage Tanks,

"Underground Storage Tank Program", n.d., <http://www.epa.gov/OUST/>
Commentary: EPA's regulations and programs dealing with UST's. The site summarizes the federal laws and regulations. There is a lot of useful information.

A 3) Methodology Sources

The following sources give us some ideas on how the current BFD UST control process works and were equally used in our Methodology section.

Camp, Dresser and McKee Federal Systems, Inc . "Underground Storage Tank Locations.", n.d., <http://www.state.ma.us/mgis/ust.htm>
Commentary: GIS maps of tank locations in Massachusetts. The maps are not available for public download for safety reasons, we're looking into requesting special permission to view them, and a lot of time will be saved if we can get permission.

Department of Fire Services, "US Query Tool" < http://db.state.ma.us/Dfs/ustQueryPage.asp>
Commentary: Querying tool used to look up UST information within the state of Massachusetts. This will be useful when we create our own query system.

Environmental Protection Agency, "Operating and Maintaining Underground Storage Tank Systems," Washington, D.C., August 2000, p. 1-49.
Commentary: Practical help and checklists, written for tank owners and managers to help them keep organized. Gives guidelines for what records to keep and also gives the information for each state for whom to contact if they have questions about UST management.

Ken Woodard and David Moorefield, " Underground Storage Tanks," n.d., <http://www.cee.vt.edu/program_areas/environmental/teach/gwprimer/ustsdmkw/ustpage.html Comm entary: Technical diagram of an underground storage tank. Displays many types of monitoring devices.

Massachusetts Department of Fire Services, Office of the State Fire Marshal, "Massachusetts UST registry query.", n.d., <http://db.state.ma.us/Dfs/ustQueryPage.asp>
Commentary: Web based search of state data base holding all licensed UST's, USEFUL for when we have to look at different parts of the City of Boston.

New England Interstate Water Pollution Control Commission, "Tank Closure Without Tears: An Inspector's Safety Guide." Boston, MA, May 1988, p. 1-18.
Commentary: Explanations of closure procedures, including diffusing, venting, and the dangers of ignition. Makes multiple mentions of the Fuel Triangle, which made up of Fuel, Oxygen and Fire because they all feed off of each other. Focused on safety procedures and accident prevention.

Underground Storage Tank Regulatory Compliance Unit, "Doing Inventory Control Right For Underground Storage Tanks," Boston, MA, p. 1-17.

Commentary: Reminds owners about safety procedures for leak detection. This helps owners to keep more accurate records about delivery, in/out flow, and more frequent leak detection.

City of Boston, "Storage Tank Building Permitting and Licensing Requirements".< http://www.uos.harvard.edu/ehs/enviro/BostonTankPermitting.pdf>

Commentary: Information on the permitting and licensing requirement within the City of Boston. It states which one is needed, who to contact, and when to reapply.

Appendix B, UST Laws and Regulations

This appendix gives a summary of the Federal and State laws governing USTs.

B 1) CFR Title 40, Part 282 – EPA Approved State programs

The Code of Federal Regulations(CFR) Title 40, Part 282 lists all state UST programs that have been approved by the EPA under CFR Title 40, Part 281. Twenty-eight states currently have approved state UST programs. Massachusetts is one of those states. It's approved state program application lists all the statutes and regulations that pertain to USTs. The Massachusetts state program is one of the few that goes 'above and beyond' the EPA's minimum requirements, to specify more stringent requirements and procedures for USTs [11].

B 2) CFR Title 40, Part 280 – EPA technical regulations for USTs

CFR Title 40, Part 280 describes the technical regulations for underground storage tanks (USTs). To prevent releases one must protect against spills, overfills, and corrosions.

Spills usually occur during delivery due to human error. A spill occurs when the filling hoses from the deliverer are removed from the filling pipe. To contain the spills, catch basins have become a required attachment to tank filling systems. The owner must periodically empty theses basins.

Overfills are another problem that can occur during delivery. As a tank becomes over-full, large volumes of material may seep out at the fill and vent pipes. To prevent against overfills, any or all of the following three devices should be used: automatic shutoff devices, overfill alarms, and ball float valves.

Corrosion is the process by which material breaks down over time, and looses some of its desired qualities. In the case of USTs this means the tanks are likely to develop leaks as the material they are made from weakens. To protect against corrosion, the tank and its piping must be made of non corrodible material, the tank must be made of steel which has a corrosion-resistant coating and have cathodic protection, or be made of steel clad with a thick layer of non corrodible material [12].

[11] Code of Federal Regulations, US Code Title 40, Code of Federal Regulations", Part 282,

[12] "Code of Federal Regulations, US Code Title 40, Code of Federal Regulations",

B 3) CFR Title 40, Part 281 – EPA State program objective

Detection releases are important in discovering leaks early before the contamination spreads. Three basic requirements must be present in UST systems, which include both the tank and pipes. A leak detection device is a requirement for any UST system that contains petroleum. The requirements stat that the leak detection device must be installed, calibrated, operated, and maintained according to the manufacturer's instructions, and the leak detection device must meet requirements in the federal regulations.

B 4) 527 CMR 9.00 – State regulations of USTs

The Massachusetts state regulations of storage tanks, including USTs, provided the basis for all city and town programs that deal with storage tanks. While the regulation is done on the state level, and such regulation is certified at the federal level, enforcement is preformed at the local level.

The Code of Massachusetts Regulations (CMR) 9.00 provides a complete view of the State level program for storage tank management. Every step of the life cycle of a tank is detailed, along with the relevant safety precautions that should be taken. The approach this body of regulation takes to dealing with storage tanks is public safety first. Most of the regulations and specifications are systems designed to prevent, detect, the control leaks. Also included in this regulation are the procedures to be followed in reporting leaks, although cleanup procedures are not detailed [13].

B 5) MGL – Chapter 148

The Massachusetts General Law (MGL), Chapter 148 details the requirements of what the state will regulate pertaining to fire prevention. These regulations are referenced in many places though out the rest of the MGL, as this is the section that gives the state the power to regulate fire prevention. Section 38 of this chapter details what regulations the state must have in place regarding storage tanks, both above and belowground. The state is required to establish permitting systems, in addition to rules to govern the cleanup and containment of spills.

Section 280.

[13] Department of Fire Services, "527 CMR: Board of Fire Prevention Regulations,"

B 6) MGL – Chapter 21E

MGL, Chapter 21E deals with the release of hazardous materials. The definition of what materials are covered by this regulation is given elsewhere in Massachusetts General Law. The first sections of the chapter deal with the detection of releases, and who is liable for releases. This liability falls to the owner of the tank. If the owner of the tank does not operate the tank then the operator of the tank becomes responsible. The possible exception to this is the case when a release is caused by a delivery service, in which case the responsibility may fall on the delivery company.

The next sections detail the procedures for containment of a release, which will not be detailed here, as hazardous material containment practices are out side the scope of this project. Then the issue of what organizations have jurisdiction is detailed. The basic structure is that the local fir department owns the seen but the State and Federal EPA's do the investigation and supervise the clean up. Finally the brown field program is discussed, as it is the final step in reclaiming hazardous waste spill sites . This section will not be discussed in length because brown fields are largely beyond the scope of this project[14].

B 7) Federal Supervision of State regulation of USTs.

The U.S. Environmental Protection Agency (EPA) is a federal government agency provided to protect human health and to safeguard the natural environment. Since USTs have been found to damage the environment and cause illness to humans by leaking hazardous material into the soil, the EPA has taken course of actions. The organization has created the Office of Underground Storage Tanks (OUST) within the agency to be solely responsible for USTs. It has also written regulations to control USTs. Knowing that state and local governments are in the best position to oversee USTs, the EPA's main role is to assist states in implementing their own UST program using their regulations as a minimum. Once a state has accomplished this, the EPA becomes the supervisor.

B 8) Contamination clean up from UST spills

The Massachusetts Department of Environmental Protection (DEP) is a state agency provided by the state to protect human health and the environment. The Bureau of Waste Site Cleanup was

[14] General Laws of Massachusetts, "CHAPTER 21E: MASSACHUSETTS OIL AND HAZARDOUS MATERIAL RELEASE PREVENTION AND RESPONSE ACT,"

created within the DEP to be solely responsible for responding to hazardous waste sites and spills. When the owner of a UST has determined, based upon the guidelines set forth in the Massachusetts general code, that a UST has leaked, the local fire department and the DEP must be notified within twenty four hours. The DEP will coordinate cleanup efforts, while the local fire department will be responsible for the immediate containment of the spill.

B 9) UST Documents

The permit for installation is not city specific. FP-290 is a form that the Department of Fire Services, Executive Office of Public Safety requires for all tanks put into operation on or after 1 January 1991 (Appendix B-3). A copy of the Notification for Storage Tanks must be sent to the Boston Fire Department (BFD) within 30 days. There is a $25,000 fine for any tank that does not complete this procedure. Information in the document includes ownership and location of the tanks, along with data about what the tank will be used for. The document has to be signed by the Captain of the Boston Fire Department prior to tank installation.

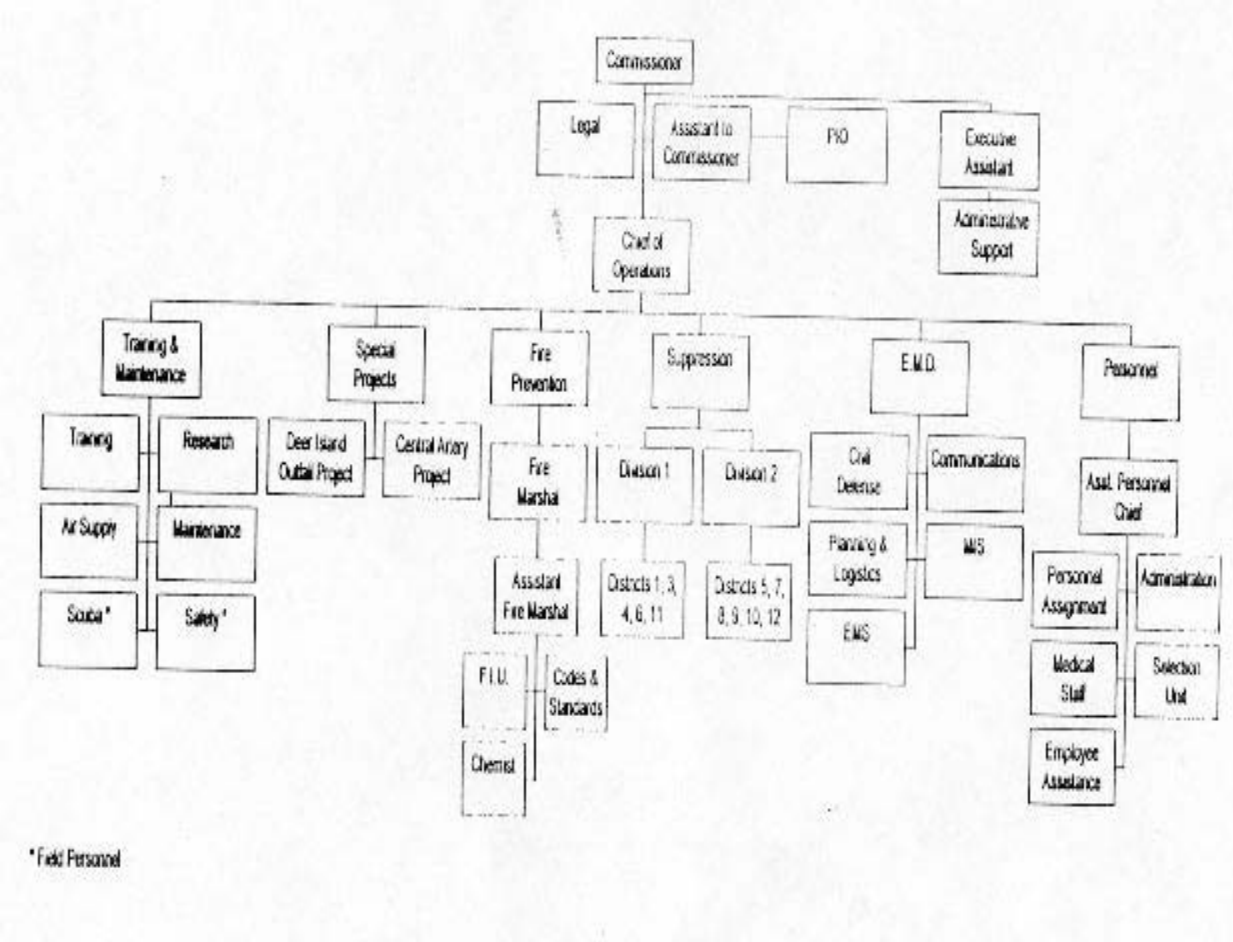
The second document that is required for installation of a storage tank in Boston is the Permit to Install/Modify Storage Tanks. This document goes to the Special Hazards Division of the BFD. It includes location and owner information and is signed by the Captain of the BFD. The permit must remain posted on the premises until installation is complete.

For removal of a disabled tank, an Application and Permit (FP-282) must be submitted to the Boston Fire Department (Appendix B-2). The form is regulated by the Department of Fire Services – Board of Fire Protection, and the BFD retains the original application. The application contains not only tank and owner information, but includes removal contractor information and contamination assessment. This procedure needs to be approved by the City and issued a permit number before removal can occur.

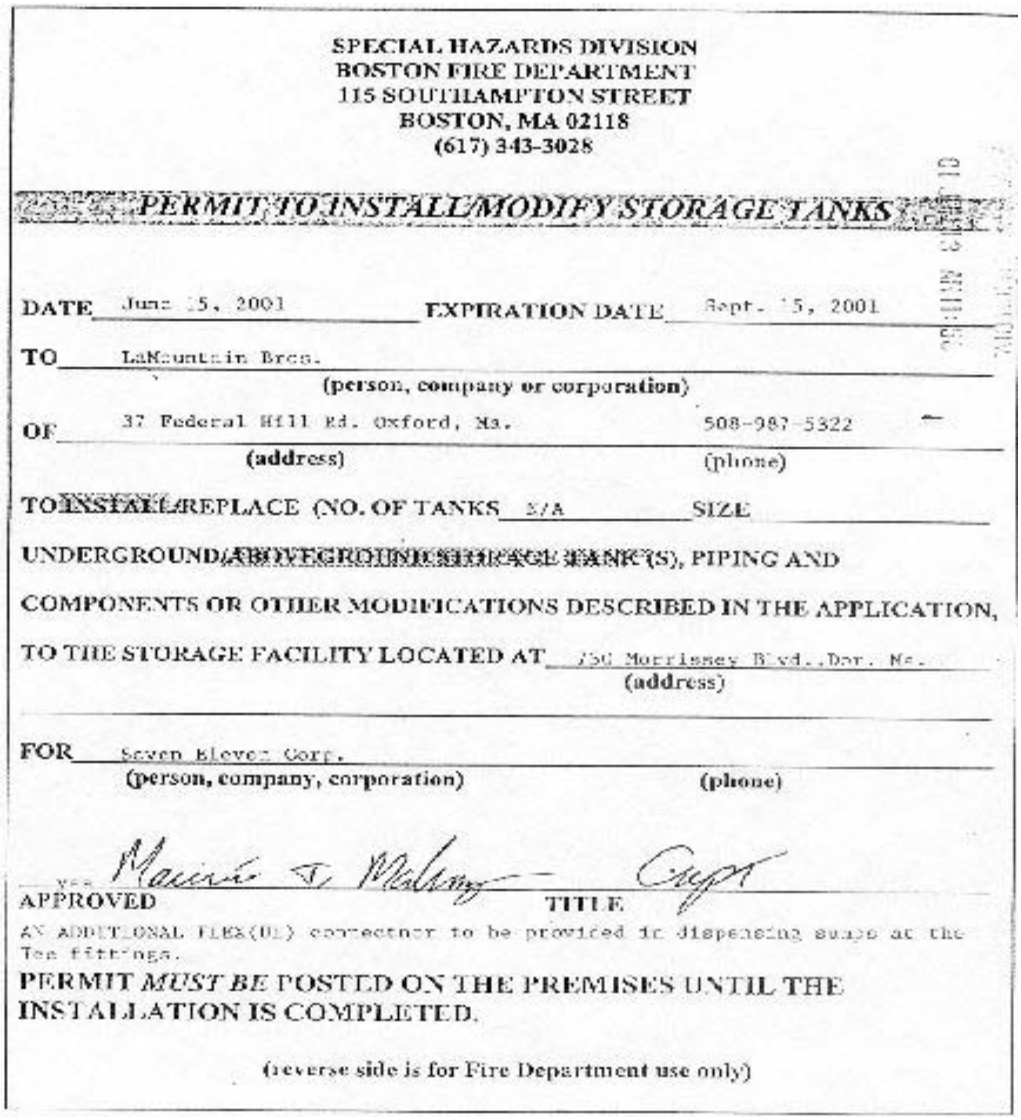
The second document required for removal of a tank is FP-292R. This form is similar to FP-290. The notification must be filed before the procedure is completed. The tank and the surrounding area must be checked for contamination prior to removal, and the process must be approved by the BFD

Appendix C, Permits and Forms

C1. Boston Fire Department Organization



C2. Permit to Install/Modify a Tank



SPECIAL HAZARDS DIVISION
BOSTON FIRE DEPARTMENT
115 SOUTHAMPTON STREET
BOSTON, MA 02118
(617) 343-3028

PERMIT TO INSTALL/MODIFY STORAGE TANKS

DATE June 15, 2001 EXPIRATION DATE Sept. 15, 2001

TO LaMountain Bros.
(person, company or corporation)

OF 37 Federal Hill Rd. Oxford, Ma. 508-987-5322
(address) (phone)

TO ~~INSTALL~~/REPLACE (NO. OF TANKS N/A SIZE

UNDERGROUND/~~ABOVEGROUND~~ STORAGE TANK(S), PIPING AND

COMPONENTS OR OTHER MODIFICATIONS DESCRIBED IN THE APPLICATION,

TO THE STORAGE FACILITY LOCATED AT 750 Morrissey Blvd., Dor. Ma.
(address)

FOR Seven Eleven Corp.
(person, company, corporation) (phone)

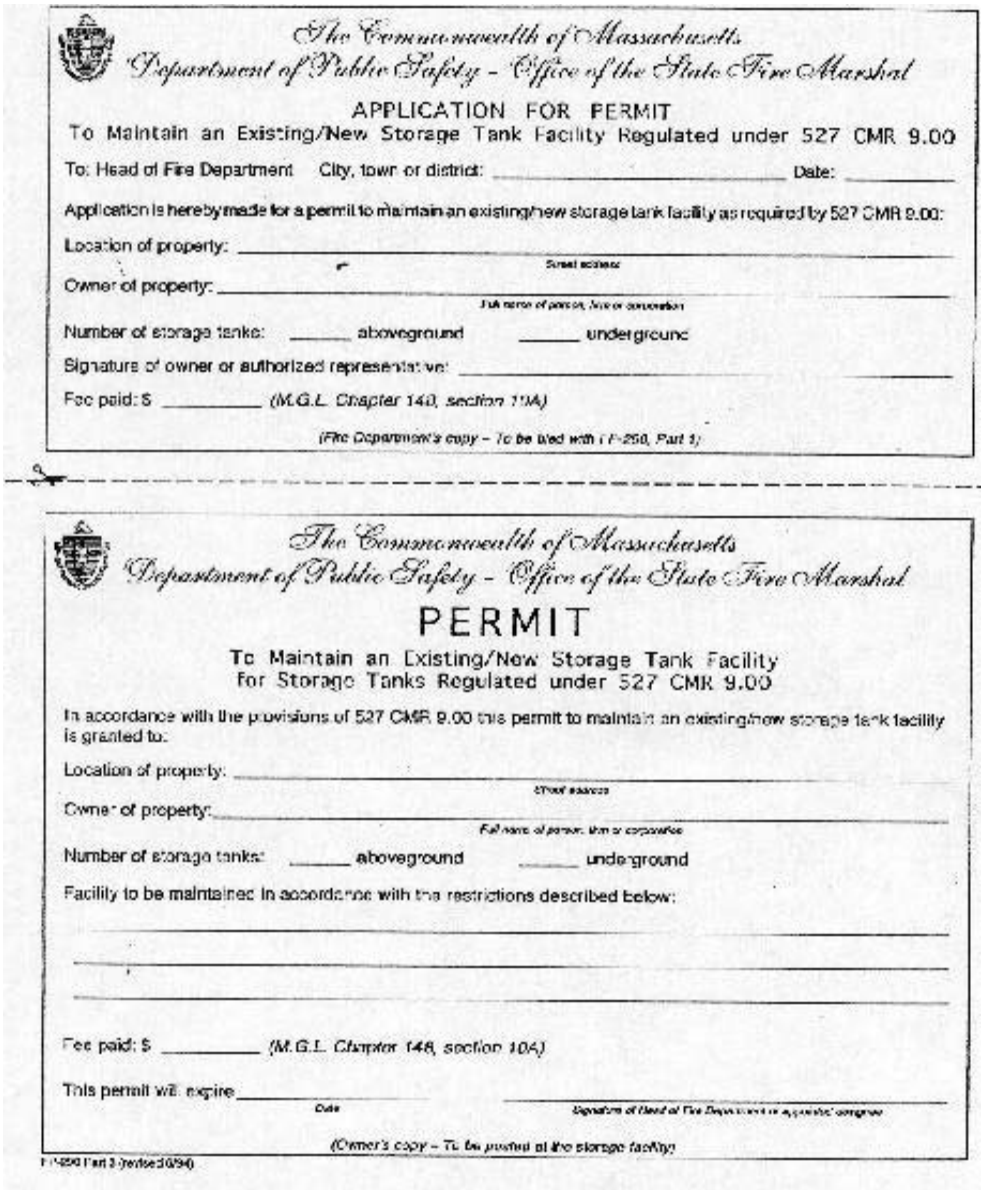
Yes Maurice F. Mahony Capt
APPROVED TITLE

AN ADDITIONAL FLEX(DI) connector to be provided to dispensing pumps at the Tee fittings.

PERMIT *MUST BE* POSTED ON THE PREMISES UNTIL THE INSTALLATION IS COMPLETED.

(reverse side is for Fire Department use only)

C3. Permit to Maintain a Tank Facility



The Commonwealth of Massachusetts
Department of Public Safety – Office of the State Fire Marshal

APPLICATION FOR PERMIT
To Maintain an Existing/New Storage Tank Facility Regulated under 527 CMR 9.00

To: Head of Fire Department City, town or district: _____ Date: _____

Application is hereby made for a permit to maintain an existing/new storage tank facility as required by 527 CMR 9.00:

Location of property: _____
Street address

Owner of property: _____
Full name of person, firm or corporation

Number of storage tanks: _____ aboveground _____ underground

Signature of owner or authorized representative: _____

Fee paid: $ _____ *(M.G.L. Chapter 148, section 10A)*

(Fire Department's copy – To be filed with FP-250, Part 1)

The Commonwealth of Massachusetts
Department of Public Safety – Office of the State Fire Marshal

PERMIT
To Maintain an Existing/New Storage Tank Facility
for Storage Tanks Regulated under 527 CMR 9.00

In accordance with the provisions of 527 CMR 9.00 this permit to maintain an existing/new storage tank facility is granted to:

Location of property: _____
Street address

Owner of property: _____
Full name of person, firm or corporation

Number of storage tanks: _____ aboveground _____ underground

Facility to be maintained in accordance with the restrictions described below:

_____

_____

_____

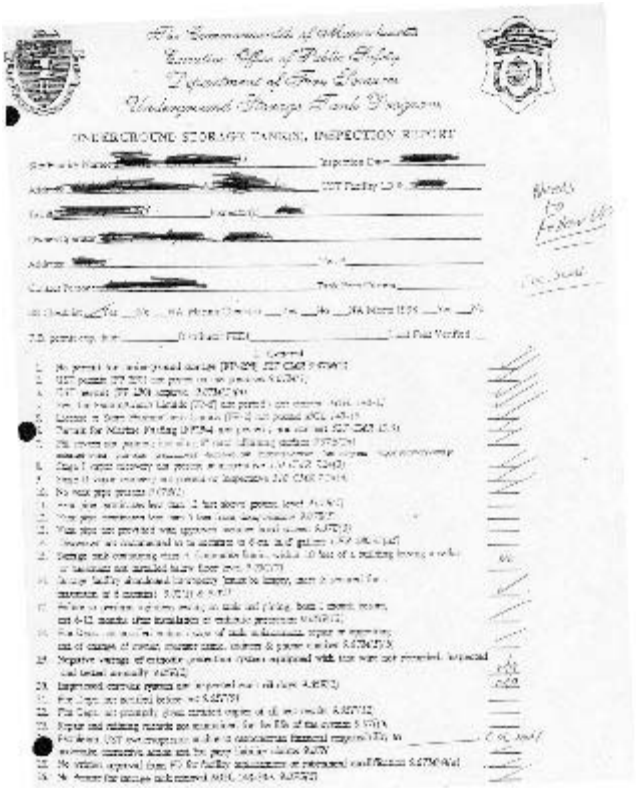
Fee paid: $ _____ *(M.G.L. Chapter 148, section 10A)*

This permit will expire _____ _____
Date Signature of Head of Fire Department or appointed designee

(Owner's copy – To be posted at the storage facility)

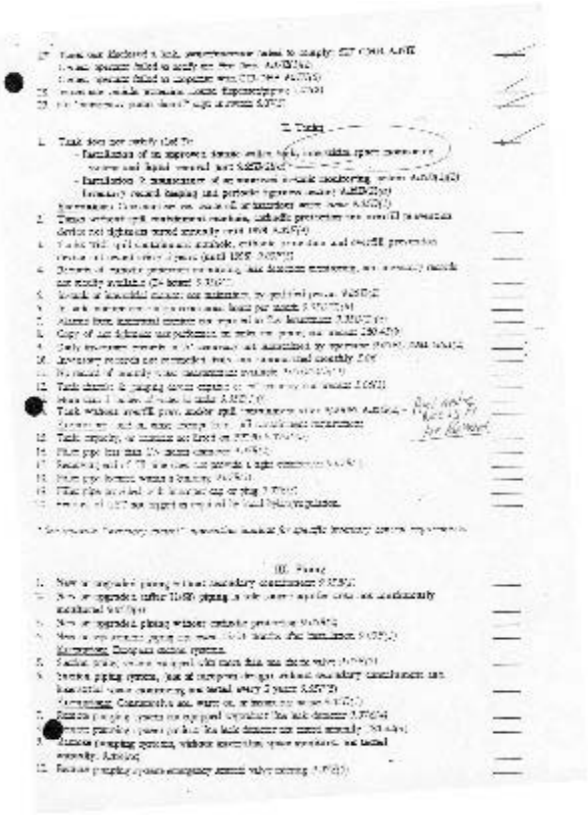
FP-250 Part 2 (revised 6/94)

C4. UST Inspection Report

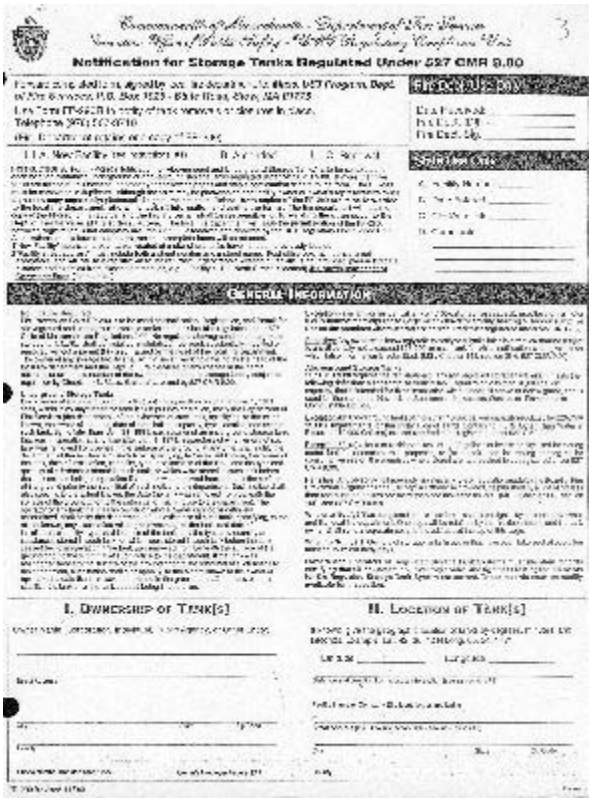


The Commonwealth of Massachusetts
Executive Office of Public Safety
Department of Fire Services
Underground Storage Tank Program

UNDERGROUND STORAGE TANKING, INSPECTION REPORT



C5. FP-290 Notification for UST Maintenance

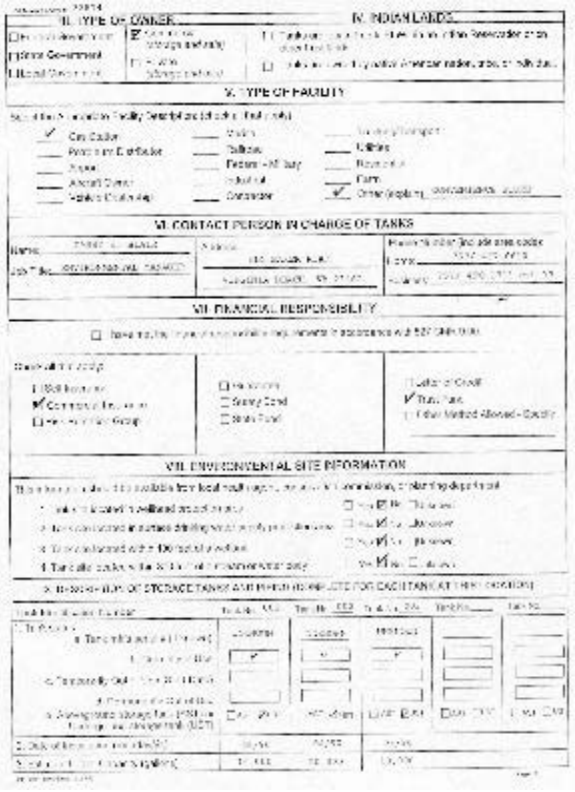


Notification for Storage Tanks Regulated Under 527 CMR 9.00

GENERAL INFORMATION

I. OWNERSHIP OF TANK[S]

II. LOCATION OF TANK[S]



II. TYPE OF OWNER

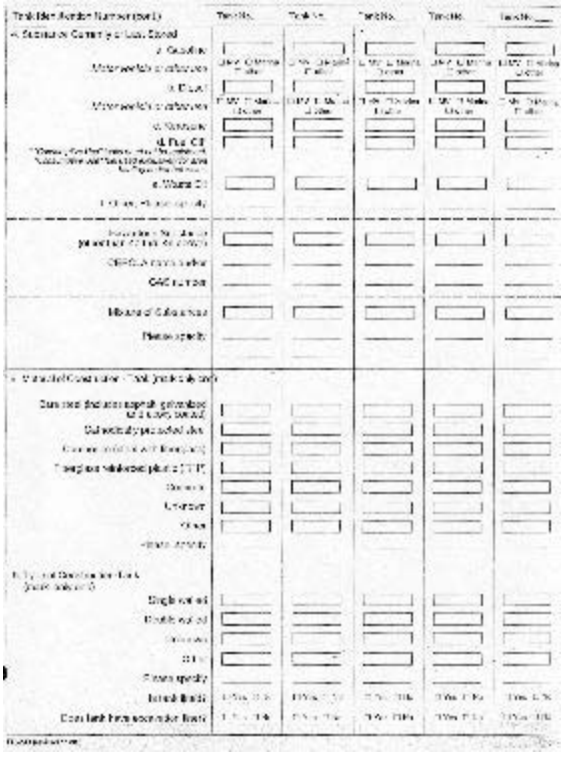
III. INDIAN LANDS

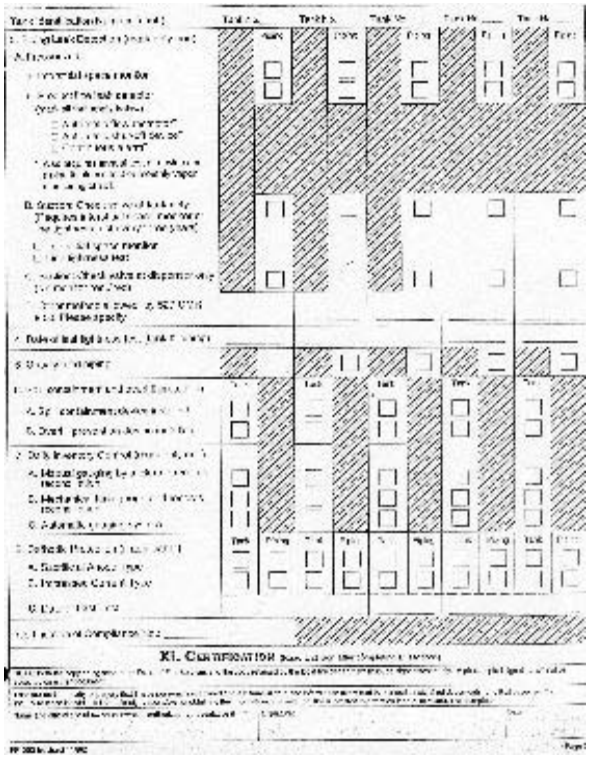
V. TYPE OF FACILITY

VI. CONTACT PERSON IN CHARGE OF TANKS

VII. FINANCIAL RESPONSIBILITY

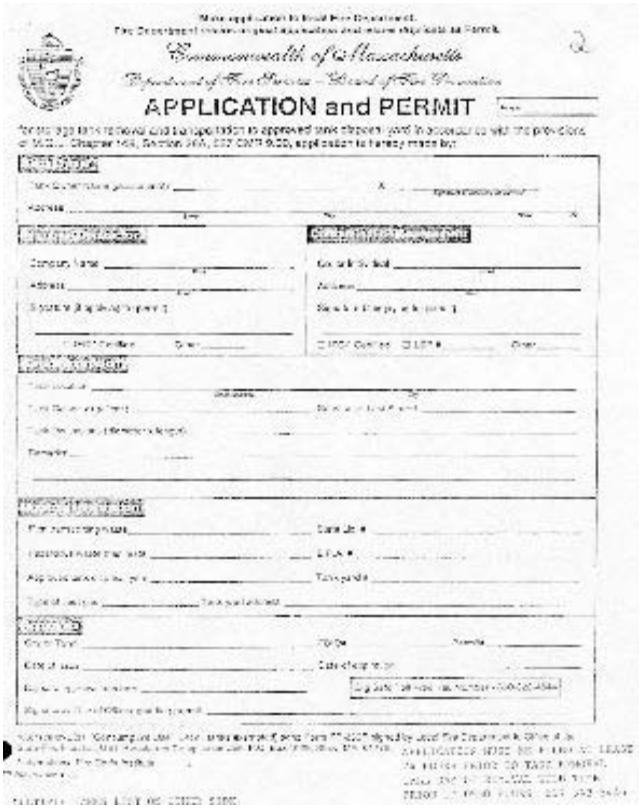
VIII. ENVIRONMENTAL SITE INFORMATION





XI. CERTIFICATION

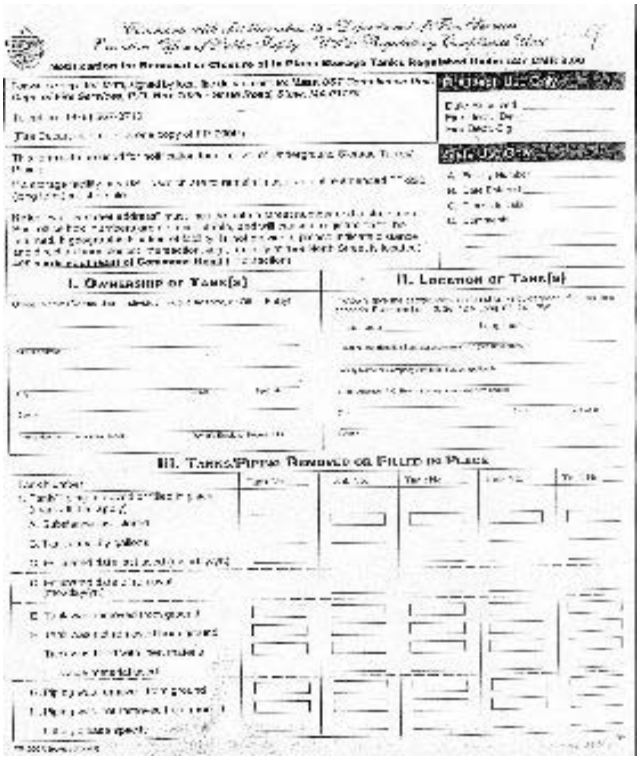
C6. Application and Permit for Removal



Commonwealth of Massachusetts

APPLICATION and PERMIT

C7. FP-290R Notification of UST Removal

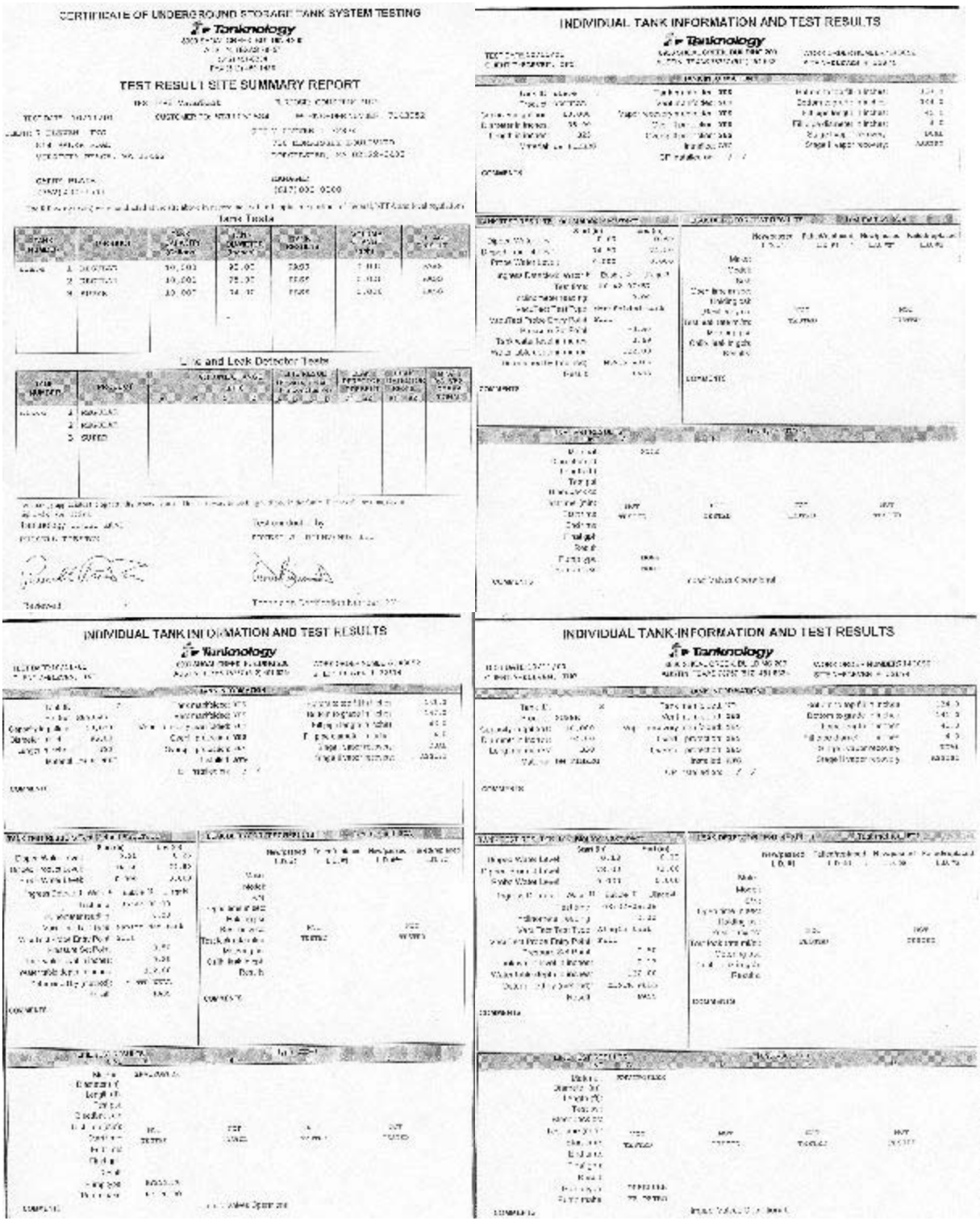


I. Ownership of Tank(s)

II. Location of Tank(s)

III. Tanks/Piping Removed or Filled in Place

C8. Tanknology Inspection Results



CERTIFICATE OF UNDERGROUND STORAGE TANK SYSTEM TESTING

Tanknology

TEST RESULT SITE SUMMARY REPORT

Line Tests

Line and Leak Detector Tests

INDIVIDUAL TANK INFORMATION AND TEST RESULTS

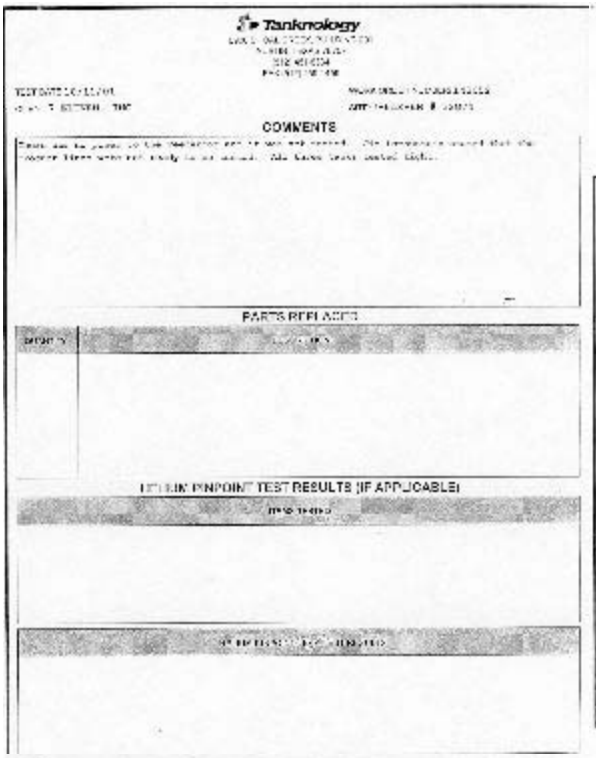
Tanknology

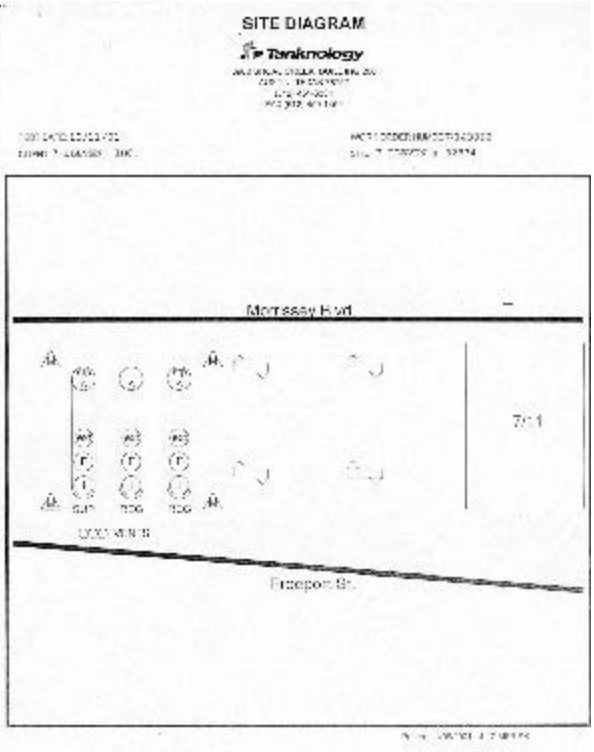
INDIVIDUAL TANK INFORMATION AND TEST RESULTS

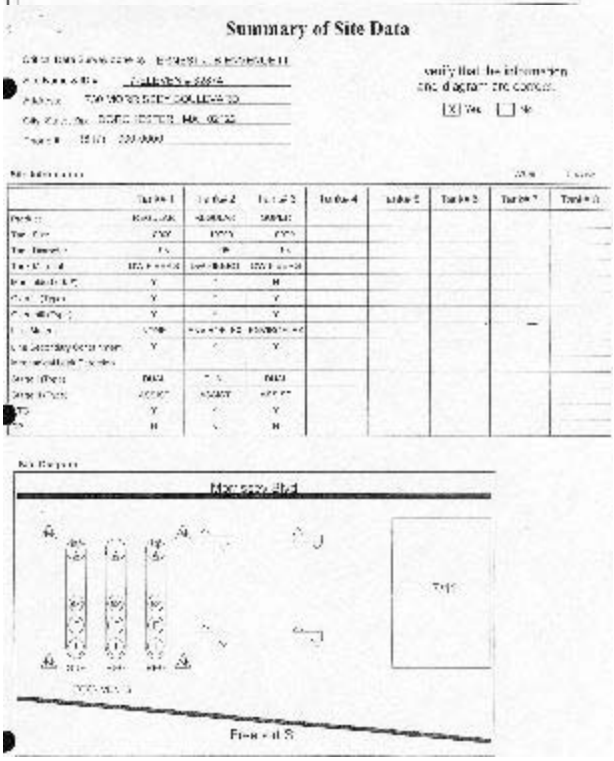
Tanknology

INDIVIDUAL TANK INFORMATION AND TEST RESULTS

Tanknology


Tanknology
COMMENTS
PARTS REPLACED
LIQUID PINPOINT TEST RESULTS (IF APPLICABLE)


SITE DIAGRAM
Tanknology
Mortissey Hwy
Freeport St.


Summary of Site Data
verify that the information
and diagram are correct.
[X] Yes [ ] No

Mortissey Blvd
Freeport St

Appendix D, Sponsor Information

The Boston Fire Department (BFD) was established in 1687, making it the 'First in the Nation'. The BFD has grown to be one of the most modern and best equipped fire departments in the US, providing fire, rescue, and emergency medical services to the citizens of Boston. In addition to providing emergency services the BFD also provides emergency prevention services.

The BFD is organized to provide rapid response. The organizational structure is divided into: two divisions, which are broken down into eleven districts. Each district is composed of several sub-districts, which are organized into companies. Each company is composed of one class of vehicles, so any emergency call will receive response from at least two companies.

Appendix E, Standard Operating Procedure

Introduction

This document will provide a Standard Operating Procedure (SOP) for the Boston Fire Department, for operations involving Underground Storage Tanks(USTs). The procedures set forth in the document should be used as a guide and checklist of steps to be taken during UST operations, and should not be considered the final authority on the matter. This SOP will include sections dedicated to the maintenance and use of a computerized UST tracking system. If such a system is not in use, or if the system in use is different from the system described in this document, the non-computer related sections of this document will still apply.

This document will cover three general areas of operation, and the specific tasks associated with each of them:

1. Record keeping for all UST related activities.
2. Field inspection of UST Installation
3. Field inspection of UST Removal

Information Maintenance

The goal of this section is to ensure that all relevant information, about all UST sites in the city of Boston, is properly maintained and can be later retrieved by BFD personnel. This means that all hardcopy (paper) records should be maintained in a single, central repository, and any files removed from this repository should be promptly returned. Electronic (computerized) records should be updated as soon as new information becomes available, and dates included on all updates to allow temporal reference to the data.

Hardcopy Records

All forms, site plans, applications, and permits should be kept in the site file that will be maintained for each UST site in operation. In the case of permits that are to be displayed on the UST site, a photocopy should be kept in the site file. Any paperwork or forms that are accepted as part of the application or permitting process should be filled out completely, the date and address fields must

be filled out on every form filed, as this information will be needed to properly track the site location and the most recent work done on the site.

Because of the existence of a computerized record keeping system the use of hardcopy records for routine work should be minimized. The reason behind this is: multiple people can access a computerized system at a time, whereas the hardcopy can only be used by one person at a time. Additionally, the speed with which records can be found is much greater then when hard copy records are used.

Electronic Records

Updating the electronic record should be done by the person who is updating the hard copy record. As new information is added to the site file, the electronic record should be updated to reflect the changes. During this process, care must be taken to ensure that the correct site is being updated, and that as much information as is known is entered. Because of issues with maintaining a single up to date version of the UST database care must be taken to ensure that there is only one copy of the database and that only one person can edit it at a time, however this issue is beyond the scope of this SOP. This issue should, however, be addressed by the Information Technology (IT) staff of the group using the UST database.

Requests for Information

All of the information contained within the UST system, both the hard and electronic copies, is public record. As such, any member of the public can come in and request this information. These requests should be initiated by: the individual filling out a request form, indicating which addresses or address range they want information about. The clerk who receives the request should check the Storage Permit, Site License and UST databases to see if there are any records in any of the systems regarding the site(s) in question.

If there are records in the databases for the requested area, the information should be printed out and supplied to the person requesting the information. If the person wants more details then the databases contain about the site, the full paper files should be pulled and photocopied. The original file should never be given to any non-BFD personnel for any reason, to prevent removal of original copies of site information.

Installation Procedure

This section of the SOP will cover the procedures to be followed during the installation or modification of a UST facility. These procedures will include the records that should be kept, and at what stages the electronic record should be updated.

Permit Application

The installation processes starts with the filing of an application for a permit to install or modify a UST. This permit must be accompanied by a full site layout, and design plan. If there are existing tanks on the site, there should also be an application for a permit to remove the existing tanks, if that is necessary (See**:** Removal Procedure). The site plans must be reviewed by an inspector to ensure that it conforms to the pertinent regulations and the manufacture's recommendations for the use of the tanks being installed. If the site plans call for islands of material dispensers there must be vehicle protection in place to prevent damage to the dispensers from vehicles.

Depending on the volume of material stored there may be a license required, this is the tank owner reconcilability to procure. The permit to install or modify should not be issued until the license to store material has been issued.

The person who is installing the tanks, who is the person that the permit will be issued to, must demonstrate certification to install USTs in order to receive an install/modify permit. There are two certifications required of such installers, the first from the tank manufacturer certifying that the installer can work on its tanks, which is required by the State of Massachusetts. The City of Boston also requires all UST installers to be certified by the Board of Examiners to install USTs. The City of Boston certification is documented in Title 9 Section 351, City of Boston Code. The licensed installer must be on site at all times during the installation process, and is the only person on the site with whom BFD personnel should interact.

If the site plans are deemed acceptable and there are no licensing or certification issues, a permit to install or modify a UST is issued and construction can begin.

Installation and Testing

Once construction has begun, there is no BFD involvement until the site is ready to be backfilled. Until the site has been inspected there should be no backfill, or other concealment, around

the USTs. The site inspection should be carried out in accordance with the checklist on the back of the Install/Modify permit. The main points of this inspection are summarized bellow:

- Verify site plans.
- Verify pressure test on tank.
- Check for damage to tank or surface coating.

The pressure testing of the tank must hold pressure for at least three hours, so it is Recommended that time be allowed to pass between the call indicating that the pressure has been applied to the tank, and the arrival of inspection personnel on the site. If there is damage to the tank from installation, the manufacturer of the tank must be contacted to repair the damage. Only the original manufacturer can certify the tank 'good as new' and extend the original warranty to the repaired tank. If the UST and site pass inspection, the site may be backfilled to the top of the tank.

Once the tank has been backfilled, the piping can be installed. Piping should be installed with swing, double elbow or flexible connectors for any bend that changes from the horizontal to the vertical plain, or vice versa. This is necessary to insure that setting of the ground will not cause the pipes to pull apart. The overall grade of the pipes should be pitched back to the tank, so that if system pressure is lost material will drain out of the pipes. When all the piping is in place, another inspection and pressure test must be preformed. The pressure for this test is based on the working pressure of the piping system. After the piping has been inspected, the backfill may be finished and surface work may be done.

Before any material is placed in the tanks, the leak detection systems must be inspected and certified as functional. The exception to this is that water may be placed in the tanks to prevent buoyancy problems, but no hazardous material may be placed in the tanks until proper leak detectors are in place and functional.

Once site inspections for the installation procedure are finished, but before surface work commences, another inspection is required. A precision test of the tank(s) and piping on the site must be preformed, in accordance with NFPA standards, before the inspection, where the results will be reviewed. This inspection should be preformed using the PEI Publication RP100-87 FPR-UST Installation checklist. A full check should be made of the material dispensers, looking for leaks, especially around the crash valves and filters. The tank sumps should be checked for leak detection sensors, which should be confirmed to be operational. Lastly, the leak detection system should be

confirmed to be operational, and if the system supports it, a hard copy status report printed out from the system

After the surface work has been completed a final inspection must be done to ensure that no damage has been done to the dispensers or piping by finish construction. The final site inspection should include:

- Crash valves in dispensers
- Fusible link in dispensers
- Leaking around pipe fittings or filters.

The crash valves and fusible link are both important safety measures in the case of a fire or something impacting and damaging the dispenser. However, both of these devices are frequently wired open, as lower quality models have a high failure rate. This final site inspection should also include a look at the attendant's stations to ensure that they can monitor the dispensers, see: Self Service Considerations for more information about the specific requirements of gas stations and self service stations.

Self Service Considerations

If the UST site is a Self Service gas station, there are additional safety precautions that must be taken before operation can begin. The major improvement that must be made for a self service station is the installation for an area fire suppression system. The plans for the fire suppression system must be submitted for approval with the site plans. Five copies of the fire suppression plans are required, one copy must be sent to the state fire marshal for approval, while another copy is checked locally to ensure that the system is adequate. Once the State Fire Marshal has approved the plans, a letter of approval is sent to the BFD for signature of approval, and then sent back to the State Fire Marshals' office. Both the company and the employees doing the installation must be certified to work on fire suppression systems.

If the plans and the system are appropriate, and the proposed installer is properly certified, the plans are considered approved and a permit to install the fire suppression system is issued. This permit is applied for separately from UST permits by the company that will be performing the suppression system installation.

The fire suppression system will usually consist of the following subsystems:

- A propellant gas cylinder
- Several fire suppression chemical cylinders
- Manual system triggers
- Automatic system triggers
- Fuel flow cut off valves

Once the installation has been finished, the suppression system must be inspected and tested. This testing procedure covers the following subsystems of the fire suppression system:

- Heat Sensors
- Automatic fuel shut off
- Manual fuel shut off
- Low pressure sensor on gas cylinder
- Actuators on chemical cylinders.
- Manual system triggers

If all of these systems, and any other systems that make up the fire suppression system, are functioning properly, based on the manufacturers specifications, the system should be certified as ready to be placed in service. Other aspects of the site that need to be inspected before the permit to operate a self service station include:

- Attendant must have a clear view of pumps.
- There must be a back up viewing system.
- There must be an attendant dedicated to watching the pumps.

The backup viewing system can consist of either mirrors to allow the attendant to see around the pumps and other obstructions, or a Closed Circuit TV (CCTV) system. Which system is required will depend on the distance between the attendant and the fuel pumps. This issue is left largely to the discretion of the Fire Department. The issue of a dedicated attendant arises in the case of a store that is also operating the self service station. One of the employees must not be distracted with matters inside the store, to pay attention to the customers pumping fuel.

If everything on the site is deemed to be in proper operating condition a permit to operate a self service station should be issued. This permit is good for one year, then must be renewed, and

should be issued with an expiration date in June. This means that a permit for a few months more or less then a year may need to be issued to bring a new site into the rotation of permits expiring in June.

Removal Procedure

The process of removing a UST starts with an application to remove a storage tank. This application includes the scrap yard that will receive the tank, and the company that will dispose of any material left in the tank. Also included is the exact number of tanks to be removed, and a list of the materials stored in them. The scrap yard and the waist disposal company both must be appropriately licensed to handle the materials they will be receiving. In the case of the scrap yard, this license comes from the State Fire Marshal, unless the facility is inside the City of Boston, in which case it is also licensed by the BFD.

If the application is in order, an inspection of the site should be made, to ensure that the proper steps are being taken to ensure a safe removal. A Licensed Site Professional (LSP) must take at least three soil samples from the site for analysis of possible contamination. The exact number will depend on the size of the site. In the presence of a Fire Dept. Officer, meter readings of the atmosphere inside the tank must be taken to ensure its safety. If an entry into the tank is planned, there must be at least 21% Oxygen by volume inside the tank, and proper protective gear should be used, thought this is outside the program of the BFD to enforce. Regardless of entry, the concentration of chemical vapors inside the tank must be lower then 10% of the Lower Explosive Limit of the material that was stored in the tank. If these conditions are in place a permit to remove the tank(s) should be issued, and the tanks removed.

Once the tank has been removed, there is a 72-hour period for the BFD to receive a receipt from the scrap yard receiving the tank, indicating that it got the tank. Once the scrap yard has received the tank, there is a 24-hour period for the scrap yard to confirm the destruction of the tank.

If the tank must be cut in place before it can be removed, a Marine Chemist must be hired to inspect the tank and ensure that it is safe for 'hot work'. This certification usually comes with the requirement of an on-site fire watch, and requires a permit from the Fire Chiefs office.

Conclusion

This document is not intended to describe all circumstance and possible procedures that should be followed. However, it is intended to provide an outline of steps that should be taken, and possible situations to look for. If there are site-specific circumstances that complicate this procedure, they should be handled at the discretion of the Fire Inspectors, and this document should be updated to indicate the handling of such situations. In all cases the training and experience of BFD Inspectors should be applied to the procedures and methods described in this document.

Appendix not included
in original submission

IQP/MQP SCANNING PROJECT

Appendix F, Database Manual

Introduction

This document outlines the use of the graphical database interface the project group designed. This document assumes a basic understanding of how to use MS access. The FP-290 form contains all information needed to add records.

Navigation

To flip through all the records in the database, or all the tanks associated with a given site, the standard tab and page selection at the bottom of the tabs are used. The main tab at the bottom of the main page is used to navigate through the sites. The tab under the tank information is used to navigate the tanks on that site shown.

The system can be searched by selecting field(s) in either the tanks or sites tabs, and then using Access's built in find tool to select only the entries that have that parameter. Access's built in filter by form can be used to get the records specified by the criteria selected on the form.

Appending

To enter either a new tank or a new site the far right button on both of the tabs will bring up a black page to input data into. If entering a tank, be sure to enter in a tank number. That number should be the same number indicated by the tank record number at the bottom of the tank information. Once data has been entered the 'Code Update' button should be used to update both site and tank code in the database.

Maintenance

To change a given record, first navigate through the database and locate the desired record. Then change the data needed to be altered. The data is being changed on the database as it is changed on the form.

Anytime data is changed or entered the codes (Tank and Site) which ever was edited, should be updated before the database is updated. This is important to ensure that all automatically generated fields are properly filled.

Special Printouts

"Print Options" opens a form window with selections of printing certain lists of sites. Those include Sites with Licenses, Sites with Expiring Permits, and Self-Service Stations. In order to exit this form, click on the button with the picture of a door.

To print a given record from the system the built in print option should be used. Navigate to the desired page of the database, then press the print button in access.