IN-DEPTH SURVEY REPORT

CONTROL TECHNOLOGY ASSESSMENT OF HAZARDOUS WASTE DISPOSAL OPERATIONS IN CHEMICALS MANUFACTURING

AT

Tennessee Eastman Company
Kingsport, Tennessee

REPORT WRITTEN BY:
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NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
Division of Physical Sciences and Engineering
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Cincinnati, Ohio 45226

PLANT SURVEYED:	Tennessee Eastman Company Kingsport, Tennessee
STANDARD INDUSTRIAL CLASSIFICATION OF PLANT:	Chemical and Allied Products Sector (SIC 28)
SURVEY DATE:	November 8-11, 1982
SURVEY CONDUCTED BY:	Mazen Anastas, Ph.D. Paul E. Caplan William A. Heitbrink
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INTRODUCTION

The Resource Conservation and Recovery Act (RCRA) (PL 94-580) of 1976 was enacted to provide technical and financial assistance for the development of management plans and facilities for the recovery of energy and other resources from discarded materials, for the safe disposal of discarded materials, and for the regulation of hazardous wastes management. Under Subtitle C of RCRA, the Environmental Protection Agency (EPA) was required to promulgate regulations on identification and listing of hazardous wastes and regulations affecting the generators, transporters, and owners/operators of facilities for the treatment, storage, and disposal of hazardous wastes. These regulations appeared in the Federal Register on May 8, 1980. Amendments affecting the listing of hazardous wastes appeared in the Federal Register November 12, 1980.

There are between 35 and 60 million tons of hazardous wastes generated annually, of which about 15 million are generated by industries in the Chemical and Allied Products Sector (SIC 28). These wastes contain toxic substances which may also be carcinogenic, mutagenic, and teratogenic. Some of the companies in SIC 28 treat, store, and dispose of the wastes that they generate. Wastes may also be transported to companies who specialize in the treatment, storage, and disposal of these wastes. This group of companies is classified as "Refuse Systems" (SIC 4953). It is estimated that about 6,200 workers are directly involved in the transportation, treatment, storage, and disposal of hazardous wastes from SIC 28.

There are many companies in both SIC 28 and SIC 4953 which are currently treating and disposing of hazardous wastes from chemicals manufacturing. Many of these companies also have hazard controls in place that are designed to protect the workers from known hazards, both during normal operations and during upsets or emergencies. The objective of this control technology study is to document and disseminate information on effective engineering controls, work practices, monitoring programs, and personal protective equipment. The NIOSH study will result in a technical report which will be designed to assist hazardous waste operators in their efforts to prevent worker exposures to occupational health hazards. Furthermore, an attempt will be made to present a spectrum of available alternatives for hazard control in various treatment and disposal operations.

The implementation of RCRA regulations has created business opportunities in the area of hazardous waste treatment and disposal. This has also created employment opportunities reflected in a steady rise in the number of workers who are involved in the treatment and disposal of hazardous wastes.

The Occupational Safety and Health Act of 1970 (PL 91-596) was enacted to "assure safe and healthful working conditions for men and women." The Act established the National Institute for Occupational Safety and Health (NIOSH) in the Department of Health and Human Services. NIOSH was charged by this Act with the duty and responsibility to conduct research and develop guidance for preventing or reducing exposure of workers to harmful chemical and physical agents. In response to this legislative mandate, NIOSH has conducted major programs to document, develop, and disseminate information regarding the health effects of such agents. To complement these ongoing programs, NIOSH has instituted a major effort to prevent occupational health and safety problems through the assessment and application of hazard control technology in the workplace.

This survey was conducted as part of a NIOSH project to assess and document effective controls in the routine disposal of hazardous wastes from chemicals manufacturing.

AUTHORITY

Two of the main policy objectives of the 1970 Occupational Safety and Health Act (PL 91-596) are to:

- o Encourage employers and employees in their efforts to reduce the number of occupational safety and health hazards at their places of employment, and to stimulate employers and employees to institute new and to perfect existing programs for providing safe and healthful working conditions.
- o Provide for research in the field of occupational safety and health with a view to developing innovative methods, techniques, and approaches for dealing with occupational safety and health.

Under Section 20 of the Act, the Secretary of Health and Human Services is authorized to conduct special research, experiments, and demonstrations relating to occupational safety and health as are necessary to explore new problems including those created by new technology.

Paragraph (d) requires the dissemination of the information obtained to employers and employees.

The National Institute for Occupational Safety and Health was established to perform the functions of the Secretary of Health and Human Services described in Sections 2 and 20 of the Act. The manner in which investigations of places of employment are conducted by NIOSH and its representatives is outlined in the Code of Federal Regulations (Title 42, Part 85a).

PRODUCTS AND MANUFACTURING OPERATIONS

Tennessee Eastman Company (TEC) is a manufacturing unit within the Eastman Chemicals Division of Eastman Kodak Company. In its plant at Kingsport, Tennessee, Eastman manufactures over 350 products in three principal categories: fibers, chemicals, and plastics.

TEC is one of the leading U.S. producers of polyester, acetate, and modacrylic fibers and cellulosic plastics and holds an important position in the manufacture of chemicals. The Kingsport plant produces materials for Kodak's photographic products, fibers, chemicals, and plastics for sale to other manufacturers and processors. Photographic hydroquinone and antioxidants, and inhibitors derived from quinone, are also produced there.

Employment in Eastman organizations in Kingsport exceeds 13,000. The physical plant of Tennessee Eastman Company includes more than 250 buildings on a 670-acre plant site.

The plant at Kingsport was established in 1920 to produce methanol (wood alcohol). The wood distillation process was discontinued in 1945. In 1930, Eastman Kodak transferred to Kingsport its production of cellulose acetate. Cellulose esters are the basic raw materials for making Kodak's safety film; for ESTRON and CHROMSPUN acetate yarns; and Eastman cellulosic plastics, trademarked TENITE, widely used in molded and extruded plastic products. Other products of cellulose esters are ESTRON tow, used in cigarette filter manufacture, UVEX plastic sheeting, and KODACEL plastic film.

KODEL polyester is used in blends for men's and women's apparel, home furnishings, and as fiberfill batting. VEREL modacrylic fiber is used in apparel fabrics, home furnishings, and industrial applications.

Other products manufactured by Tennessee Eastman Company include TENITE polyterephthalate plastics, adhesives, Eastman industrial and agricultural twine, and textile dyes.

Texas Eastman Company, another Eastman Chemicals Division unit, produces alcohols and aldehydes required in large quantities at Kingsport.

HAZARDOUS WASTES

Hazardous wastes generated in tonnage quantities by TEC manufacturing operations fall into four broad categories. They include those that are 1) ignitable, 2) corrosive, 3) reactive, and 4) halogenated and nonhalogenated solvents and/or organic species. The TEC RCRA application also has listings of a variety of hazardous wastes that are generated in relatively small amounts (1 to 1,000 pounds). These consist of specific compounds that are listed in the RCRA regulations.

Company officials explained that TEC has in place a Waste Management System which was designed to safely and effectively handle hazardous wastes. Before a waste is generated in significant quantities, data is compiled on its characteristics (both chemical composition and health effects) and appropriate disposal methods are considered. This review takes place at the pilot stage of development. TEC attempts to anticipate regulation of a given waste (if it is not already listed by Federal and local regulations) by assuming that a limited discharge rate will be imposed in the future.

Within TEC, a catalog of all hazardous wastes from manufacturing operations is maintained. To reduce analytical requirements, process waste streams are characterized and recorded and are mixed with other waste streams only when they are compatible, thus reducing the frequency with which wastes are characterized.

All waste containers are labeled. A typical label is shown in Figure 1. The label has detailed information on the origin of the waste (waste name, building, and phone number) and its sequence number. The latter is used to obtain detailed information on the waste from a computerized data base or computer printout. The label also identifies the method of disposal or disposal site. As can be seen from Figure I, the label contains detailed information on exposure hazards (inhalation and skin), fire hazards, and reactivity hazards. Ratings between 0 and 4 are assigned to each of these hazards and these are written in the appropriate boxes. There is also information on how to avoid or deal with some of the hazards.

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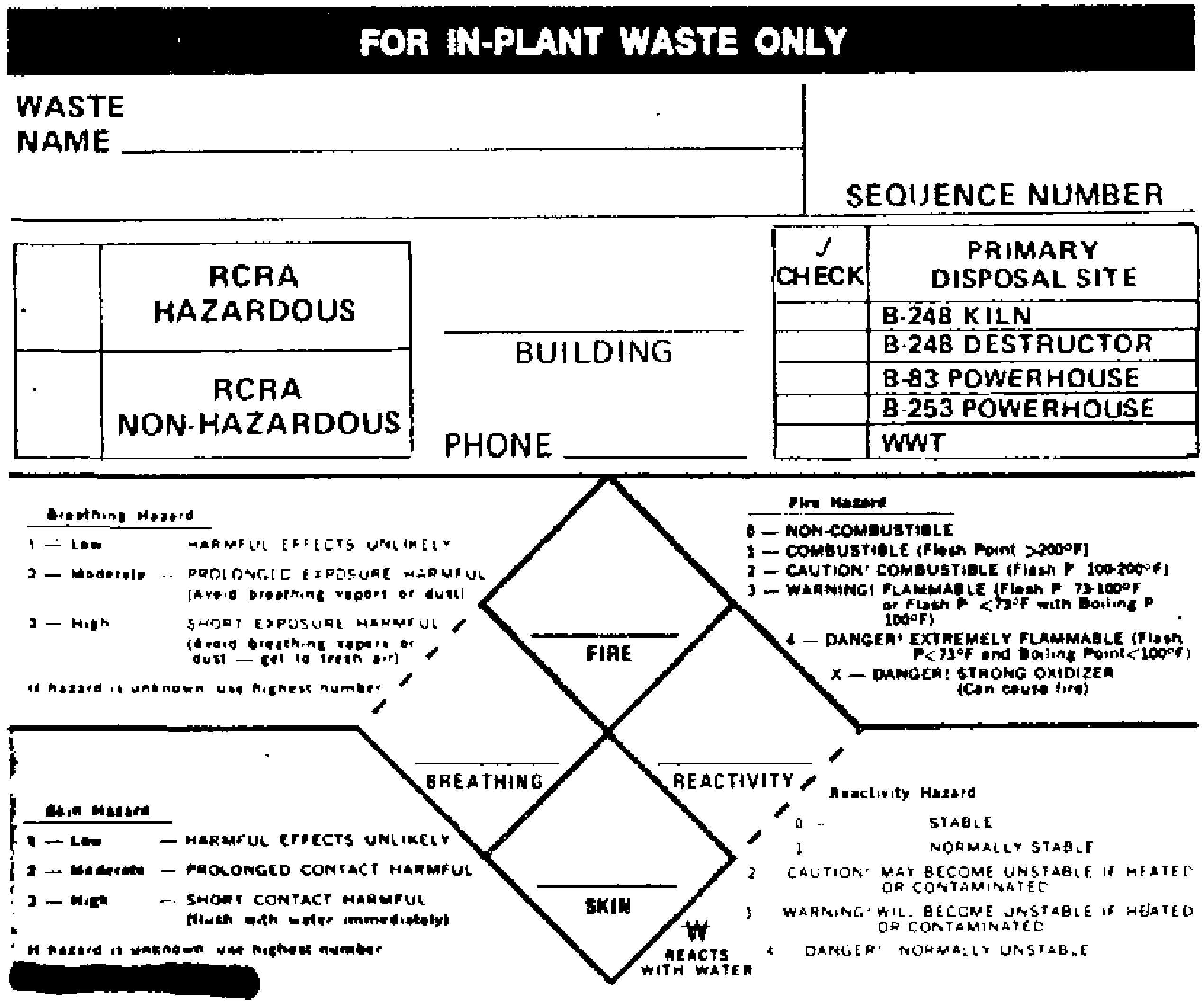

Figure 1 Hazardous Waste Label

HAZARDOUS WASTE INCINERATION OPERATIONS

OVERVIEW

Thermal treatment of hazardous wastes by incineration is carried out in two rotary kilns and one stationary liquid injection incinerator (or liquid chemical destructor). The two rotary kilns are rated at 50 million BTU per hour each. Both are fitted with waste heat boilers and scrubbers. Only 10 percent of the solid waste incinerated is considered hazardous. The balance consists of plant refuse such as off-specification polymers, process residues, cardboard boxes, and paper. Only the rotary kilns were in operation during the NIOSH survey.

Figure 2 is a plan view of the two tank farms, one dumpster pad, one trailer pad, and the solid waste sample bottle disposal areas. Operation of the two rotary kilns is achieved by one control room operator and two "outside" kiln workers who: 1) hook up trucks and dumpsters; 2) push trash into the incinerators; and 3) perform such tasks as starting pumps and taking readings. Supervisory personnel include a chief operator and a foreman. The chief operator's responsibilities include completion of paper work (charts, log sheets, etc.), assigning specific job duties to the kiln workers, and assisting in various duties as needed. Figure 3 is a perspective view of the solid waste and sample bottle feed areas.

Each kiln has five burners. One is for fuel oil and the other four are nozzles for burning waste liquids. The latter are transported to the incinerator site either by 5,000-gallon trailers or 750-gallon portable tanks (or dumpsters). There are provisions for transporting liquids from these mobile tanks directly to the burner nozzles. Stationary tanks are available for temporary storage of waste liquids before disposal in either of the two rotary kilns or the liquid chemical destruction. There are also facilities for handling and temporarily storing wastes originally contained in 55-gallon drums.

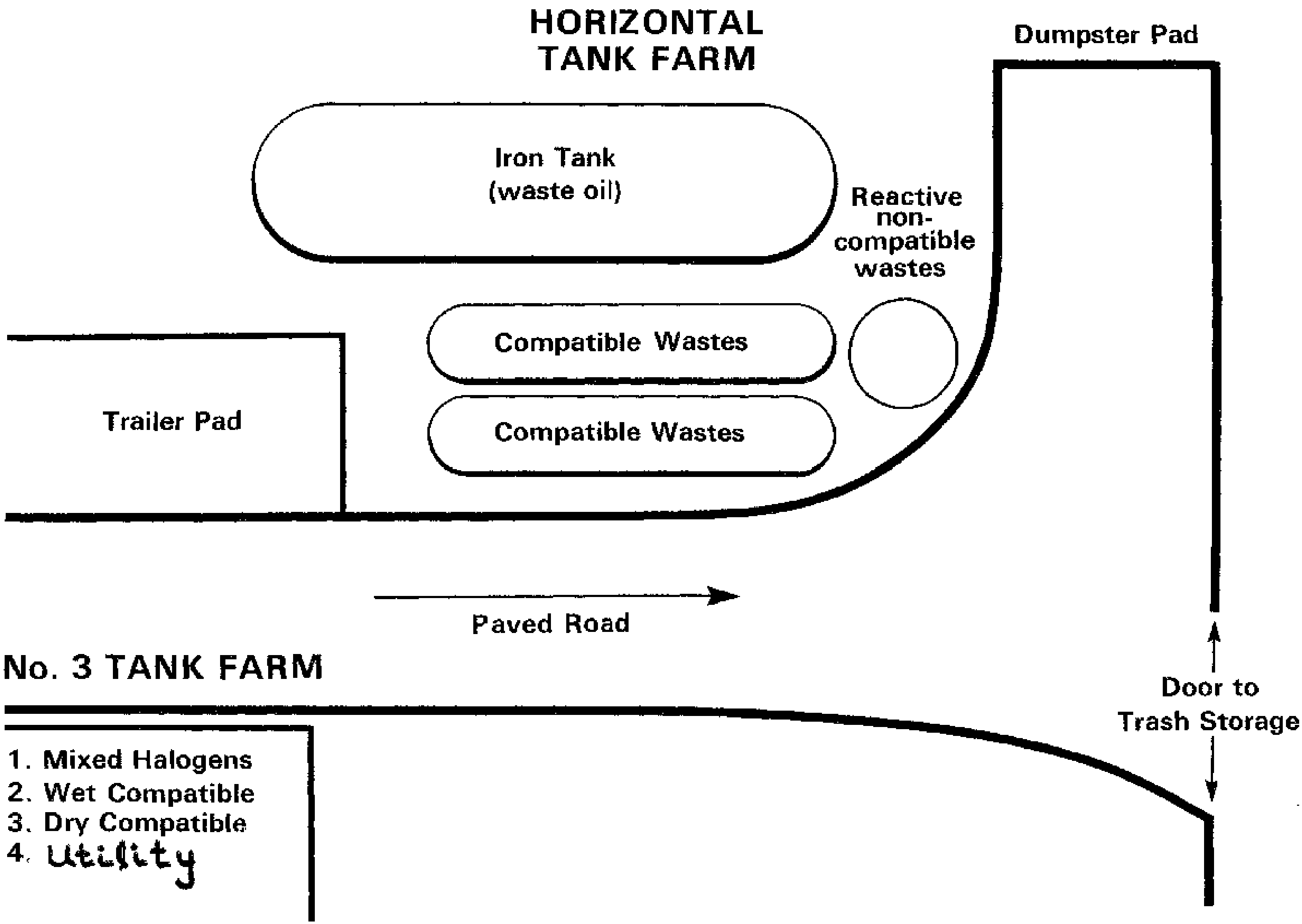

Figure 2 Plan View of Selected Components of the TEC Hazardous Waste Disposal Facility

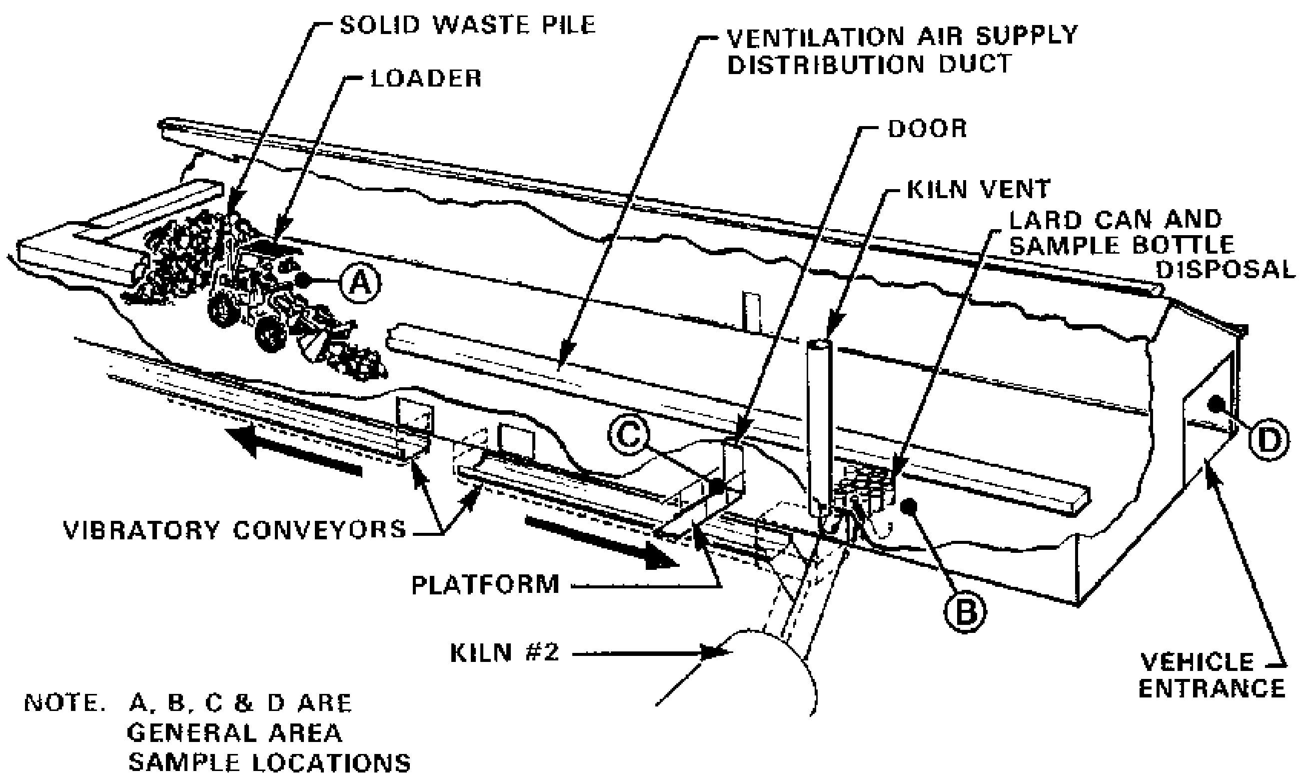

Figure 3 A Schematic View of Solid Waste Disposal and Lard Can and Sample Bottle Disposal Operations

There are two stationary (tank) storage facilities at this site. The No. 3 tank farm consists of four, 20,000-gallon storage tanks that provide fuel for the liquid chemical destructor and the two kilns. Filling, monitoring tank levels, and control of the pumps at this tank farm are the responsibility of the liquid chemical destructor operator. When the two kilns use these tanks as a fuel source, chemical flow, line selection, and block valve control are at the discretion of the kiln operator.

The horizontal tank farm consists of: two 2,500-gallon stainless steel tanks; one 7,000-gallon iron tank; and one 750-gallon reactive chemical tank. Chemicals transported to the site in 55-gallon metal drums are the primary source of chemicals supplying these tanks. General service personnel, under the direction of the chief operator, are responsible for filling these tanks. Tank selection and monitoring of the filling process is assigned to the chief operator. Chemicals from these tanks can be incinerated in either kiln. Pump control, line selection, and chemical routing are the responsibility of the rotary kiln operator.

There are two dumpster pads in service. These pads are used as unloading stations for mobile liquid chemical dumpsters. Line selection, chemical flow, and pump control from these stations are controlled by the rotary kiln operator.

Two trailer pads are used to dispose of "direct burn" trailers. No. 1 trailer pad serves No. 1 kiln and No. 2 trailer pad serves No. 2 kiln. The incinerator worker is responsible for making the appropriate line connections at these stations. The rotary kiln operators are responsible for line selection, pump control, and chemical flow.

The No. 1 trailer unloading pad is also the unloading station for the fuel oil storage tank. This tank is the fuel source for the main burners on No. 1 and No. 2 kilns. Use of this tank as a fuel source is controlled by the rotary kiln operator. Maintaining an operational tank level, pump control, and trailer unloading are also the responsibilities of the rotary kiln operators.

HAZARD ANALYSIS

The TEC incineration operation includes hazard controls for a number of potential hazards. There are potential inhalation and skin exposures to a variety of volatile organic compounds and reactive or corrosive materials with varying permissible exposure limits. Controls have also been implemented for the prevention of fires and explosions resulting from 1) static electricity generated by flowing fluids, 2) inadvertent mixing of incompatible materials, and 3) explosive chemical/air mixtures. There are provisions included in the facility design and its operating procedures to reduce the potential for leaks.

In routine operations, the chief operator and the two kiln workers are most likely to be exposed to chemicals and solid wastes that are handled at the facility. In the case of liquid wastes, the main sources of potential exposure are 1) hooking up and disconnecting dumpsters and trailers, 2) emptying of 55-gallon drums, 3) leaks from piping fittings or pumps, 4) cleanup of line strainers, and 5) handling of solid waste (discarded filter media) with residual solvent.

CHARACTERIZATION OF HAZARD CONTROLS

The hazard controls at the TEC incineration facility were characterized during a 4-day in-depth survey between November 8 and November 11, 1982. The characterization involved 1) air sampling for contaminants that were likely to be present, 2) assessment of work practices and engineering controls and their roles in reducing exposures to contaminants, and 3) observations of the use of personal protective equipment. While the NIOSH team was at the site, the following operations were active at the rotary kiln incinerator: 1) solid waste handling and disposal, 2) direct burning of liquid wastes from dumpsters and trailers, and 3) feeding of sample bottles and fiber drums and lard cans.

Air sampling was conducted over 3 days (November 9 to November 11, 1982) and was performed only during the 7:00 a.m. to 3:00 p.m. shift. Side-by-side sampling was conducted by NIOSH and TEC for both area and personal samples. Because there is a wide variety of chemicals in use at the manufacturing complex and because it was not possible to determine a priori what materials were likely to be disposed of at a given time, the air sampling methods employed were, of necessity, general in nature. Charcoal tubes (100 mg/50 mg) were used to collect nonpolar organic materials and solvents and silica gel tubes (100 mg/50 mg), to collect polar organics such as methanol. Air samples of the order of 10 liters, collected at a rate of 50 cc/min, were deemed adequate. Short-term personal samples were also collected on workers during specific operations such as the connect/disconnect of a trailer or dumpsters. However, these operations were of too short a duration (of the order of a few minutes) for adequate quantitation and qualitation.

Many area samples were used to qualitate the various species. Charcoal tubes (area samples) were analyzed for organic materials using NIOSH Method P&CAM 127. These tubes were desorbed with carbon disulfide spiked with tridecane as an internal standard. Chromatograms were developed using gas chromatography techniques. The column used was a 30 meter DB-1 bonded phase, fused silica capillary column (splitless mode) and the detector was a flame ionization type. All chromatograms from this preliminary analysis were identical and are exemplified by Figure 4. These analyses revealed the presence of very small amounts of acetone, xylene, and toluene.

On November 10, 1982, a faint smell of acetic acid was discernable in the solid waste storage area. Analysis of charcoal tubes confirmed the presence of small but measurable amounts of acetic acid. At this point, it was decided that all charcoal tubes from personal samples should be analyzed for acetic acid since, among the contaminants that were revealed by the qualitative analysis, it had the lowest permissible exposure limit. The samples were analyzed, using NIOSH Method S-169, by desorption with 1 ml formic acid and analyzed by gas chromatography FID using a 6-foot, 1/4-inch glass column packed with 0.3% SP1000/0.3% HyPO on Carbopak A. The limit of detection (LOD) for the method is 6 ug/sample (about 0.2 ppm) and the limit of quantitation (LOQ) is 16 ug per sample (about 0.5 ppm).

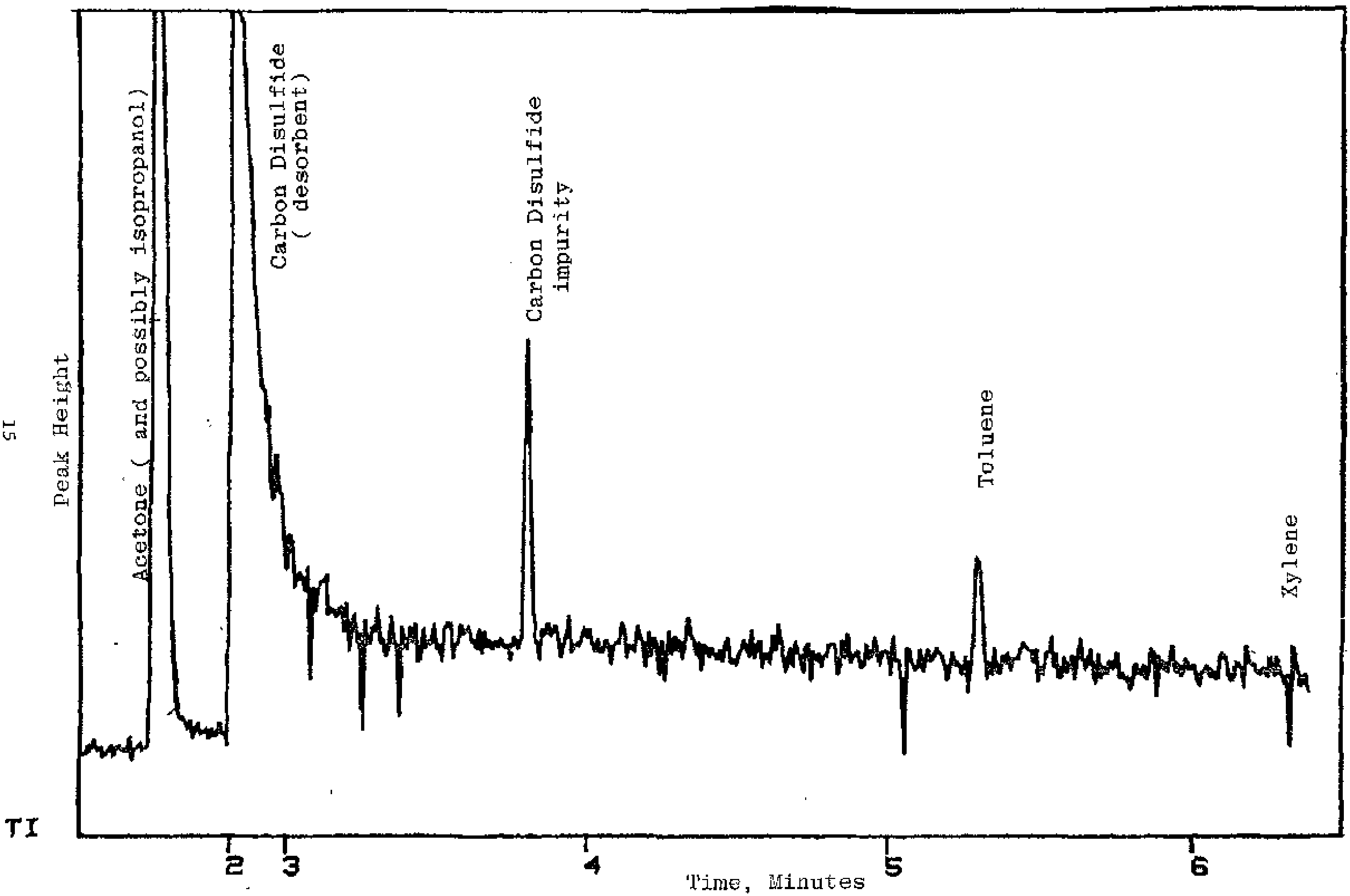

Figure 4 Typical Total Ion Chromatogram From GC/MS Analysis

HAZARD CONTROLS

GENERAL CONSIDERATIONS

Important hazard controls in effect at the TEC incinerators fall into four categories:

1. Engineering Controls - These include ventilation, automation, and other system design features that directly or indirectly contribute to lowering occupational exposures to chemical and physical agents or enhance worker safety (fire and explosion hazards).

2. Training and Education Programs - Effective programs result in work practices which significantly minimize the potential hazards associated with the worker's performance of his job. These programs may include on-the-job training and formal and specialized training inside or outside the company.

3. Monitoring - This includes both environmental and medical monitoring of the employee and observation of the employees in the workplace to assure management that job duties are performed in a safe manner.

4. Personal Protective Equipment - Equipment is provided to the employees and used to either further reduce or completely eliminate exposure to hazards.

ENGINEERING CONTROLS

The TEC incineration facility has been designed to handle a wide variety of wastes with respect to physical properties (consistency and state), and chemical and toxicological properties. The flexibility built into the design and operation is such that, except for hazardous wastes in drums, incoming wastes (trailers, dumpsters, and lard cans and sample bottles) may be directly disposed of into either the kilns or the liquid chemical destructor. This flexibility is viewed as an engineering control since it reduces the number of transfer operations of the wastes and eliminates the potential hazards associated with mixing incompatible materials in storage tanks. Also built into the system are process control schemes and devices which reduce the potential for small or large leaks and spills while liquid wastes are being transferred to the kilns for disposal.

Each kiln has four waste burners and nine possible sources of hazardous wastes. These are 1) trailer sludges and liquids (2 sources), 2) dumpster liquids, sludges, and diketene (DK) sludges (3 sources), 3) reactive chemicals, waste oils, and compatible waste chemicals from the horizontal tank farm (2 sources), and 4) wet wastes, dry wastes, and mixed halogens from the "No. 3" tank farms (2 sources). Even though the No. 3 tank farm represents only 2 sources of waste at any given time, a switching station which consists of flexible hoses and quick connect/disconnect fittings permits disposal of wastes from the utility, mixed halogen, wet compatible, and dry compatible wastes from that tank farm.

Two other switching stations facilitate disposal of wastes from the nine sources mentioned above as needed.

The discussion of engineering controls will be organized by group or type of waste as follows:

- Trailers
- Dumpsters
- Tank farms
- Sample bottle and lard cans
- Solid waste (trash)

Trailers

As mentioned earlier, trailers containing liquids or sludges are brought to either one of two pads. Figure 5 is a photograph of an "insulated" trailer at pad No. 2. Before line connections are made by one of the kiln workers, the hazardous waste permit is taken to the control room for inspection by the operator. The latter decides which suction lines/burner combinations to use.

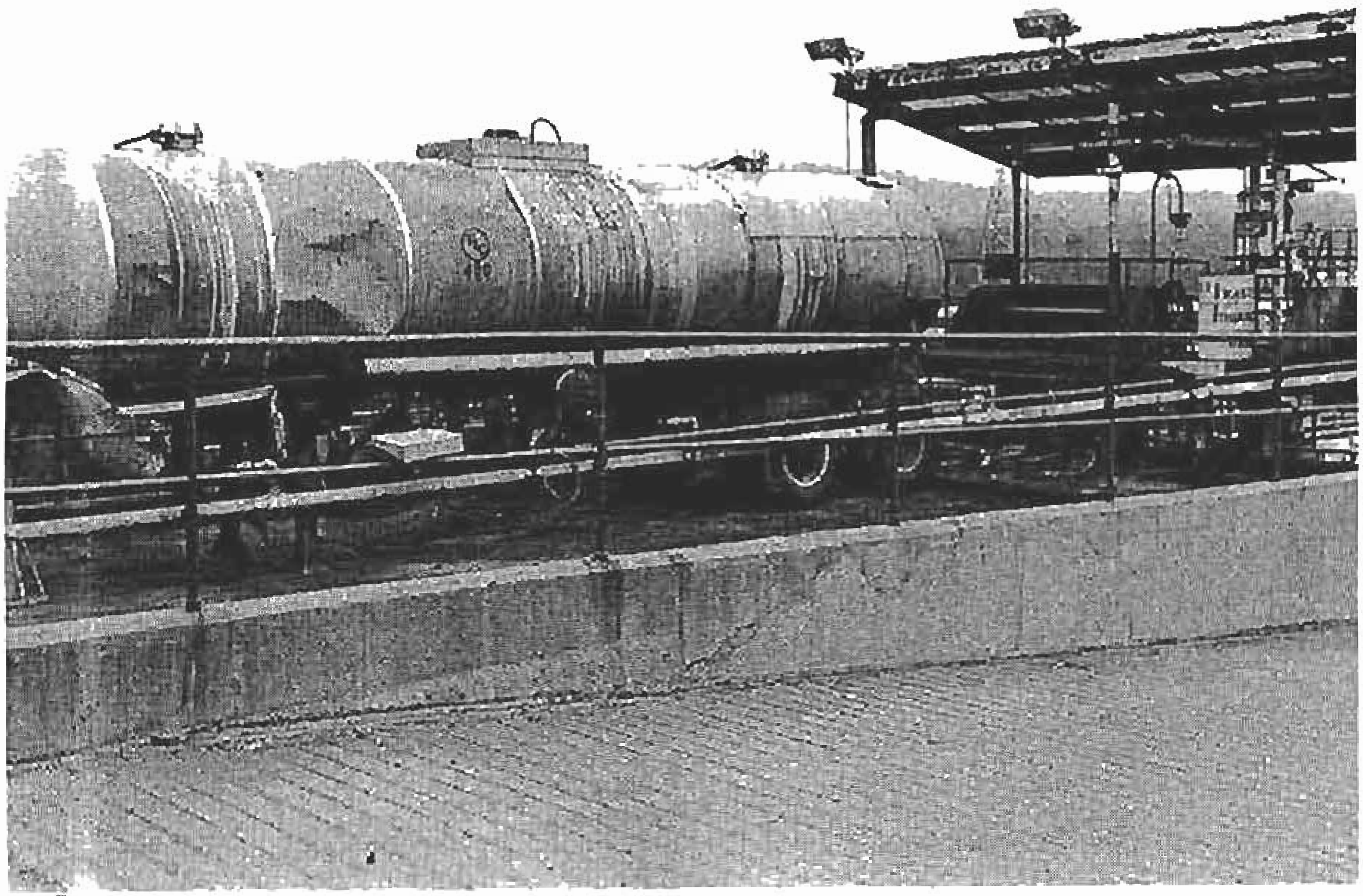
Figure 5 View of Trailer Pad No. 2

The kiln worker then returns to the trailer pad and makes these connections. A ground wire is first attached to a metal part on the trailer body. A flexible hose (which has previously been steamed) with appropriate fittings is attached to the trailer at one end and to the appropriate fitting (liquid or sludge) at the other end. The suction and supply lines for both liquids and sludges (and the respective instrumentation) are shown in Figures 6 and 7. It may also be necessary to make appropriate connections to the designated kiln burner at the switching station.

If trailer liquids are being disposed of, the kiln operator starts the centrifugal pump and opens the electrically operated block valves 2, 3, and 4. Valves 3 and 4 will not open unless upstream pressure is at least 40 percent of normal operating level. When block valves 3 and 4 are open, valve 1 at the suction side of the pump is also opened. These valves fail shut upon loss of signal.

The trailer liquid pumps are electrically driven constant speed centrifugal pumps with explosionproof motors and are fitted with double mechanical seals to prevent leakage of wastes. A liquid recirculation loop, with a relief orifice, around the pump is incorporated to prevent damage to the pump and lines in case the flow is obstructed. Steaming of the lines (and flexible hoses) is facilitated by providing controlled sources of steam at 3 locations, as shown in Figures 6 and 7. Frequent steaming of the lines is essential to remove residues which may otherwise react with incompatible wastes that are subsequently disposed of using the same circuit.

The kiln operator can tell whether the proper line connections have been made by the kiln worker by observing indicator lights on the panel board graphic in the control room. These indicator lights are turned on by pressure sensors which in turn are activated by instrument air. Interlocks are incorporated such that block valves will not open (and the pump will not start) unless all connections are complete. This prevents the occurrence of spills and consequent exposures.

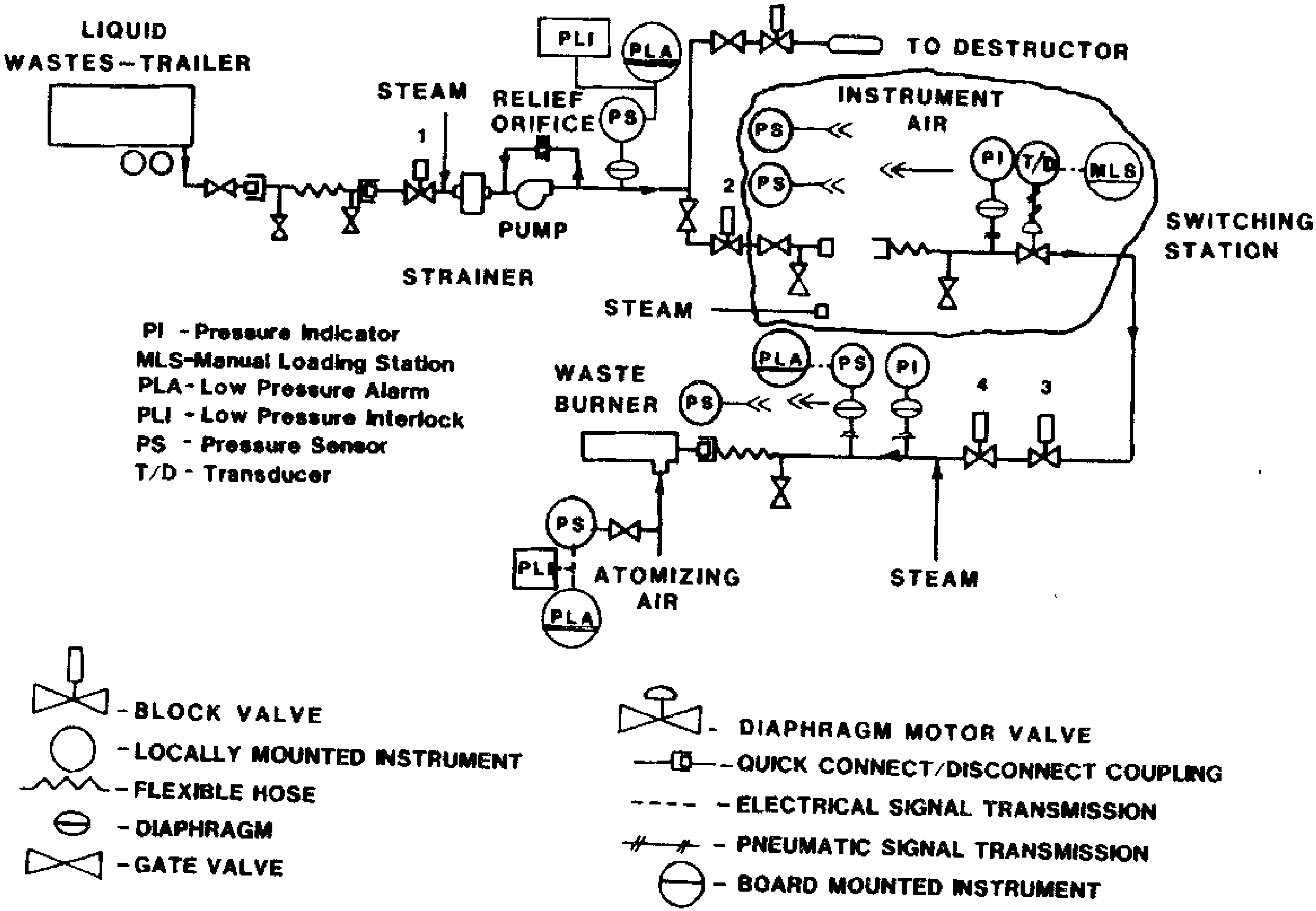

Figure 6 Instruments and Controls Associated With Disposal of Liquid Wastes in Trailers

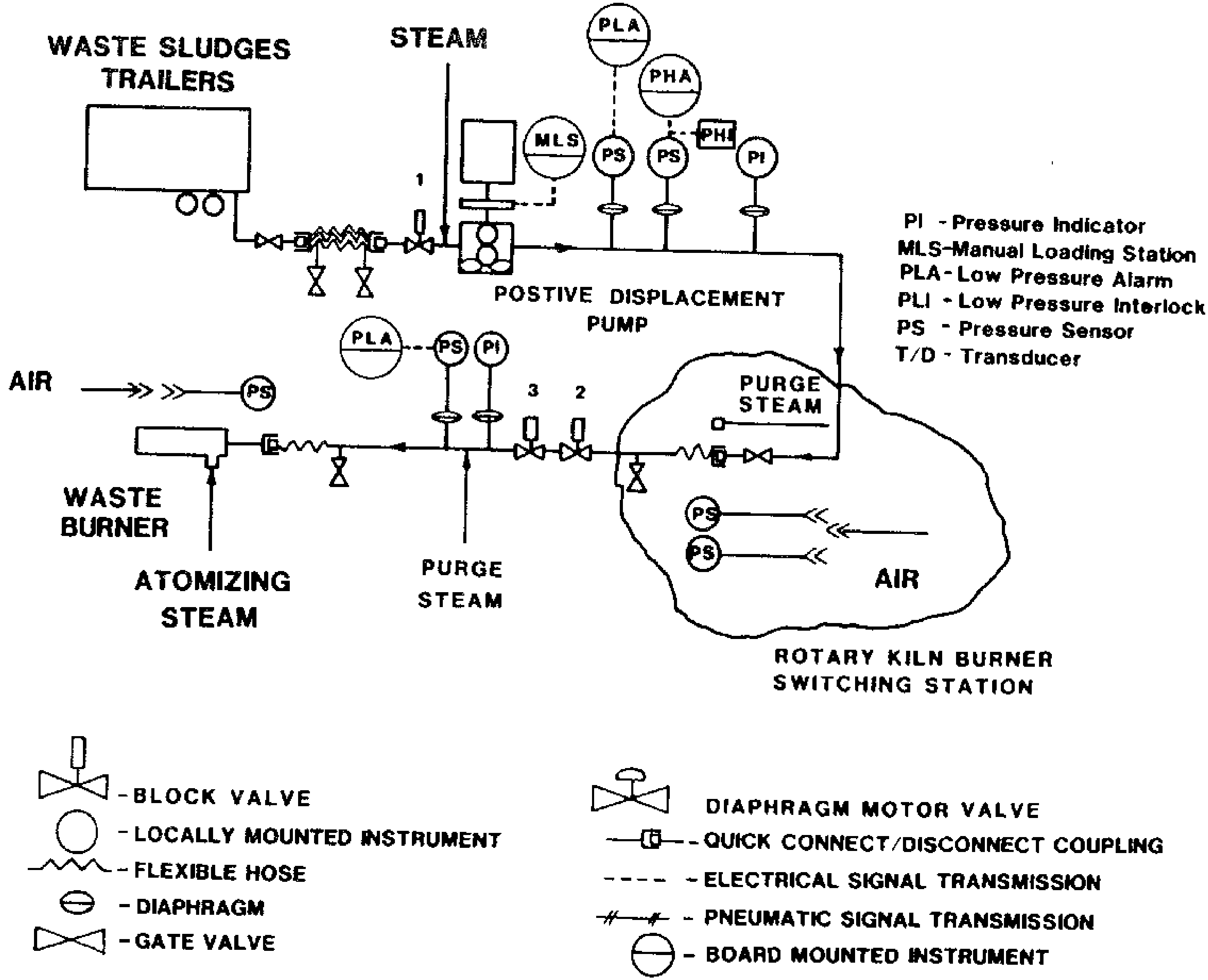

Figure 7 Instruments and Controls Associated With Disposal of Sludges in Trailers

For certain liquid wastes, pumping is not necessary. Inert gas pressure aided by gravity is used to force the liquid through the lines. A flexible hose connected to a gas pressure source is available at the trailer pad. When its use is indicated, the other end of the flexible hose is attached to an appropriate fitting located at the top of the trailer. Use of gas pressure to displace the liquid reduces the maintenance requirements for pumps and, in turn, lowers the frequency of exposures. Also, blanketing tanks that contain materials which tend to form explosive mixtures with air is a desirable precaution.

There are also facilities for disposal of sludges at each trailer pad. These are of higher viscosity than liquids and may require steam heat and/or insulation to keep them in the liquid state. The trailer sludge lines are therefore steam-traced.

A positive displacement variable speed pump is used to force sludges through the appropriate lines. A high-pressure alarm (PHA) and high-pressure interlock (PHI) are incorporated. The PHI interlock causes a pump shutdown if pressure in the lines becomes too high. This engineering control, in addition to protecting the integrity of the process, also reduces the potential of unwanted leaks and spills that may result from line damage caused by high pressure. Other control features incorporated into the sludge line are similar to those for the trailer liquid line (block valves, line connection indicators, etc.). Block valve 1 will automatically close when steaming of the line is started at the suction side of the pump.

Dumpsters

Dumpsters are 750-gallon metal containers with appropriate fittings to facilitate connect/disconnect operations and with provisions for steam or electrically heating and agitation so as to maintain the wastes in a liquid state.

Figure 8 is a photograph showing a typical dumpster in use at this facility.

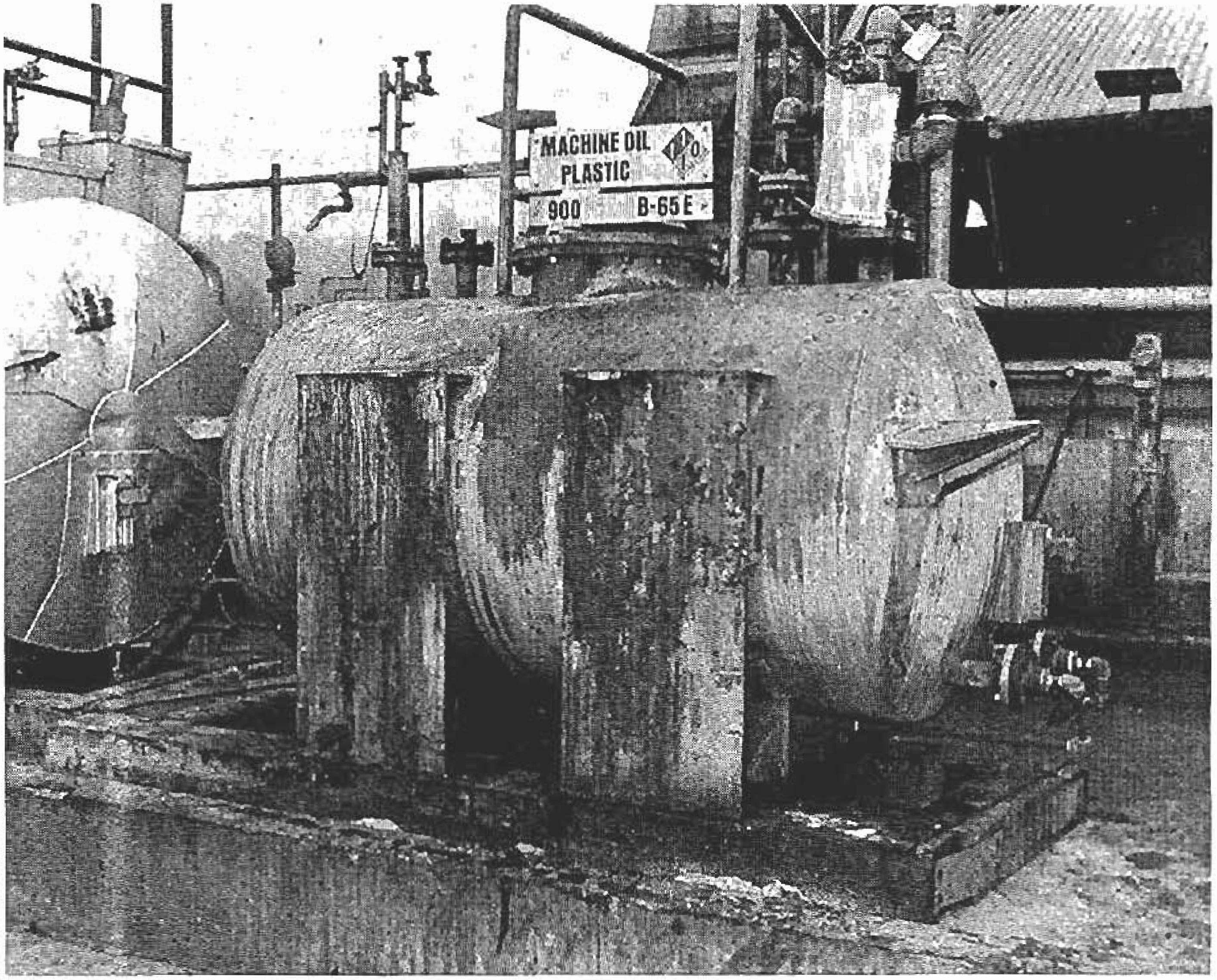

Figure 8 Dumpster at Dumpster Pad No. 2

Three types of wastes arrive at the facility in dumpsters. These are liquid wastes, sludges, and so-called "DK sludges", which represent a class of corrosive materials. Many of the principles and concepts of spill prevention that have been incorporated for wastes in trailers are also applicable to dumpsters. The essential details of a typical dumpster used for liquid wastes is shown in Figure 9. Those used for sludges are steam heated through a coil within the tank. Inert gas pressure is used to force liquids and DK sludges through the lines to the burners. A positive displacement pump is used to pump sludges.

Tanks

There are two tank farms that supply wastes for incineration in the kilns. These are the horizontal tank farms and the "No. 3" tank farm.

The horizontal tank farm consists of four tanks: an iron tank for oil wastes, two stainless steel tanks for wet compatible wastes, and one stainless steel tank for reactive chemicals. The wastes are received in 55-gallon drums, at No. 2 trailer pad. A ground cable is attached to the drum and the bungs are removed using sparkproof tools. The drum is then dumped over a sump. A strainer in the line from the sump to the tank(s) is incorporated for removal of grit.

Wastes from the two wet compatible and oil waste tanks are transferred to the kilns by two centifugal pumps fitted with double mechanical seals and explosion-proof motors. The two pumps are in parallel and may operate simultaneously or independently. Strainers for removal of grit are located at the suction side of the pumps. There are electrically (and remotely) operated block valves in the discharge line from the tanks. When these are opened, an automatic recirculation loop, consisting of a relief orifice and an electrically operated block valve, is activated. Recirculation helps keep grit in suspension and thus reduces the frequency of maintenance as a result of buildup of grit in tanks and discharger lines. A low-pressure alarm and interlock is provided at the discharge side of the pump. The active pump is turned off when low pressure is indicated. Low pressure can result from

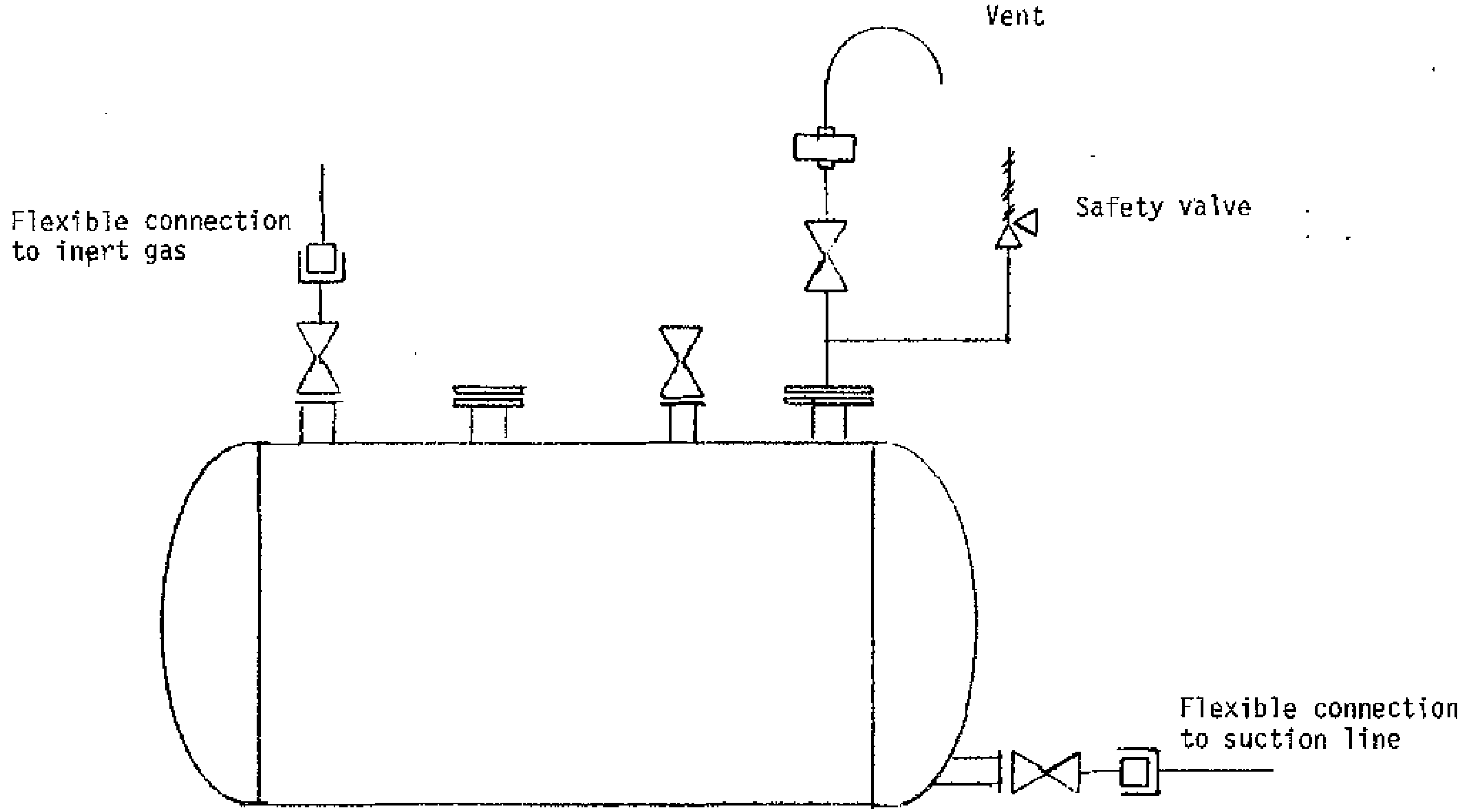

Figure 9 Dumpster Used for Liquids and Associated Connections

excessive grit buildup in the strainer, pump malfunction, or rupture in the line upstream or downstream of the pump. Provisions for steaming of supply lines from the tanks have been made.

The reactive chemicals tank is similarly equipped. However, the two pumps which transfer material from the tank to the kiln switching stations are incorporated in the line by flexible hoses with appropriate quick connect/disconnect fittings. Only one of the pumps can be attached at any given time. Instrument air connections that turn on indicator lights in the control room inform the operator which pump is on and whether proper connections have been made.

The No. 3 tank farm consists of five 20,000-gallon storage tanks. These are the dry compatible waste tank, the wet compatible wastes tank, the mixed halogens tank, the utility tank, and a tank for reactive chemicals. These tanks normally feed the chemical destructor. However, a switching station is available which facilitates transfer of wastes from the dry, wet, mixed halogen, and utility tanks to either kiln. It consists of two lines that are connected to the four sources mentioned above. One of the lines is for dry (moisture free) wastes and the other is for wet wastes. No reactive chemicals are transferred from No. 3 tank farm to the kilns.

Segregation of wastes at No. 3 tank farm is maintained both under routine and nonroutine conditions in order to prevent unsafe situations which may result from mixing of incompatible materials. Each tank has a concrete catch basin built around it designed to collect tank contents in case of tank rupture. The discharge lines from these basins have valves which are normally closed. In the event of a spill in one of these basins, the valve is opened and the spill empties into a common sump. A sump pump is available to pump sump contents to any of three tanks if indicated. These are the wet compatible, dry compatible, and mixed halogen tanks.

After appropriate flexible hose connections are made at the appropriate switching stations, flow and distribution of wastes from the No. 3 tank farm is controlled by a series of electrically operated block valves. Each of the four lines running from the four tanks has a block valve and two hand valves. Two flow totalizers located downstream of the tank farm switching station monitor the amount of flow from each tank. Provisions for steaming of lines have been made.

Solid Waste

Solid wastes (cardboard boxes, fiber drums, filter media, paper, etc.) are brought to the solid waste storage area shown in Figure 3 using trucks such as the one shown in Figure 10. The solid wastes are fed to the kilns using a loader, shown in Figure 11, and two vibratory conveyors (one for each kiln) connected to one side of each feed chute. One incinerator worker loads the conveyors. The kiln operator controls the rate at which the solid wastes are fed by on/off switches located in the control room which override on/off switches adjacent to the kiln doors.

Potential exposures of the kiln workers to solvents (such as acetone) may occur as a result of disposal of filter media with residual solvent in them. The primary engineering control is general ventilation at an estimated 12 volume changes per hour. The distribution of ventilation air is as shown in Figure 3.

Fiber Drums, Lard Cans, and Sample Bottles

Fiber drums and lard cans are fed by one of the kiln workers through a door at the front end of the kiln. The kiln operator instructs the worker on how many drums should be placed in the kiln. Figure 12 shows one of the incinerator workers in the process of feeding a drum to the kiln. Sample bottles are fed by Waste Haulers after the worker checks the permit.

The primary hazards associated with disposal of these items are: 1) the kiln worker may lose his footing and fall into the kiln and 2) materials in sample bottles or lard cans may cause explosions to occur at the front end of the kiln which in turn may cause injury to the worker. The first hazard is practically eliminated by having the worker don a safety belt attached to a

Figure 10 Dumpster-Type Solid Waste Truck

Figure 11 Loader Used to Load Conveyors with Solid Wastes

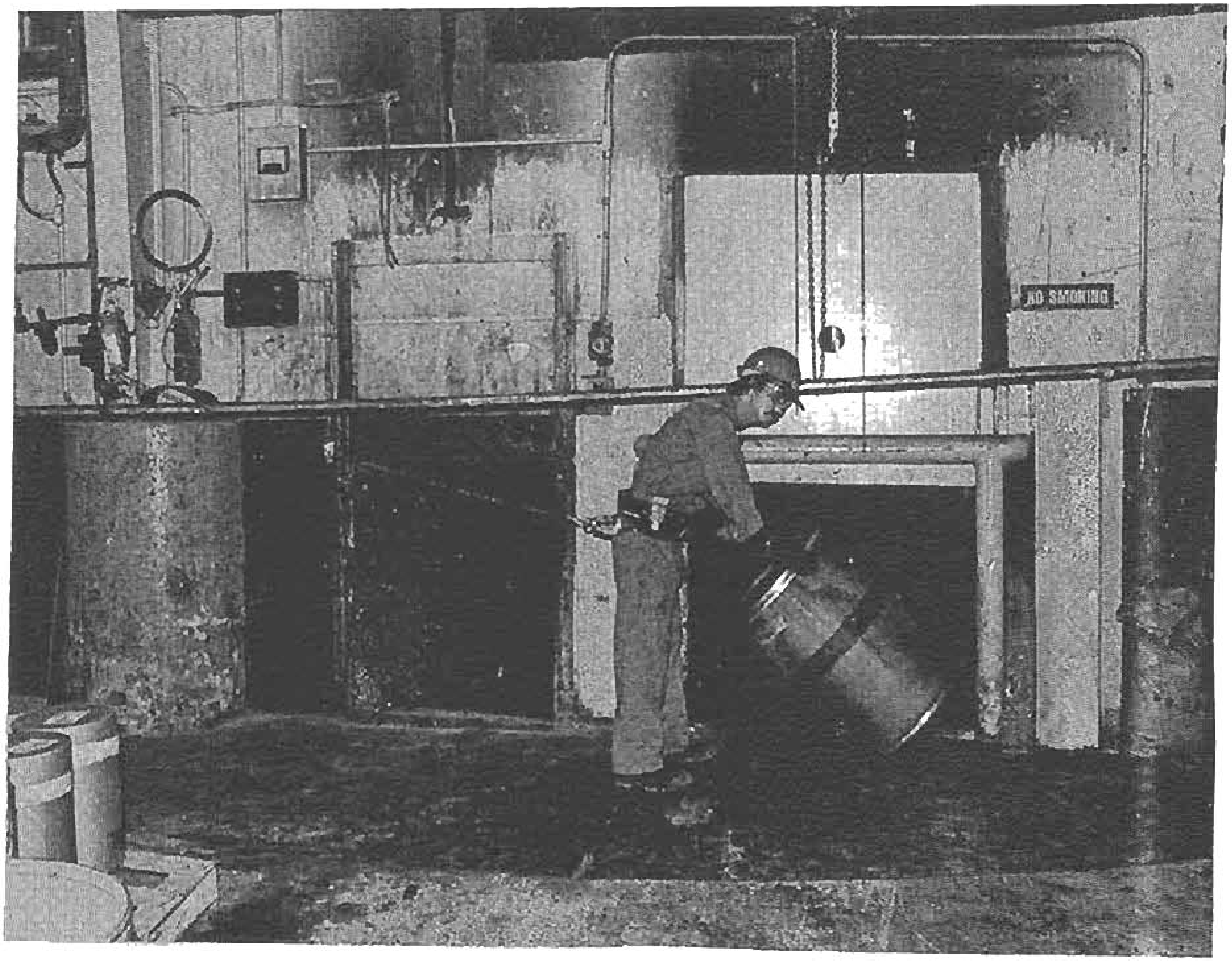

Figure 12 Kiln Worker Directly Feeds Fiber Drum to Kiln

cable with the other end firmly fixed to the wall. This is shown in Figure 12. The consequences of the second hazard are alleviated by venting the kiln chute as shown in Figure 3 and by requiring that the workers not stand directly in front of the kiln door.

WORK PRACTICES

Training and Education

TEC has developed a training manual for workers who operate the kilns. The manual specifically describes procedures to be followed in performing various operations such as hooking up of trailers and dumpsters, steaming of lines, establishing flow from tanks, etc. It also provides brief descriptions of the functions, uses, and methods for activating or inactivating various pieces of equipment such as pumps, conveyors, control valves, etc. The manual also contains photographs of various system components (pump screens, switching stations, etc.) and sections of the process schematic (or graphic) in the control room. The process indicating instrumentation, control switches, and indicator lights and alarms are an integral part of the process schematic. This assists the kiln operator in readily identifying lines and pumps that are active. In the piping and instrumentation drawings, each process instrument and piece of equipment has been provided with an alphanumeric designation consisting of two letters and three numbers. These same codes are used to label the process schematic (or graphic) in the control room. Also, whenever these pieces of equipment are mentioned in the training manual, they are referred to by the designation in the engineering drawings.

Specific work practices that are pertinent to waste handling and transfer operations will be discussed in the following paragraphs.

Trailers

For both waste liquids and sludges, written procedures call for the following. After arrival of the waste of the trailer pad, the kiln worker carries the waste permit to the kiln operator in the control room. The control room operator inspects the permit to determine whether it has been properly filled out and which line (liquids or sludges) to hook up the trailer to. If the permit is valid, the operator instructs the worker to connect the trailer to the appropriate line.

The kiln worker returns to the trailer pad and performs the following operations:

- o He places two stands under the trailer as a safety precaution in case the landing gear of the trailer collapses.

- o He clamps a ground wire to the metal body of the trailer.

- o He connects the inert gas supply hose to the appropriate fitting on top of the trailer and opens the valve after making sure that all other valves are closed. Inert gas pressure is used to pump thin liquids only.

- o He attaches a freshly steamed chemical flexible hose to the discharge fitting on the trailer after inspecting the gaskets at both ends of the hose. The worker should replace the gaskets if they are defective or worn.

- o He secures the flexible hose connection by tying the "ears of the connector shut with wire." This is an added precaution to prevent accidental spillage of waste should the connection come loose.

- o He opens the trailer's discharge hand valve. Makes sure that no leaks are visible. Leaks are to be repaired by the worker after the hand valve is closed. A hydraulic valve in the discharge line of the trailer is also opened by turning the valve handle and manually pumping the hydraulic fluid pump handle.

After the wastes in the trailer have been disposed of, the kiln operator instructs the worker to disconnect the trailer. The worker performs the following:

- He closes the hand valve on the trailer discharge line.

- He closes the valve on the inert gas supply line and disconnects the hose slowly.

- He vents the trailer by opening the vent valve or opening the top hatch.

- He makes sure all liquid in the trailer has been pumped by looking through the top hatch.

- He disconnects the flexible hose after opening the bleed-off valve to relieve the pressure. Any liquid coming through this valve is collected in fiberboard containers which are later disposed of at the bottle drop.

- He steams out the flexible hose and line by attaching the disconnected end to the steam supply. All bleed-off valves are closed during steaming. The operator tells the worker when steaming is complete. Excess steam (pressure) is eliminated by opening the bleed-off valve.

- He disconnects the ground cable, removes the safety stands and the "TANK CAR CONNECTED" sign.

- He calls the operator on the intercom and informs him that the trailer is ready to leave the site. The worker is to double check that all lines have been disconnected.

The incinerator worker is to check sealing fluid levels and pump seals during pump operation.

Dumpsters

The procedures for hooking up and disconnecting dumpsters and steaming lines are similar to those used for trailers.

Tanks

The contents of tanks are measured at the beginning and end of each shift. This procedure prevents the accidental overfilling of tanks. All pumps at the horizontal tank farm are checked every four hours and observations are recorded on a log sheet. The kiln worker also checks for leaks in the pump seal and checks the seal fluid level. Strainers are inspected and cleaned periodically or as necessary (low-pressure alarm).

Reactive chemicals (placed in the reactive chemicals tank in the horizontal tank farm) are burned at once and the line steamed out.

There are detailed instructions on how to handle material spills in the catch basins of the No. 3 tank farm.

Strainers

Usually, hazardous liquid waste contains dirt and grit which must be removed before they pass through transfer lines to storage tanks or directly to the kilns. At the TEC incineration facility, in-line strainers are installed at the suction side of all centifugal pumps (tanks, trailer liquid lines, and dumpster liquid lines). The strainer must be cleaned periodically to remove the dirt and grit accumulation. The cleanup procedures for all these are similar if not identical.

With the pump stopped, the worker isolates the strainer by having block or hand valves upstream and downstream closed. The strainers have drain valves in the housing which can be opened to empty the liquid. All liquid drained is accumulated in a fiberboard drum. The worker loosens the strainer's cover plate (or lid) bolts and removes the lid. The basket is then removed and steam-cleaned or water-washed. The gasket in the cover plate is inspected and replaced if necessary. The strainer is reassembled and inspected for leaks by observation while the pump is running.

Recordkeeping

In general, good recordkeeping is essential to safe operation. At the TEC facility, the chief operator maintains a log book to record what happens during each shift. An "Operator Shift Log" form should be filled out each shift. On the first three sections of this form are entered necessary details on what happened during the 3 shifts including 1) malfunctions, 2) needed repairs of mechanical and electrical equipment and instruments, 3) repairs that were completed, and 4) additional notes and comments. The fourth section of the form is EPA-required inspection information. The inspection is mainly concerned with integrity of piping and pumps throughout the facility. The log includes 1) time of inspection, 2) the initials of worker performing the inspection, 3) notes on observations made, and 4) corrective action(s) and date(s) of corrective action(s). The areas to be inspected are identified in detail.

Any problems encountered with dumpsters and trailers are recorded. The foreman contacts the generator of the waste and resolves the problem.

A log sheet is used to record the amounts (in gallons) and levels (inches) in each tank in the horizontal tank farm during each shift. The data recorded includes initial shift inventory, ending inventory, amount received during the shift, and amount incinerated. Also, a record of the amount of solid wastes brought in by trash compactors, empty fiber drum trucks, solid waste dumpsters, and dump trucks during each shift is maintained.

A comprehensive weekly inspection is performed on 1) safety equipment such as safety showers, fire extinguishers, and eye wash fountains, 2) firefighting equipment, 3) integrity of tanks and associated concrete structures, 4) operation of sump pumps, and 5) grounding cables. The check list tells the worker how to perform the inspection and what to look for. There is space provided for entering information on needed maintenance and corrective actions taken and dates.

MONITORING

During the 3-day survey, personal samples were obtained for the two kiln workers and the chief operator. One of the kiln workers (Worker A) performed "outside" work including the connection and disconnection of dumpsters and trailers, inspection of pumps, cleaning strainers, etc. The second kiln worker (Worker B) operated the loader and pushed solid waste onto the conveyor. The chief operator (Worker C) assisted the kiln workers in the performance of their tasks, as necessary, in addition to supervising the operation and completing necessary paperwork.

Area samples were obtained at the following locations (see Figure 3):

- o Loader Cab (Location A) about 8 feet above ground level.
- o Kiln Charging Door where samples bottles are dropped (Location B). The sampling medium was placed 6 feet above floor level and against the wall.
- o Platform railing above conveyor No. 2 (Location C).
- o Entrance to solid waste storage area about 6 feet above floor level (Location D).
- o Control room.

Personal samples were analyzed for acetic acid as explained earlier. The results are shown in Table 1. The TEC values were obtained by a titrimetric procedure which involves desorption of the acid from silica gel, using water, and titration using a base.

Table 1

Exposures to Acetic Acid
ppm (OSHA Standard 10 ppm)

	11/9		11/10		11/11	
Worker	NIOSH	TEC	NIOSH	TEC	NIOSH	TEC
A	0.8	0.8*	1.6	0.7*	ND**	0.8*
B	2.7	0.7*	2.0	0.6*	1.5	0.7*
C	1.8	0.8*	1.4	0.7*	1.0	0.7

* less than quoted value
** nondetectable

As mentioned earlier, the ion chromatogram shown in Figure 4 is typical of the results of analyses of area sample charcoal tubes, both with respect to the species found and the concentration levels. Although method P&CAM 127 is not a universal method for detection of all organic species in air, it is sufficiently general to allow the detection of at least some of the species that are not usually quantitated using the method. Presumably, samples at Location A would contain species that may be present with the solid waste (such as acetone in the filter media). Samples at Location B would in principle contain species that may be present in sample bottles and lard cans while being disposed. Samples at Location C would contain species in the solid waste and, to a much lesser extent, species that may be present at outside sources such as dumpster pad No. 2 and the kiln switching station. The fact that the all ion chromatograms were similar for both inside (A and B) and outside (C) locations seems to suggest that outside sources of exposure are insignificant.

PERSONAL PROTECTIVE EQUIPMENT

Before performing operations that have the potential for exposure, the kiln worker is required to don personal protective equipment. This equipment includes a hard hat with face shield, safety glasses, a long raincoat, and rubber gloves. The operations which require such equipment include hooking up and disconnecting trailers and dumpsters, cleaning strainers, etc.

CONCLUSIONS

The TEC incineration facility has been designed to dispose of a variety of combustible solid wastes and ignitable liquid hazardous wastes. The design includes provisions for the prevention and control of spills and leaks, fires, and explosions. The engineering controls incorporated into the process include 1) interlocks and alarms, and special instrumentation and equipment which reduces the potential for leaks and spills of liquid wastes, 2) general ventilation in the area of solid waste storage, and 3) kiln overpressure relief vent and a safety belt for the worker disposing of lard cans, fiber drums, and sample bottles. Good work practices were observed and these are at least partly due to the development of a training manual for workers at this site. Recordkeeping requirements are such that workers at the kiln routinely maintain records on hazardous wastes that are either stored or disposed of. Segregation of incompatible wastes is a direct result of such recordkeeping. Routine inspections of safety equipment and process equipment are performed frequently. Detailed forms are available for such inspections.

Air monitoring activities (personal and general area samples) at the site during the NIOSH survey revealed the presence of low levels of acetic acid, toluene, and acetone. Worker exposures to these materials were most likely to have occurred in the area where solid wastes are stored.