United States
Environmental Protection
Agency

Solid Waste And
Emergency Response
5403W

EPA 510-R-92-703
September 1987

EPA

Causes of Release From UST Systems

Attachments

Printed on Recycled Paper

FINAL REPORT TO U.S. EPA/OUST

ATTACHMENTS

CAUSES OF RELEASE FROM UST SYSTEMS

EPA CONTRACT: 68 – 01 – 7053
SUBCONTRACT: 939 – 5
WORK ASSIGNMENT: 24

September 30, 1987

ATTACHMENT A

QUESTIONS FOR MAJOR COMPANIES

WITH UST SYSTEM MANAGEMENT PROGRAMS

1. <u>UST SYSTEM PERFORMANCE/CAUSES OF RELEASE</u>

- o Types, numbers, typical ages;
- o Most common source of release (%):
  - Overfills and spill;
  - Tanks;
  - Piping. (suction and pressurized)
- o Most common causes of failure for each source of release:
  - Corrosion (external and internal);
  - Installation; and
  - Other.
- o What are the sources of the worst (largest or most costly) releases?
- o What procedures are used to assure proper installation?

2. <u>RELEASE DETECTION PROGRAM</u>

- o What types of leak detection are in use - both manual and automatic?
- o How many locations are using each technique?
- o How did the company decide to use each technique?
- o How has each technique been performing? (i.e., operating problems, false alarms, defects, etc.)?
- o How are releases being discovered?
- o What fraction of the releases are discovered by each technique?
- o What fraction of the releases are discovered by other means?
- o How often are releases discovered upon installation of the device?
- o What sizes of releases are discovered with each technique?

3. RELEASE CONFIRMATION AND INVESTIGATION

- What "suspected releases" does your company investigate?
- What techniques or procedures are following to confirm release?
- What are typical points of contact and activity with local and state governments concerning release confirmation?
- How often do "false alarms" occur and how are they resolved?

4. REPAIR OR RETROFITTING OF UST SYSTEMS

- Are repairs allowed and, if so, what types and how is the quality controlled?
- What types of retrofitting of existing tank systems are performed?
- What oversight and performance checks are performed on upgraded systems?
- Do you allow re-use of tanks removed from the ground?

5. CLOSURE

- What procedures are typically used at closure?
- Is some form of site assessment/testing performed to assure clean closure?
- What are the result of closure testing?

6. SPILLS AND OVERFILLS

- What are the correct practices and equipment used to prevent spills and overfills?
- What is the estimated contribution of spills and overfills to releases identified in response program (e.g., frequency, sizes)?

ATTACHMENT B

QUESTIONS FOR LOCAL REGULATORS

EPA OUST has questions in three general areas of underground storage tank regulation and enforcement:

- Causes of release;
- Release detection techniques; and
- Program implementation.

Questions in each of these topic areas are identified below.

CAUSES OF RELEASE

Of the total population of tanks systems in the jurisdiction:

- What is the incidence of releases:
- Has the incidence gone down since starting the program;
- How many of the releases are due to overspills;
- How many of each type of tank systems are failing--bare steel, coated steel, CP steel, clad steel, FRP galvanized pipe, CP pipe, FRP pipe, suction piping, pressurized piping;
- Where are the leaks occurring (i.e., at pipe joints, tank bottoms, underfill tubes);
- What is the age distribution of the failed tank and piping systems;
- Can the failures be attributed to improper installation or repair;
- What basis does the local jurisdiction have for the above numbers--judgments based upon experience; permit database; release notification database; corrective action database--can these databases be put together to confirm these numbers.

RELEASE DETECTION TECHNIQUES

- What types of leak detection are in use--both manual and automatic;

- How many of each;
- How did the regulator choose limitations on use;
- How did the regulator decide to allow each technique;
- How has each technique been performing;
- Are release being discovered with the technique--at installation or after;
- What sizes of releases are being found with each technique.

PROGRAM IMPLEMENTATION QUESTIONS

- What are the installation requirements--how does the regulator insure proper installation;
- What is the phase-in schedule for upgrading--is it being met;
- What repairs and retrofits are allowed--how does the regulator insure proper repair;
- What are the spill and overfill control requirements--what is the phase-in schedule;
- What is the Leak Detection phase-in schedule--is it being met;
- What are the Leak Detection reporting and confirmation procedures;
- What are the closure requirements;
- Are many releases being discovered through the closure process;
- How many people on staff;
- How many inspections are performed;
- How many permits are filed.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION: Arkansas Best Freight Systems

CITY: Fort Smith, AR

VISIT DATE: June 4, 1987

INTERVIEWER/S: Robin Parker (JEG)

CONTACT: Jim Halladay

DATA COLLECTION METHOD: Telephone contact

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	3%
TANK FAILURES	25%
PIPE FAILURES	72%
UNDETERMINED	--------

BASIS FOR DATA:

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Amoco Oil Co.
CITY:	Chicago, IL
VISIT DATE:	June 18, 1987
INTERVIEWER/S:	Robin Parker (JEG)
CONTACT:	Randall Farmer - Staff Director, Environmental & Safety Jay Scrivener - Environmental Specialist Dennis Strock - Engineering

DATA COLLECTION METHOD: On-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	10%
TANK FAILURES	35%
PIPE FAILURES	55%
UNDETERMINED	--------

BASIS FOR DATA:

Corporate data

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION: Ashland Oil

CITY: Ashland, Kentucky

VISIT DATE: June 16, 1987

INTERVIEWER/S: Robin Parker (JEG)

CONTACT: Dick Hale

DATA COLLECTION METHOD: Telephone conversation

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	Infrequent
TANK FAILURES	10%
PIPE FAILURES	90%
UNDETERMINED	

BASIS FOR DATA:

Corporate records

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Ashland Oil
CITY:	Ashland, Kentucky
VISIT DATE:	July 25, 1987
INTERVIEWER/S:	Ramesh Maraj (JEG)
CONTACT:	Dick Hale
DATA COLLECTION METHOD:	Telephone Conversation

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	
TANK FAILURES	9 releases (8%)
PIPE FAILURES	34 releases (92%)
UNDETERMINED	

BASIS FOR DATA:

FRP tankage and piping - corporate records.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION: Austin Underground Storage Program

CITY: Austin, TX

VISIT DATE: March 9 and April 27 - Both visits combined in report

INTERVIEWER/S: Tom Willard (VERSAR)
Dave O'Brien (USEPA)

CONTACT:

DATA COLLECTION METHOD: On-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	------
TANK FAILURES	24%
PIPE FAILURES	44%
UNDETERMINED	------

BASIS FOR DATA:

1. Review of local tank testing reports.
2. Analysis of tank test records conducted by a local vendor.

15% of UST systems failed integrity test.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION: Boeing

CITY: Seattle, WA

VISIT DATE: June 11, 1987

INTERVIEWER/S: Robin Parker (JEG)

CONTACT: David Smukowski

DATA COLLECTION METHOD: Telephone interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	12%
TANK FAILURES	6%
PIPE FAILURES	12%
UNDETERMINED	

BASIS FOR DATA:

Corporate records (internal study).

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Environmental Quality Control Board
CITY:	Broward County, FL
VISIT DATE:	April 2, 1987
INTERVIEWER/S:	Kim Green (EPA OUST) Bill Meyers (VERSAR) Tom Schruben (JEG)
CONTACT:	Jim Andrews (BCEQCB) Greg Balicki (BCEQCB) Fran Henderson (BCEQCB)
DATA COLLECTION METHOD:	On-site interview
SAMPLE SIZE:	14 incident reports

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERSPILLS	46%
TANK FAILURES	23%
PIPE FAILURES	31%
UNDETERMINED	--------

BASIS FOR DATA:

Examination of incident release reports.

2% of UST systems have reported releases.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION: Department of Environmental Resource Management

CITY: Miami, FL DADE COUNTY

VISIT DATE: April 3, 1987 TRIP I

INTERVIEWER/S: Kim Green (EPA OUST)
Bill Meyers (VERSAR)
Tom Schruben (JEG)

CONTACT: Amando Villanueva (DERM)

DATA COLLECTION METHOD:: On-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	#1 major cause
TANK FAILURES	#3 cause
PIPE FAILURES	#2 cause
UNDETERMINED	---------

BASIS FOR DATA:

Impressions of Mr. Amando Villanueva.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Department of Environmental Resource Management
CITY:	Miami, FL DADE COUNTY FILES
VISIT DATE:	May 13/14, 1987 TRIP II
INTERVIEWER/S:	Frank Hicks Tom Abel
CONTACT:	Amando Villanueva (DERM)
DATA COLLECTION METHOD:	On-site interview
SAMPLE SIZE:	148 release files (out of possible 215)

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	45.1%
TANK FAILURES	25%
PIPE FAILURES	21.5%
UNDETERMINED	8.4%

BASIS FOR DATA:

1. Monthly status report on contamination incidents.
2. Information contained in inspection reports.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION: Fuel Quality Services

CITY: Buford, GA

VISIT DATE: May 18, 1987

INTERVIEWER/S: Al Nugent (Hart)

CONTACT: Howard Chesneau, President

DATA COLLECTION METHOD: Telephone data collection

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	Unknown
TANK FAILURES	20%
PIPE FAILURES	80%
UNDETERMINED	

BASIS FOR DATA:

Personal recollections

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Circle K Stores
CITY:	Phoenix, AZ
VISIT DATE:	July 7, 1987
INTERVIEWER/S:	Robin Parker (JEG)
CONTACT:	Don Esperson
DATA COLLECTION METHOD:	Telephone contact

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	0%
TANK FAILURES	1%
PIPE FAILURES	99%
UNDETERMINED	--------

BASIS FOR DATA:

Impressions of Don Esperson who has approximately 20 years of experience in the UST industry.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION: Consolidated Freightways

CITY: Menlo Park, CA

VISIT DATE: August 7, 1987

INTERVIEWER/S: Mary Ann Parker (JEG)

CONTACT: Sue Black

DATA COLLECTION METHOD: Telephone contact

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	5%
TANK FAILURES	40%
PIPE FAILURES	55%
UNDETERMINED	

BASIS FOR DATA:

Corporate files

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Corrosion Research Centre & Ministry of the Environment
CITY:	Denmark
VISIT DATE:	April 2nd through April 3rd, 1987
INTERVIEWER/S:	Phil Stapleton (D&M)
CONTACT:	Mr. Finn Yding
DATA COLLECTION METHOD:	On-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	65%
TANK FAILURES	14%
PIPE FAILURES	21%
UNDETERMINED	

BASIS FOR DATA:

Regulatory records

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Fiberglass Petroleum Tank and Pipe Institute
CITY:	McLean, VA
VISIT DATE:	July 14, 1987
INTERVIEWER/S:	Robin Parker (JEG)
CONTACT:	Ed Nieshoff
DATA COLLECTION METHOD:	Meeting for comment presentation

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	Not addressed
TANK FAILURES	0.25% of Population
PIPE FAILURES	No Data
UNDETERMINED	

BASIS FOR DATA:

FRP Tankage data from Owens Corning files, 1978 & 1984.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Murphy Oil
CITY:	El Dorado, AR
VISIT DATE:	May 27, 1987
INTERVIEWER/S:	Robin Parker (JEG)
CONTACT:	Dave Petty
DATA COLLECTION METHOD:	On-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	< 1%
TANK FAILURES	50 - 60%
PIPE FAILURES	39 - 44%
UNDETERMINED	--------

BASIS FOR DATA:

Impressions of Dave Petty.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Ministry of Consumer & Customer Relations Fuel Safety Branch
CITY:	Ontario, Canada
VISIT DATE:	May 20th through May 22nd, 1987
INTERVIEWER/S:	Robin Parker (JEG)
CONTACT:	Bill Drake (FSB) Paul Beaumont (FSB)
DATA COLLECTION METHOD:	On-site interview
SAMPLE SIZE:	50 documented releases in 1986 (.16%)*

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	--------
TANK FAILURES	44%
PIPE FAILURES	56%
UNDETERMINED	--------

BASIS FOR DATA:

Examination of incident release reports.

* Probably represents a steady-state condition; incidence has decreased with program phase-in.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Ministry of the Environment
CITY:	Ontario, Canada
VISIT DATE:	July 28, 1987
INTERVIEWER/S:	Ramesh Maraj (JEG)
CONTACT:	Ray Valentine
DATA COLLECTION METHOD:	Telephone conversation

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	Unknown
TANK FAILURES	9 releases
PIPE FAILURES	2 releases
UNDETERMINED	

BASIS FOR DATA:

1983 Records

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Petroleum Equipment Institute
CITY:	Dallas/Ft. Worth Airport
VISIT DATE:	July 8, 1987
INTERVIEWER/S:	Robin Parker (JEG) David O'Brien (EPA)
CONTACT:	Bob Renkes Sandra Parkison
DATA COLLECTION METHOD:	Expert Panel

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	1 - 4%
TANK FAILURES	20 - 30%
PIPE FAILURES	70 - 80%
UNDETERMINED	

BASIS FOR DATA:

Consensus opinion of expert group.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	PIECO (Petroleum & Industrial Equipment)
CITY:	Hialeah, FL
VISIT DATE:	May 20, 1987
INTERVIEWER/S:	Frank Hicks Tom Abel
CONTACT:	William F. Wynne
DATA COLLECTION METHOD:	On-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	Majority of releases
TANK FAILURES	3rd major cause of release
PIPE FAILURES	2nd major cause of release
UNDETERMINED	

BASIS FOR DATA:

Impressions of William Wynne, President of PIECO.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION: Ryder Truck Rental, Inc.

CITY: Miami, FL

VISIT DATE: May 18, 1987

INTERVIEWER/S: Frank Hicks (JEG)
Tom Abel (JEG)

CONTACT: James R. Barr, Manager of Environmental Services

DATA COLLECTION METHOD: On-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	50%
TANK FAILURES	5%
PIPE FAILURES	45%
UNDETERMINED	--------

BASIS FOR DATA:

Impressions of James Barr, Manage of Environmental Services, Properties and Construction.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION: Department of Health Services

CITY: San Diego, CA

VISIT DATE: June 1, 1987

INTERVIEWER/S: VERSAR Personnel

CONTACT:

DATA COLLECTION METHOD: On-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	
TANK FAILURES	
PIPE FAILURES	50%
UNDETERMINED	

BASIS FOR DATA:

Field experience of inspectors.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Regional Water Quality Control Board
CITY:	San Francisco, CA
VISIT DATE:	March 27, 1987
INTERVIEWER/S:	Tom Schruben (JEG)
CONTACT:	Peter Johnson (SFBRWQCB) Tom Callaghan (SFBRWQCB) Steve Morse (SFBRWQCB)
DATA COLLECTION METHOD:	On-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	
TANK FAILURES	
PIPE FAILURES	
UNDETERMINED	

* No information obtained during interview concerning causes of release. Referred to files at Sunnyvale and San Jose.

BASIS FOR DATA:

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION: San Jose City Fire Prevention Bureau

CITY: San Jose, CA

VISIT DATE: April 3, 1987

INTERVIEWER/S: Tom Schruben (JEG)

CONTACT: Joe Afong (HMD)

DATA COLLECTION METHOD: On-site visit and interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	25 - 33%
TANK FAILURES	67 - 75%
PIPE FAILURES	67 - 75%
UNDETERMINED	

BASIS FOR DATA:

Personal recollections

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION: The Southland Corporation

CITY: Dallas, TX

VISIT DATE: July 9, 1987

INTERVIEWER/S: Robin Parker (JEG)

CONTACT: Hal Miller

DATA COLLECTION METHOD: Telephone conversation and on-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	Unknown
TANK FAILURES	23%
PIPE FAILURES	39%
UNDETERMINED	

BASIS FOR DATA:

Corporate records (for FRP)

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION: Suffolk County Health Department

CITY: Long Island, NY

VISIT DATE: March 4, 1987

INTERVIEWER/S: David O'Brien (EPA)

CONTACT: Jim Pim

DATA COLLECTION METHOD: On-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	Not addressed
TANK FAILURES	10%
PIPE FAILURES	90%
UNDETERMINED	

BASIS FOR DATA:

Suffolk County data

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Department of Public Safety
CITY:	Sunnyvale, CA TRIP I
VISIT DATE:	March 27, 1987
INTERVIEWER/S:	Karen Reed (EPA OUST) Eric Yunker (EPA Region 9) Bill Meyers (VERSAR) Tom Schruben (JEG)
CONTACT:	Ruben Grijalva (DPS)
DATA COLLECTION METHOD:	On-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	Majority of incidents
TANK FAILURES	Substantial cause of release
PIPE FAILURES	Substantial cause of release
UNDETERMINED	

BASIS FOR DATA:

Impressions of Ruben Grijalva.

18% of UST systems have reported releases since 1983.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	Fire Department
CITY:	San Jose, CA TRIP II
VISIT DATE:	April 26, 1987
INTERVIEWER/S:	Bill Meyers (VERSAR)
CONTACT:	Ruben Grijalva
DATA COLLECTION METHOD:	On-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	Less than 2%
TANK FAILURES	60%
PIPE FAILURES	38%
UNDETERMINED	52 cases

BASIS FOR DATA:

124 incident release reports, 41 with reported cause of release.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	City of Sunnyvale - Department of Public Safety
CITY:	Sunnyvale, CA TRIP II
VISIT DATE:	April 26, 1987
INTERVIEWER/S:	Bill Meyers (VERSAR)
CONTACT:	Ruben Grijalva
DATA COLLECTION METHOD:	On-site interview

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	N.A.
TANK FAILURES	44%
PIPE FAILURES	56%
UNDETERMINED	27 cases

BASIS FOR DATA:

45 incident release reports, 18 had reported cause of release.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION:	VARIOUS
CITY:	Sunnyvale, CA
VISIT DATE:	May 22, 1987
INTERVIEWER/S:	Bill Meyers (VERSAR)
CONTACT:	Vendors of various organizations
DATA COLLECTION METHOD:	Telephone interviews, TRIP II
SAMPLE SIZE:	7 vendors

CAUSES OF RELEASE - VENDOR INFORMATION

Vendor 1: Estimated 40% of releases due to pipes, 20 - 30% of releases due to tanks.

Vendor 2: Majority of releases due to pipes (if steel piping). If fiberglass piping, more tank leaks observed. Some releases caused by overfills.

Vendor 3: Majority of releases occur from tanks.

Vendor 4: 2/3 of releases are associated with piping, especially the fittings.

Vendor 5: Majority of releases along the piping at unions and fittings.

Vendor 6: Most leaks occur in the piping and secondarily at the vent pipe.

Vendor 7: Releases evenly distributed between piping and tanks.

BASIS FOR DATA:

Impressions of vendors who manufacture, install and repair tanks.

SUMMARY OF CAUSES OF RELEASE

ORGANIZATION: State of Virginia (Pollution Response Office)

CITY: Richmond, VA

VISIT DATE: August 5, 1987

INTERVIEWER/S: Elaine Strass (JEG)

CONTACT: Mary Ann Sykes

DATA COLLECTION METHOD: On-site visit

CAUSES OF RELEASE	PERCENT OF TOTAL
SPILLS/OVERFILLS	12%
TANK FAILURES	75%
PIPE FAILURES	13%
UNDETERMINED	

BASIS FOR DATA:

State of Virginia files

TRIP REPORT SUMMARY

PIECO

May 20, 1987

Pieco supplies and installs equipment for service stations.

Overfills and spills are felt to be the major cause of releases. Piping leaks are more prevalent than tank leakage. An estimated 85 percent of tank leakage is related to pipe fittings or connectors. Corrosion is a major problem and is thought to be a result of bad backfill or locating tanks near power plants. The worst releases are overfilling and long term, undetected leaks, which produce a contamination problem.

Proper installation is felt to be a major factor in preventing future releases. It was suggested that from the time the tank is designed to the time it is put in service it should be inspected by certified and professional people. Electronic gauging systems are preferred over automatic release detection equipment, which has little value due to lack of maintenance and operator attention.

Monitor wells are the most prevalent means of release detection. Additional wells or excavation are used to confirm releases. Repair of pumps and lines is accomplished but fiberglass coating of existing tanks was frowned upon. Tanks are removed in 99 percent of closures; otherwise they are filled with sand.

The protection system for spills and overfills was a "double overfill protection system" consisting of a ball float that stopped filling at 95-98% full and a containment system at the manway.

Modifications in the original state regulations have eliminated an exemption from secondary containment for new installations of pressurized product lines. The regulatory personnel in the county are in agreement that pressurized product lines require a means of both detecting and containing release. They pointed out that a number of severe incidents were caused by a pressurized product line that failed.

There is a evidence that the San Diego program has succeeded in drastically reducing the number of overfill incidents associated with tanker re-fueling operations. The county imposes a $1000 fine for either owners or delivery personnel that fail to report an overfill incident. The air quality regulatory personnel imposed these fines through their field monitoring of vapor recovery operations. As a result of the enforcement effort, vendors now fire any employee that fails to report an overfill incident, and will also dismiss any employee if they are involved in more than one overfill incident. This regulatory enforcement approach coupled with the cooperation of the bulk storage and delivery facilities have led to only 6 overfill incidents reported in 1986 out of over 25,000 deliveries.

Ground water and vadose zone monitoring systems have not been permitted for use in San Diego County. In order for a new installation to

be granted an operation permit that employs either of these methods the county requires that the owner provide evidence that supports the claim that they will be able to effectively detect unauthorized release on-site. This evidence must include a determination of the soil characteristics, background contamination, and ground water flow. The regulated community has come to the conclusion that the cost of designing and installing such systems exceeds the cost of installing a double-walled system. Ground water monitoring may, however, be approved for some chemical tank systems in the future that are not currently permitted to use inventory monitoring. The use of ground water monitoring will then only be permitted in non-beneficial use areas.

The county has proposed a modification to the California Legislature that would establish a state-wide clearinghouse to evaluate and approve for use equipment testing procedures and devices associated with the storage of hazardous substances underground. The regulators in the county stated that such a clearing house would remove the burden, form the local enforcement agency, of evaluating a steady stream of new devices and enable qualified experts in the area of leak detection technology to assess the reliability and effectiveness of the devices.

When the program began in April 1984, emphasis was placed on the identification and investigation of suspected releases. As of June 1987, the office had an active file of 520 cases where a release is suspected. Of those active cases, the initial means of identification were classified as: soil contamination, failed precision test, or complaint. The soil

contamination incidents, which accounts for 276 or 53% of the active cases, were commonly identified through tank removal or replacement. Failed precision test accounted for 139 or 27% of the active cases. The investigators indicated that most of the suspected releases were determined to involved small quantities of lost product that can usually be corrected by removing the contaminated soil.

The degree of remediation required is determined on site by site basis. The general scheme is to allow no more than 1000 ppm total petroleum hydrocarbons in the soil in non-beneficial use areas, and no greater than 100 ppm in beneficial use areas.

TRIP REPORT SUMMARY

SAN FRANCISCO BAY

March 27, 1987

In California, the regional water quality control boards are responsible for groundwater corrective actions. Santa Clara County is thought to have the best fuel release detection and corrective action program. The cause of release is categorized into fuel releases or hazardous substance release.

The San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) tracks fuel releases but not causes. Approximately 40 percent of the 1249 reported underground fuel leak cases are in Santa Clara County. Considering the region's population distribution, this percentage is higher than expected.

Guidelines have been established for addressing fuel leaks and the SFBRWQCB is working with the localities to implement the program. A ranking system for the severity of the releases helps the localities put their limited resources into the cases that pose the greatest threat to the environment.

Hazardous substance releases are being tracked separately from fuel releases and the corrective action activities are not being delegated to the local water districts as are the fuel leak groups.

Two databases are used for cause of release analysis. The first contains materials of construction, corrosion protection, release detection techniques, and type of release. The second contains the site description and status report.

The progress of the corrective action programs is being limited due to current staffing levels. However, they have developed corrective action tracking systems for hazardous substance releases and fuel releases. The group with hazardous substance has initiated a number of corrective actions and has closed some cases. The group with fuel releases is still developing its corrective action program in cooperation with local agencies.

TRIP REPORT SUMMARY
SUNNYVALE, CALIFORNIA TRIP I
MARCH 27, 1987

Overall management of the Sunnyvale UST Program is placed in the Department of Public Safety, with the State Board of Water Resources assuming the lead for guaranteeing the proper installation of monitoring devices and any necessary remedial actions that may be required for releases of hazardous waste and/or chemicals. All sites are required to have an operating license issued by The Department of Public Safety. The department reviews and approves both the location of the monitoring wells and any device used for detection and/or containment.

Sunnyvale has a total of approximately 575 tanks. Since 1983, 102 releases have been reported, with the majority due to overfills and spills. Wrapped-steel tanks make up 70% of the tank population and 90% of tank failures come from this group. Most of the failures are in systems that are over 20 years old. Only one double-walled tank has failed. Most of the piping releases occur in the pressurized FRP piping, due to piping glue joint failure.

All new UST's are required to have secondary containment on piping and the tank. Existing tanks are required to have monitoring wells or automatic inventory control (with periodic precision testing), 518 tanks have monitoring wells.

Most of the releases are discovered through precision testing and a number of previously unknown releases are being discovered.

Approximately 70% of the facilities are in compliance with the monitoring regulation. Repairs are allowed only if the tank can retain its U.L. listing. Existing tanks are allowed to remain in use indefinitely (with monitoring). Tank closures are inspected and approximately four closures per month are performed. Abandoning in place is not allowed in Sunnyvale.

Whenever a potential release is discovered, the facility is required to either perform a precision test or pull the tank system. If site contamination is observed, a form letter is sent to the facility requiring them to initiate a remedial action.

TRIP REPORT SUMMARY

BROWARD COUNTY, FLORIDA

April 2, 1987

Broward County UST Program is governed by state and county regulations. The bulk of investigation responsibilities is directed to the County Environment Quality Control Board (EQCB).

A rather prolific sand formation, the Biscayne Aquifer, lies beneath the county at depths ranging from one to thirty feet. In order to protect the Aquifer, the county has calculated a 270-day flow radius about their in place well fields.

There are 1,050 permitted facilities that have a combined total of 3,500 to 4,000 underground storage tanks (UST). An additional 500 tanks are estimated to be at unpermitted facilities. The tank failures seen by the EQCB are only at older installations. Only one new piping system failed due to poor installation. Broward County investigated 46 release cases; in 14 cases, cause of release was determined. The greater percent of releases was due to overfills and spills.

All facilities, regardless of location, require groundwater monitoring wells. Secondary containment and a continuous monitoring system is required for the sites within the zone of influence.

Piping system leak detectors (PSLD) are required of all UST and have proved to be effective. The majority of the releases are discovered at the time of monitoring well installation and when a tank system is closed.

Besides the groundwater monitoring and PSLD, Broward County is also using overflow protection. All three of these systems have been installed at all facilities within three to six months after license issuance.

Pipe repairs are allowed but lining the tank is not. Abandonment of tank in place is permitted after properly following regulations. Fifteen to twenty releases have been found out of 300 closures.

The county realizes that their program is not perfect but they also recognize its good features. The county UST program is staffed by three groups: 1) the industrial waste section; 2) the technical support section; and 3) the enforcement section. These groups meet with the state staff on a monthly basis to divide release cases. Another feature about the UST program is the preparation of as-built drawings by professional engineers which helps to assure improved installations and has eased the permit evaluation burden.

TRIP REPORT SUMMARY

DADE COUNTY, FLORIDA

April 3, 1987

Dade County Underground Storage Tank (UST) Program is governed by two sets of regulations -- those by the state and those by the county. Unlike Broward, Dade County does not have a cooperative relationship with the state to share release investigations.

Also, in contrast to Broward County, Dade County's Biscayne Aquifer (a prolific sand formation that lies beneath the county) lies at very shallow depths, usually five to seven feet and often more shallow.

There are 1,405 permitted facilities in Dade County and an estimated 4,000 to 6,000 tanks at these facilities. Since 1983, 600 of the 1,405 facilities have been inspected and 215 releases have been discovered. They expect to find 200 to 300 more cases as they inspect more facilities. The majority of the releases are due to overfills and spills. The second major cause of release is loose piping and the third is corrosion of bare steel tanks. Sometimes FRP tanks fail at installation or from gauging stick punctures.

Dade County has a fairly complex approach to protecting its water supply. They divide the Aquifer into four zones according to distance from their currently in-place pumping well. The requirements become more stringent as the zone gets closer to the well field. All zones require

continuous monitoring devices while only some require secondary containment.

Secondary containment provision allows systems ranging from synthetic "skirts" to double walled tanks. Cathodic protection for metal tanks is required but cannot be substituted for secondary containment and release detection systems. A Florida PE must approve all systems and should be on site when the system is constructed. Both the containment tank system and the monitoring wells must have as-built drawings in the final submission.

For sensitive areas, in addition to the above requirements, it is required that existing wells be bailed and checked for sheen.

The variety of release detecting devices that are used include: 1) monitoring devices, which have detected approximately 90% of the releases discovered; 2) manual groundwater monitoring; 3) automatic groundwater monitoring (pollutant); 4) soluble cable-type detectors; and 5) inventory

controls which has been more useful in determining the volume lost than in discovering releases.

The County's program implementation includes: 1) modifying the secondary containment and monitoring requirements to a four-tiered system; 2) repair of tank systems, including lining; 3) development of overfill and spill control requirements; 4) monitoring wells; and 5) requirement to report releases within four hours.

In-place abandonment of tanks is allowed but it is required that monitoring wells be placed around the tank and checked for sheen. If the tank is to be pulled, it is checked for free floating product in the tank hole.

It is felt that the best feature of Dade's UST program is the extensive communication with UST owners and operators and that the best way to implement a program is on an local level.

ONTARIO PROVINCE, CANADA
MINISTRY OF CONSUMER AND CUSTOMER RELATIONS
FUEL SAFETY BRANCH

SUMMARY

Ontario Province has a successful regulatory program for underground fuel storage tanks which was initiated in 1974 and presently regulates 30,000 tanks at some 8,000 locations monitored by 33 inspectors. Voluntary compliance is working extremely well and those subject to regulation are seeking more, not less regulation. While the number of locations has decreased from 13,5000 to 8,000, the decline appears to be based on economic reasons other than regulatory costs. Maximum environmental protection is obtained with standards less than proposed by USEPA. Cost of implementation is not oppressive to small businesses.

A protracted 15 year phase-in of regulations of pre-regulation tanks has not produced any appreciable environmental impact. Simple upgrading by addition of cathodic protection and interior lining appears to be working successfully. FSB estimates 72% of pre-regulation tanks have been retrofitted.

Utilization of existing association standards for equipment and installation functi0ons as well as federally instituted standards.

Release incidents on tanks and piping covered only 0.16% of the tanks under regulation. Post regulation release incidents are virtually all piping failures; post regulation tank failures are attributable to faulty and improper installation rather than corrosion. Of the reported releases, 34% resulted in off-site migration of liquid or vapor. The majority of releases were site confined without secondary containment and required disposal of an average of 10 cubic yards of soil, 90% of releases were owner reported and tank releases are 95% from pre-regulation tanks and detected by manual DIPS. FSB data indicates that reported release incidents have peaked and appear to be on a downward curve.

TRIP REPORT SUMMARY
CITY OF AUSTIN
AUSTIN, TEXAS
MARCH 9, 1987

- Austin estimates that close to 90% of the registered facilities are in compliance with their regulations. The apparent success of the Austin UST program is due to a large degree on their inspection program that involves witnessing each tank test, closure and repair activity. The tracking systems used, which relies on well developed concise forms, supplies documentation on the case history or each facility.

- Two independent research efforts, that used local tank testing and repairs records as the data sources, found that most of the problems identified were not related to the tank itself. One study, conducted by the Austin Fire Department, examined 197 tank system test reports. Only 30, or 15%, did not pass the integrity test. From a review of inspectors' field notes, repair records and tank testers comments it was found that 5 of the 30 failed systems were attributed to corrosion of the tank surface or structural failure of the tank. Structural failure of the tank, was interpreted for this study, as a loss of structural integrity, for example breaks in weld seams. The problem area identified for 25 of the 30 failed systems were attributed to : vent line leaks, leaking pipe unions, loose fittings on top of the tank, or corrosion of the piping. The results of this study were confirmed through the field experience of the Austin inspectors. Versar interviewed the principal investigator of the study and confirmed the completeness of the information sources used and the procedures followed to obtain these findings.

- A local vendor, that services the Texas area who has performed more than 5000 tank tests since 1981, conducted a similar analysis of 483 tank test records. He found that of 217 problems identified by tank testing, only 13, or 8%, had a problem with the tank (other than loose fittings). According to this study, 37% of the repairs that were identified through tank testing were related to the product line. The specific leak catagories included under this heading were: pipe, union, and flex hose leaks. The next most common problem area was identified as tank fittings that represent 33% of the repairs required. These findings were corroborated by interviews with other vendors that service the Austin area.

- Through interview with the Austin regulatory personnel, it was determined that tank system closures generally occur for one of three reasons: 1) the tank system has been abandoned or taken out of service,, 2) the tank system failed a tightness test and cannot identify the problem, or 3) the parent company removes the existing tank system as part of a tank replacement program.

- A review of the program file that included both tank testing and closure reports indicate that most of the problems identified were not with the tank, but rather with the tank fittings, vents, and product lines. For example of 41 closure records that had comments related to the condition of the tank, only 7 indicated the presence of holes or perforations on the surface.

TRIP REPORT

THE SOUTHLAND CORPORATION

July 9, 1987

The visit was a follow-up on telephone conversations between Messrs. Lynch and Miller of Southland and Dave O'Brien of USEPA documented in Dave O'Brien's memo to the file on April 7, 1987. The main area of concern was in FRP tankage. Mr. Miller indicated that out of a population of some 3,000 tanks, installed by Southland, only 30 had failed. Some FRP tanks obtained by Southland in a buy-out in Florida had a high rate of failure which is traceable to one installation contractor who had failed to follow proper installation procedures. FRP performance is 95%+ dependent on proper installation.

TRIP REPORT SUMMARY

RYDER TRUCK RENTAL, INC.

May 18, 1987

Ryder has 1,200 facilities with an estimated 6,000 tanks. Approximately 50% of the releases are due to overfills and spills, leaking pipes account for 45% of releases with the other 5% being attributed to leaking tanks. The principle cause of line failures is corrosion and it is felt to be the most severe problem.

All piping systems throughout the company have "Red Jacket" leak detectors. In the preferred installations, tanks have double walls with a space between the tank walls that is partially filled with brine. A level detector will inform the owner if either tank wall is leaking. Inventory control is also used to locate releases but monitor wells were not thought of favorably.

After a suspected release is reported, an initial investigation is made. Precision tests of tanks and lines are made and if the release is confirmed, the state government, the local fire department and the local environmental program, as applicable, are notified.

Tanks are never reused. The only retrofits that are used are to add cathodic protection or overfill protection. Tanks are removed from the ground only if in an environmentally sensitive area, or in the event that the tank has evidenced a past problem. If a tank is removed, soil or groundwater samples are taken.

TRIP REPORT SUMMARY
AMOCO OIL COMPANY
JUNE 18, 1987

Amoco oil company operates 4,675 outlets with a tank census of 21,500 tanks, 20,000 which are steel. An internal tank retrofit program, Amoco Leak Assessment and Risk Management (ALARM), was initiated in 1984 for tanks 10 years of age or older to reduce risk and liability exposure. Since program inception, reported releases have been in the 40-50 range annually (0.2% of tank population).

Major causes of release are 90% from tanks and piping and 10% from overfills. Response to the major causes is accommodate by the retrofit/replacement aspects of the ALARM program.

Release detection is accomplished through inventory reconciliations and monitoring wells. Suspect releases are approached through API's recommendations.

Amoco believes precision test methods cannot be accurate and repeatable below 1.0 gph. Further, the Rogers age and soil correlation is not accurate; internal formula have twice the accuracy.

Amoco supports the UST regulation by EPA but fears the specifitivity of the pending state regulations.

TRIP REPORT SUMMARY
MURPHY OIL COMPANY
MAY 27, 1987

Murphy Oil operates 250 outlets with a tank census approaching 800 tanks. An internal program is in place to replace all tankage with new FRP units; the program has slowed to determine what EPA's final regulation will require.

Causes of release are estimated as: Tanks 50 - 60%, Piping 39 - 44%, and Overfills 1% or less. Only 3 releases have been reported in the last year. Release detection is from manual inventory reconciliations.

TRIP REPORT SUMMARY
SAN JOSE CITY
April 3, 1987

Responsibility for implementing the underground storage tank (UST) regulation in San Jose is with the fire department but is shared with the state water board, department of health services and the Santa Clara water district.

San Jose considers their entire aquifer to be equally valuable, regardless of the distance from existing wells. Implementation of the UST regulation is going slow due to: (1) lack of resource; (2) policy of requiring the installation of monitoring devices only after city inspection; and (3) responsibility for implementation of the program is too divided.

San Jose has an estimated total of 1,300 to 1,500 tanks in approximately 800 locations. Since 1983, there have been 250 reported releases. Release incidents are increasing and it is felt that the increases are partially due to increasing city enforcement and a large number of old UST. Approximately one fourth to one third of releases were due to overfills. Other releases are attributed to 10-15 piping failures per year. These are largely bare steel, galvanized steel and FRP pipe. Approximately 30 steel tanks have been repaired. New tankage installed are double wall tanks made of FRP, clad steel or coated and cathodically protected steel. Three of the new FRP tanks have failed.

Existing tanks are required to have either monitoring wells or automatic inventory control (with periodic precision testing). Vadose zone monitoring is required unless the site can demonstrate that their tanks are in the groundwater at all times. Vadose zone systems consist of at least one well in the backfill near each gasoline tank, two for each diesel tank, one for each island, and one or more for the piping. The installation must be certified by a registered geologist. Clayey material, San Jose's primary soil composition, could have a detrimental effect on the functioning of the Vadose system.

Abandonment of a tank in place is allowed. When a tank is removed, a soil sample must be taken from the bottom of the hole and tested for hydrocarbon content.

San Jose has been unable to develop and implement a data management system because of the lack of resources. The shortage has also prevented the program from being fully operational.

TRIP REPORT SUMMARY
PEI INSTALLERS
DALLAS, TEXAS
JULY 7, 1987

The meeting with the PEI installers resulted in several important findings:

- The experienced and knowledgeable installers believe state licensure would be a giant step in the right direction. Most installation problems must be solved by the installers themselves.

- Corrosion is the major release cause with the tanks; installer errors or accidents with piping.

- A build-up of poor attitudes and the survival of bad practices must be overcome to solve the installation problem.

- Great progress has been made through the use of interim prohibition tanks. (They confirmed the 0.5% failure rate of FRP tanks.) However, piping is more complicated and less forgiving of mistakes that are human and unavoidable to a large extent.

- Pressurized piping is more of a threat and they recommend pressure leak detectors be installed as quickly as possible on existing tanks.

- The influence of corrosion will vary in different parts of the country. The use of clean, sandy backfills appears to eliminate the localized (or pitting) corrosion phenomenon, but not generalized corrosion. All corrosion holes do not leak--many get plugged up by the corrosion by-products or surrounding dirt.

- Failures in delivery piping are inevitably going to continue because of human control problems. Annual testing and pressure detectors are needed. More than 70% of volume releases will be thereby avoided in the future.

- Overfill shut-off is the best approach, but not yet widely available in this country.

- Double-walled tanks and piping are good ideas, but there is not much experience with them and most people will not voluntarily buy it.

TRIP REPORT SUMMARY
STATE OF VIRGINIA
August 5, 1987

The Pollution Response Office of the Virginia Water Control Board (VWCB) maintains three data sources: (1) a telephone log book of pollution complaints received by phone at the VWCB; (2) monthly investigative reports of pollution complaints received by the VWCB; and (3) a computerized database of oil spill incidents from June 1985 to the present.

From July 1986 to June 1987, VWCB's database has 160 UST-related pollution reports on record. Half of the reported cases were concerning LUST and another twenty percent involved line leaks. Unlike the telephone log or monthly report, all of the incidents on database were investigated. There is no computer database set up for data collected earlier than July 1986. Information for that time period would have to be derived from the telephone logs and monthly reports.

TELEPHONE REPORTS SUMMARY
FRED C. HART
RESULTS OF TELEPHONE DATA COLLECTION ON CAUSES OF RELEASE

Telephone calls were made to ascertain whether documentation existed on the causes of releases from underground storage tanks containing petroleum products, and to determine if the documentation could be made available to EPA. The calls also attempted to qualitatively prioritize the major causes of releases in terms of their frequency of occurrence. The following 7 persons were called, 6 representing the transportation industry and one representing a regulatory agency.

- Richard Cross
  Commercial Carrier Journal
- John Java
  Yellow Freight System
- Don Dawson
  Roadway Express
- Bill Scherrer
  Consolidated Freightways
- Captain John Hall
  Los Angeles City Fire Department
- Bill Tracy
  American Trucking Association
  Maintenance Council
- Howard Chesneau
  Fuel Quality Services

The calls identified piping problems as the most common cause of releases, with installation being the second most identified cause. Most respondents admitted their information might not be able to accurately identify whether the piping failed due to faulty material or design or failed due to installation errors such as improper backfill or improper protection from overhead loads.

Most respondents were hesitant to say that they actually had well-documented records which could be used to identify causes of release. However, the following persons agreed to discuss the matter further with EPA and agreed to potentially give EPA access to their records (all emphasized the importance of EPA specifying exactly what information was required):

- John Java
  Yellow Freight Systems

- Bill Scherrer
  Consolidated Freightways

- Captain Hohn Hall
  Los Angeles City Fire Department

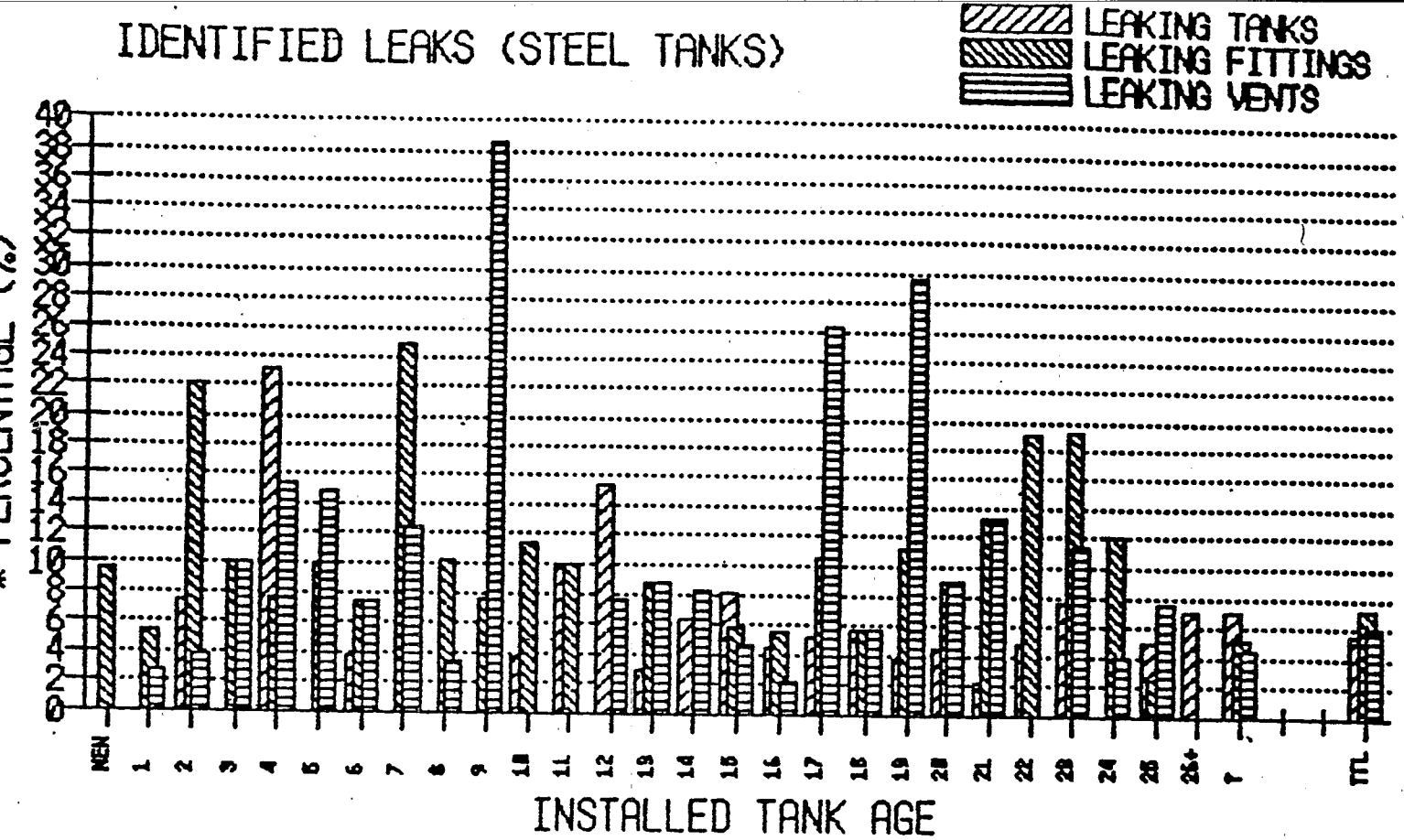
Additional persons were also identified who might have records on the causes of releases. Most of these additional references were in the regulatory agencies who receive reports or releases as they occur. Calls to these persons will be made when we are authorized by MRI and EPA. The additional contacts which we recommend be made are:

- Harry Fink
  ABF

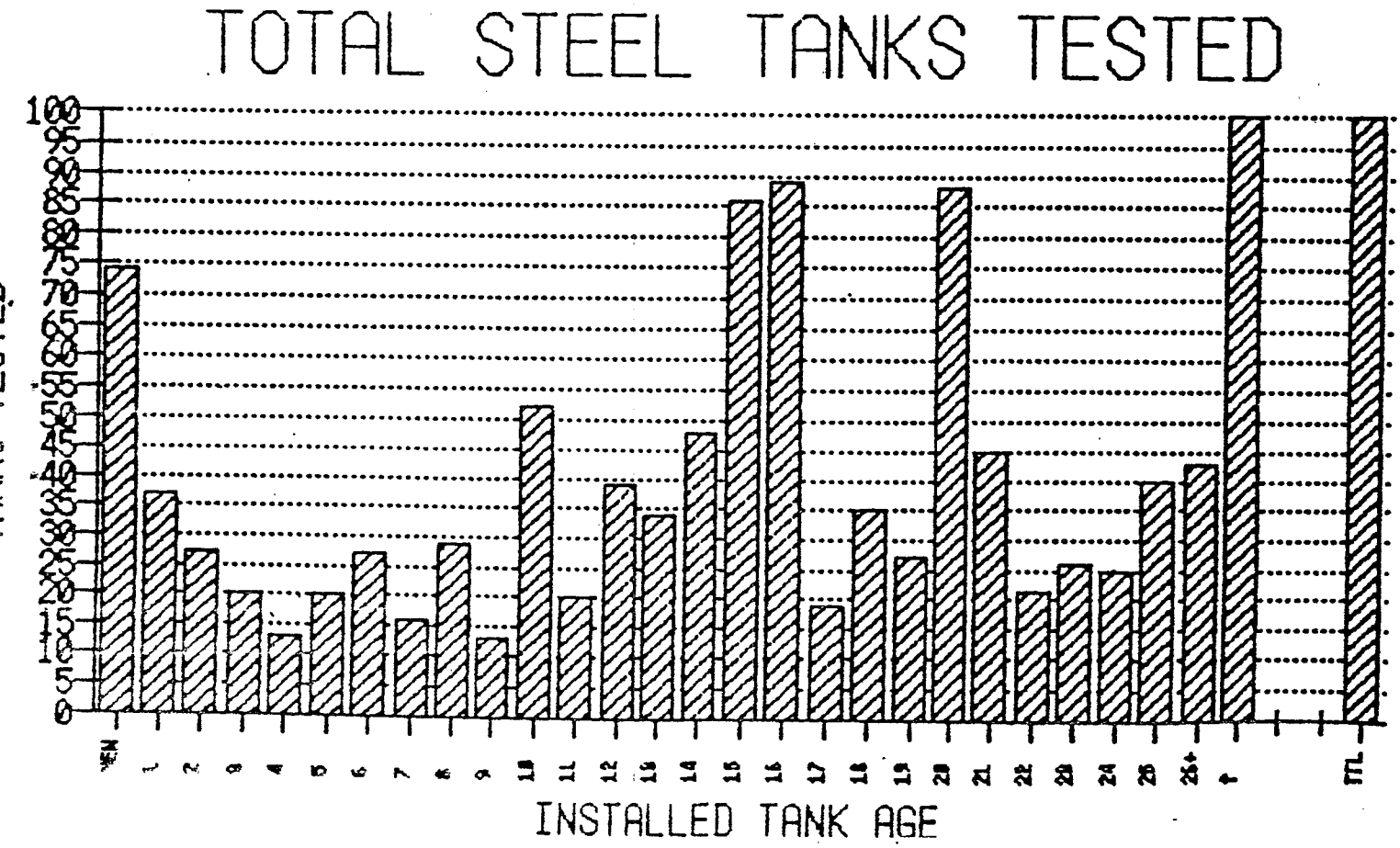
- Karl Sjoberg
  Los Angeles County Engineer

- Hank Yacomb or Hosh Workman
  Los Angeles Regional Water Quality Control Board

- Bob Flesher
  AGA Gas



Percent of total tanks tested by installed age bracket, 100% corresponds to the total number of tanks tested in that catagory. (See graph below)



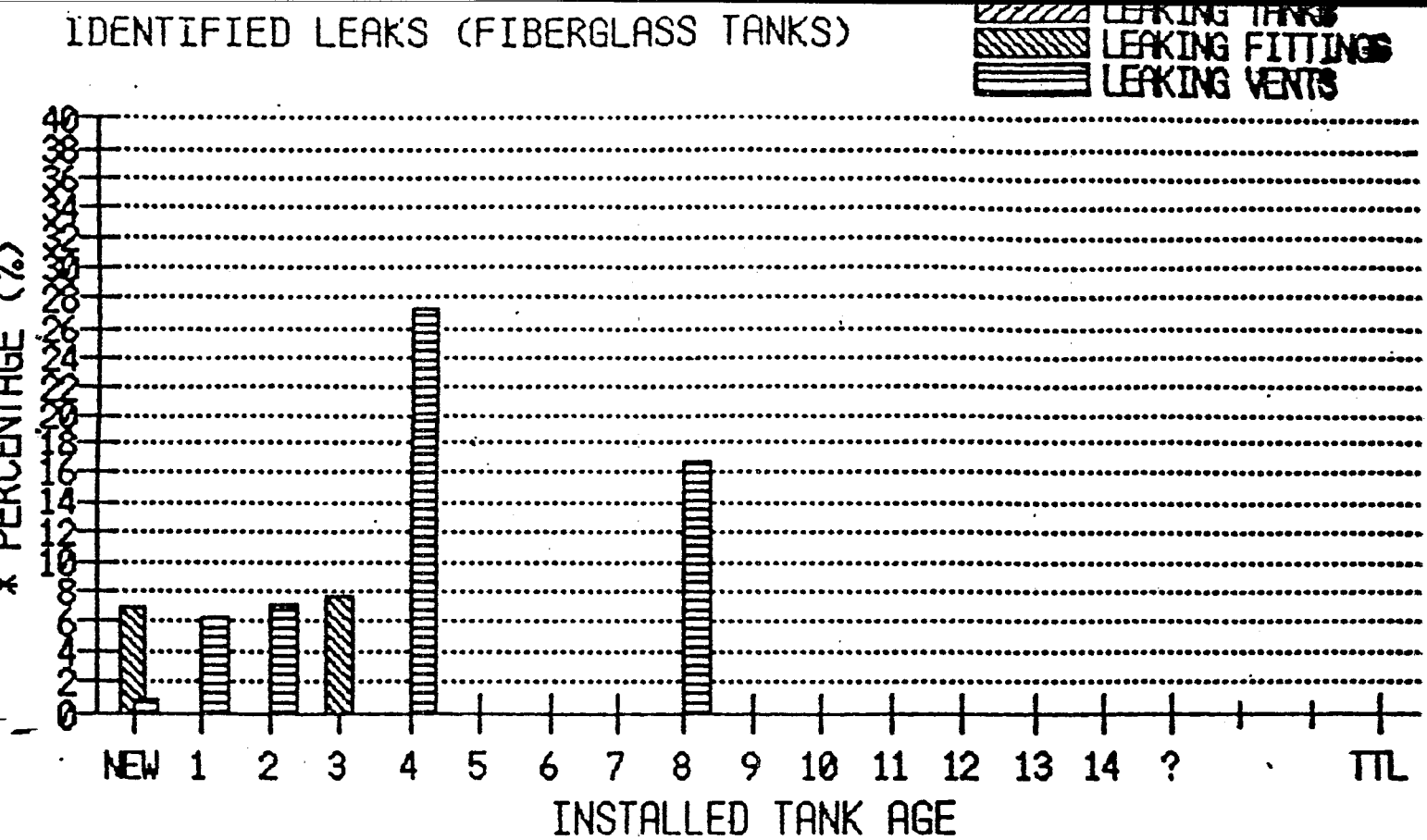
SERVICE STATION TESTING INC.
L.U.S.T. SURVEY
"COMPARISON OF FIBERGLASS TANK TIGHTNESS RESULTS BY AGE OF TANK"

INSTALLED TANK AGE	TIGHT SYSTEMS * #	TIGHT SYSTEMS * %	LEAKING TANKS #	LEAKING TANKS %	LEAKING FITTINGS #	LEAKING FITTINGS %	LEAKING VENTS #	LEAKING VENTS %	TOTAL TANK SYSTEMS * TESTED
NEW	118	92.2%	0	0.0%	9	7.0%	1	0.8%	128
1	15	93.8%	0	0.0%	0	0.0%	1	6.3%	16
2	13	92.9%	0	0.0%	0	0.0%	1	7.1%	14
3	12	92.3%	0	0.0%	1	7.7%	0	0.0%	13
4	8	72.7%	0	0.0%	0	0.0%	3	27.3%	11
5	10	100.0%	0	0.0%	0	0.0%	0	0.0%	10
6	3	100.0%	0	0.0%	0	0.0%	0	0.0%	3
7	1	100.0%	0	0.0%	0	0.0%	0	0.0%	1
8	5	83.3%	0	0.0%	0	0.0%	1	16.7%	6
9	1	100.0%	0	0.0%	0	0.0%	0	0.0%	1
10	1	100.0%	0	0.0%	0	0.0%	0	0.0%	1
11	1	100.0%	0	0.0%	0	0.0%	0	0.0%	1
12	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0
13	3	100.0%	0	0.0%	0	0.0%	0	0.0%	3
14	6	100.0%	0	0.0%	0	0.0%	0	0.0%	6
UNKNOWN	10	100.0%	0	0.0%	0	0.0%	0	0.0%	10
TOTALS	207	92.4%	0	0.0%	10	4.5%	7	3.1%	224

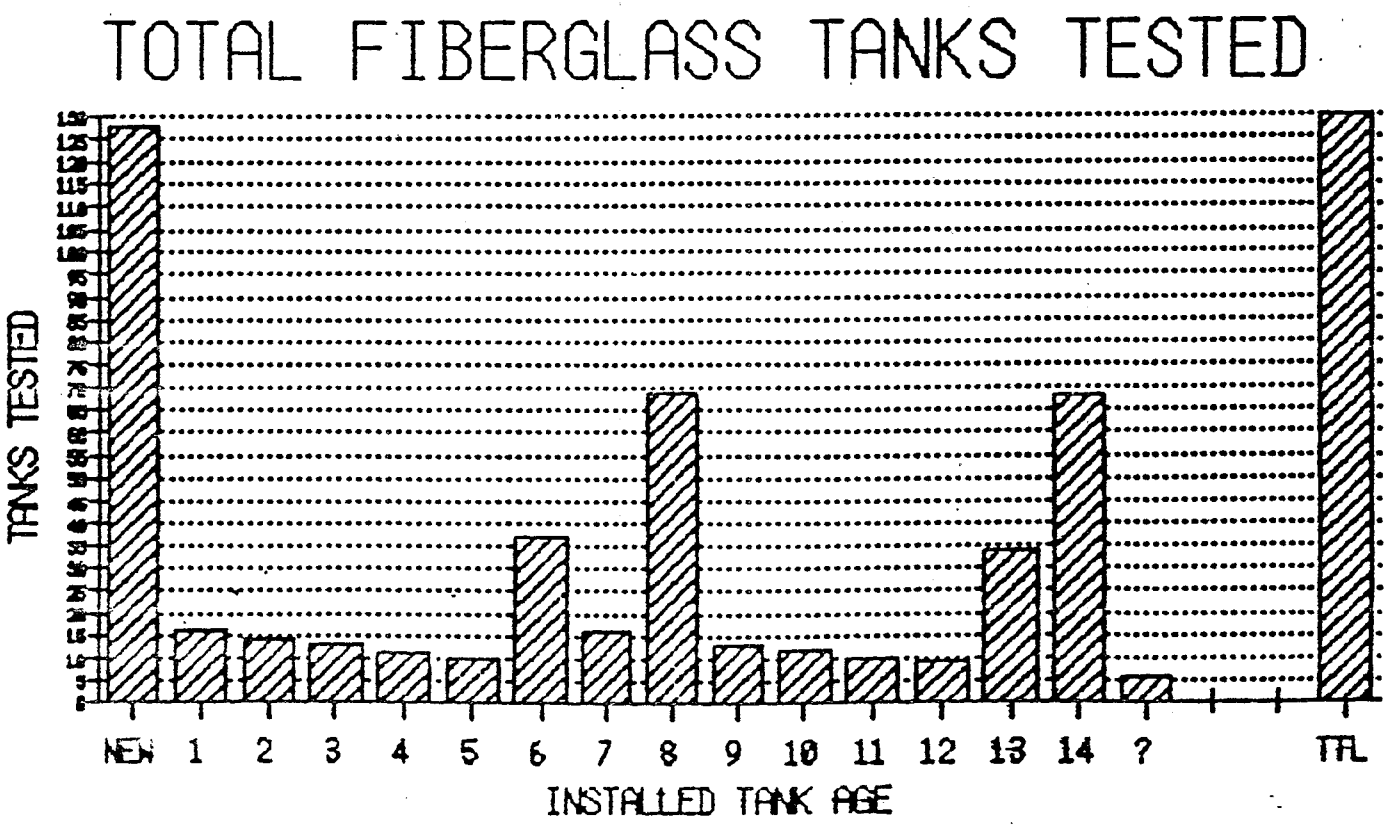
* Systems as used here include the tank, fittings attached directly to the tank, and the tank vents. product lines are excluded except for the fitting attaching the line to the tank.

L.U.S.T., Leaking underground storage tanks

No available data for fiberglass with installed ages older than 14



Percent of total tanks tested by installed age bracket, 100% corresponds to the total number of tanks tested in that catagory. (See graph below)



Notes of the
July 8th, 1987 Meeting
with PEI Installers
at Dallas/Fort Worth Airport

July 15, 1987

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

PEI MEETING OUTLINE

SECTION	TITLE	PAGE
	PREFACE	1
I.	EXECUTIVE SUMMARY	2
II.	BACKGROUND INFORMATION AND MAJOR RECOMMENDATIONS	3
III.	TECHNICAL DISCUSSIONS	9
	o Tanks	10
	o Piping	13
	o Spills/Overfills	16
IV.	FAILURE ANALYSIS REACTION	18

PREFACE

On July 8, 1987, Robin Parker (Jacobs Engineering) and David O'Brien (EPA-OUST) met with Bob Renkes (Executive Vice President) and Sandra Parkison, (Administrative Director) of the Petroleum Equipment Institute) and eight PEI member/installers from different parts of the country to discuss underground storage tanks. This meeting was arranged to take place at the Dallas/Fort Worth Airport by PEI. EPA reimbursed the PEI installers their costs of travel for getting to the meeting. Letters were sent out to each meeting attendee by PEI prior to the meeting and included a list of questions prepared by EPA and several trip reports summarizing results of local visits by EPA contractors concerning causes of release. Several of the installers had obviously discussed those questions with several of their work crews in preparation for the meeting. The average experience of these installers was between 20-30 years. EPA's purpose of this meeting was to record (as viewed "from the trenches"), the response of several experienced installers concerning some important technical questions pertaining to underground storage tank systems.

I. EXECUTIVE SUMMARY

The meeting with the PEI installers resulted in several important findings:

- The experienced and knowledgeable installers believe state licensure would be a giant step in the right direction. Most installation problems must be solved by the installers themselves.

- Corrosion is the major release cause with the tanks; installer errors or accidents with the piping.

- A build-up of poor attitudes and the survival of bad practices must be over-come to solve the installation problem.

- Great progress has been made through the use of interim prohibition tanks. (They confirmed the 0.5% failure rate of FRP tanks.) However, piping is more complicated and less forgiving of mistakes that are human and unavoidable to a large extent.

- Pressurized piping is more of a threat and they recommend pressure leak detectors be installed as quickly as possible on existing tanks.

- The influence of corrosion will vary in different parts of the country. The use of clean, sandy backfills appears to eliminate the localized (or pitting) corrosion phenomenon, but not generalized corrosion. All corrosion holes do not leak -- many get plugged up by the corrosion by-products or surrounding dirt.

- Failures in delivery piping are inevitably going to continue because of human control problems. Annual testing and pressure detectors are needed. More than 70% of volume releases will be thereby avoided in the future.

- Overfill shut-off is the best approach, but not yet widely available in this country.

- Double-walled tanks and piping are good ideas, but there is not much experience with them and most people will not voluntarily buy it.

II. IMPORTANT BACKGROUND INFORMATION AND MAJOR RECOMMENDATIONS (Provided by PEI Representatives)

A. The Profile of PEI Installers

It was noted at the meeting that the installers in attendance were unique in several respects. First, they were from all parts of the country, including California, Colorado, Iowa, Texas, Wisconsin,

Georgia, Delaware, and Pennsylvania. (PEI made sure a wide cross-section was in attendance.)

Second, they were very experienced with servicing underground storage tank systems and reported 20 years and 38 years as the shortest and longest experience in the group. (Twenty-five years was most common).

Third, Mr. Renkes reported that this was a very successful group of businessmen each knew the technical aspects of UST installation/servicing and repair business quite thoroughly.

Fourth, all of these installers provided both steel or fiberglass tanks and several tested both tanks and lines.

Fifth, most of these gentlemen only got 10 to 20% of their business from major oil companies (one got approximately 50% from that sector of the industry). In sum, Mr. Cooper succeeded in gathering a unique group of men who were independent-minded, who had not gotten together before the meeting; who clearly had wide-ranging and long-standing experience with the underground storage tank system technology; and who clearly felt free to provide technical information that could be helpful to EPA in finalizing the UST system regulations. It became obvious in the meeting that these esteemed gentlemen knew what they were talking about.

C. Important Changes within the Industry

During the meeting, these installers reported that a significant transformation has taken place over the last 15 years in the petroleum marketing industry. Fifteen years ago, the major oil companies dominated the retail motor fuel market place. Each had very experienced teams of engineers who developed their own firm's detailed company specifications for designing retail stations (including blueprints and drawings). The on-the-job oversight by the companies was extensive then, and resulted in the actual training (in effect) of many of the present PEI membership. This was also significant because, prior to the oil crisis of the early 1970's, major oil also controlled many of the gasoline stations. Thus, although major oil company engineers would often look for economical tank systems, they generally insisted upon adequate technical designs as part of the "bottom line."

Since the early 1970's, there has been a major shift in the retail motor fuel marketing industry. Major oil companies no longer dominate and have progressively withdrawn as builders of gasoline stations. Major independents and jobbers have become the major purchasers of new tanks and have prompted significant changes in customer attitudes faced by PEI members. The independents are still very concerned with costs as a bottom line, but often do not have the technical knowledge to insist on effective equipment selection and installation. Thus, the low bidder often gets the new installation job or the independent gasoline station owner arranges several deals which cover separate contracts within the

new tank installation. Cut-rate backfilling of piping or construction of substandard concrete pads is not uncommon in an effort to reduce costs. Also, there are many new non-PEI installers in the business (many simply plumbers with spare time), who do not know proper system equipment choice and installation. Their inadequate understanding and quality control enables them to low bid new installations.

The PEI members reported they are often called by these new guys concerning various technical matters, and it is obvious that a whole new round of learning is necessary for them to become successful installers in the future -- but, there is no one around to train them now. Some of these new firms are highly capitalized construction companies, but with little actual experience in this area. The major oil companies are also generally running "mean and lean" right now and their reduced engineering teams are often recent college graduates with budgets of between 2 to 8 million dollars to spend, but no field experiences. (Apparently, the same major oil company representatives now call PEI members for technical advice; not vice versa.)

It was suggested at the meeting that all these major changes portend the difficult times ahead in trying to improve installation performance through regulation. The basic infra-structure for installation is still undergoing major changes. The misinformed or under-informed customer is now causing technical problems to be glossed over by this unsuspecting "low-bidders" type of decisionmaking; according to these experienced installers.

C. Implementation Is the Key

These PEI members suggested that problems in the industry have been buried for years and covered up by an "out-of-sight, out-of-mind" mentality. Implementation of good practices is the key issue, and therefore, they strongly recommend to EPA that installer certification or licensure be a requirement in the final rules. They cited the licensure of electricians as an example of the kind of internalization of standards and professionalization of the industry that is needed to make proper installation an industry-wide practice. This other industry was noted as having self-directed technicians, primarily because licensure assures their livelihood is threatened if they do not do their job right.

These PEI members believed that self-directed installers are the only way to assure proper implementation. They noted that, at present, there are many inexperienced third party inspectors of installations making the rounds. In addition, most installations are not inspected at all. Thus, most decisions about equipment choice and proper installation are completely upon the shoulder of the installer "in the trenches." State licensure programs would be a giant step forward in assuring sound installation practices are followed.

D. Enforcement Is Important

The PEI members at the meeting also emphasized the need for a regulator's presence in the field. They were quick to point out the past bad practices and short-cuts that resulted in environmental releases had no adverse reprecussions to these irresponsible installers. Apparently, the cost of going back and repairing mistakes was not a sufficient enough incentive to assure sound initial installations. While growing liability problems will change this attitude somewhat in the future, new standards will be ignored if the regulated community does not believe that EPA and the states will enforce requirements. These experienced PEI members would welcome an independent third party inspection requiring minimum standards are applied consistently at each site.

These members were emphatic to point out that there are presently real problems in the field because special interests and connections within the industry are well established. The business goals they support are in direct conflict with societal goals of environmental protection. The example of this conflict they described at the meeting was the case of a tank tester who serves the regulated community and finds a leak. Must he report it? If he is good at finding leaks, will his service be used? They believe that an absence of enforcement will assure these established patterns, conflict of interest, and ties remain undisturbed, and current behavior and attitude problems will not change.

E. The Major Causes of Release

The PEI members cited two major causes of release that had to be controlled/regulated by EPA.

1. There is a need to have better control over who installs the tanks, what is hooked up to them, and did they do it right. As previously mentioned, they believe state licensure and enforcement are the key controls needed. The "system" is an installer's problem.

2. They believe that corrosion (the primary failure mode) must be prevented. They also believe that the new "interim prohibition tanks" will largely solve this problem for the tanks.

III. TECHNICAL DISCUSSIONS

Attached to this trip report is a copy of the questions that were mailed out to the PEI members prior to the meeting (Attachment I). Each of the four technical topics (piping, fittings, tanks, and spills/overfills), were discussed at the meeting in consideration of these basic questions. The installers emphasized that corrosion and improper installation are the major causes of release.

They provided the general estimate that 4-5 years ago, 50 percent of the systems would not have passed a tank tightness test and 10 percent were significant problems. They estimate that this earlier level has decreased somewhat due to the on-set of new state and local UST programs and on-going risk reduction programs initiated by several major companies, including most major oil companies. They confirmed that their collective experience has shown many systems with perforations that do not leak. It was estimated that perhaps 15 to 20 percent of existing systems are leaking (not counting spills and overfills).

A. Tanks

Concerning tankage, the installers reiterated that corrosion and improper installation were the primary causes of tank failure. Improper installation in their minds includes the use of improper soils (loam or clay soils that foster corrosion, or poorly compacted soils) in the backfill. They estimated tank failures as contributing 20 to 30% of all equipment-related releases.

Bare Steel Tanks

They expressed the opinion that external corrosion of bare steel tanks was primarily induced by contaminated backfill (including the use of clays or other native loams). They confirmed that the use of sand or gravel backfills has been seen to produce generalized, but not localized (or point) corrosion. External corrosion was often seen to occur at

the bottom of the tank. End cap seam corrosion was another culprit. With internal corrosion, the bottom foot to eighteen inches of the tank is the first to go; with a focus on the shell to head seam.

An informal polling revealed a wide disparity in the reported onset of corrosion-induced tank system failures with age and location:

Age of Tank	South California	Mid-Atlantic Coast	Atlanta	Wisconsin*	Denver
0-10 years	30%	30%	0%	0%	0%
10-20 years	60%	60%	40%	10%	10%
21-30 years	Few	Few	Few	25%	25%

* Depends on groundwater level.

Thus, while the consensus was that corrosion-induced failures of bare steel tanks was significant, it is apparently a very site-specific phenomenon. One of the mid-west installers reported that less than 100 of the 300 tanks he closed and his dealer cut-up last year were leaking; 75% of the leakers were corrosion-induced (one was internal corrosion).

Protected Steel Tanks

The discussion of coated and protected or clad tanks related that experience is not yet extensive, but no one had seen any failures yet. One installer noted he had closed several tanks with anodic protection and they were in fine shape. There was some experience with wrapped tanks, which appear to improve upon bare steel performance, but had some

problems with installation and water getting in between the tank and the wrap. The general sense was that the premanufactured protected steel tanks work and will result in at least an 80 to 90% improvement over the current bare steel tank corrosion situation.

Fiberglass Tanks

Initial discussion of FRP tanks revealed some reservations about the technology and a swapping of "war stories" An informal polling revealed, however, that these installers had installed an estimated total of 1,500 to 2,000 FRP tanks over the years with approximately 7-8 failures. These installers reported only one failure over the last 10 years. They all complimented the industry training work that has been provided towards the installation of FRP tanks and expressed their awareness of the need to carefully install FRP.

Double-walled Tanks

Many of the installers expressed a preference for double-walled tanks as a way of further reducing leaks. However, at least one was concerned that it may introduce new problems that are as yet unknown. Few appeared to have extensive experience with this technology and expressed reservations as to how well it would be received by cost-conscious buyers, if required by EPA in their state.

B. Piping

The installers expressed their opinions/experiences that piping failures are the main problem by a 5 to 10 to 1 ratio compared to problems with the tank. They reported that it is not uncommon to re-pipe tanks for reasons other than they are leaking, e.g., site modifications. In general, they expressed the concern that piping and equipment fitted to the tanks are less forgiving (than the tanks) of installation errors and are generally more complex to install -- there are more conditions prevailing in assuring proper installation of piping versus tanks (e.g., a 10% breakage rate by other trades during construction was cited as typical with the piping).

Steel Piping

They witnessed that more than a few "pipe-benders" are still in operation and these practices weaken piping and induce corrosion. Steel or galvanized piping has corrosion problems similar to bare steel tanks. They also see numerous fitting failures/stress breaks; accidents at the site that jog the unanchored impact values at the dispenser and break the piping; and corner-cutting by the owners at installation that can weaken piping. One example cited was numerous sub-contractual arrangements that had someone else placing backfill around completed pipework, final grading, and doing inappropriate pad construction that is inadequate in protecting the piping from normal stress forces from above.

FRP Piping

Some expressed work crew preferences to work with FRP piping as intrinsically easier and cleaner to use. Some FRP product piping are damaged during shipping but, in general, the materials are improving. they emphasized their collective experience is that you cannot mix the different types of FRP piping and proper installation must closely follow manufacturer's instructions.

It can get tricky to install FRP piping in cold weather, and they fear other construction site workers damaging it once it has been completed and left in place. The same fears were highlighted about possible adverse affects of frost heaves upon FRP piping failures. Also, not enough is yet known about how much future work on-site (e.g., digging up asphalt) will disturb FRP piping. They all insist it be integrity tested after the full job at the site is completed.

Suction versus Pressure Lines

Suction systems were cited as generally having only minor "leakage problems." The installers pointed out that suction pumping has operational problems in high altitude areas and some hot places during the summer months. Besides certain technical/operational advantages, pressure systems can be less expensive:

o one suction pump and line	$1100
o pressure pump lines	$400-$500
o one pressure pump that can service several dispenser lines	$800-$900

In general, failure modes for suction versus pressure lines are the same. But, pressure systems are acknowledged to pose more of a release threat. The buyers only focus on costs and ignore the additional risks posed by pressure piping. Significant losses can occur with pressure lines, particularly when owners do not carefully track their product. Each installer said he could easily cite at least 10 cases of significant damages posed by releases from pressurized piping failures. One example cited was where a faulty pressurized pipe resulted in an owner refilling a tank twice before noticing the breakage. The group further estimated that at a minimum, 70 percent of line volume losses could be eliminated by retrofitting continuous pressure leak detectors on all product lines within twenty four months. Such devices would only increase the typical $10,000 piping installation costs by $500 at new facilities.

Because of disruptions caused by future work at the site, accidental damage during system operations, and installation errors, the installers may only be able to reduce the volume loss about 20 percent if automatic pressure in line detectors are not required.

Costs of retrofitting continuous pressure sensors are about $165 per unit plus 2 hours labor cost in 80 percent of the cases. In

some situations, retrofitting is not straight forward and an additional extractable section of the pump must be added (and an additional cost of $650), taking 12 hours more labor. They further estimated that retrofitting on existing systems would result in 20-25% of the lines to be identified as leaking.

Automated line detectors are widely available in Southern California and cost $6,000 for 3 tanks and lines plus $2,000 installation costs. Pipe trench liners or double-walled pipe was estimated to cost within $500 of each other. Annual line testing costs about $200 per station and one member cited that at 100 Texaco or Shell stations, the following results from annual testing could be estimated:

10 - 12 faulty impact valves

1 leak (every 2 years)

2-3 bad Red Jackets

The installers did not believe manifolded pipes or fill tubes presented a leaking problem, except in overfill situations. Ninety percent of all commercial accounts (e.g. truck fleets) are suction pumping and 95 percent of all new retail/motor fuel accounts are pressure systems.

C. Fittings/Overfill and Spills

Three basic kinds of overfill/spills control equipment were discussed:

- An overfill shut-off device located in the tank or vent/fill lines (several types), most not widely available in the United States.

- A small containment catch basin at the fill pipe.

- A large volume catch basin at the fill pipe or manway catch basins available from tank manufacturers.

The large catchment basins/manway equipment are believed to pose safety threats due to explosions -- however, no examples were available of this happening yet.

They estimated that they see 75 out of 100 closed sites as having been contaminated by releases (at least somewhat), and 50 of them appear to be caused by overfill/spills. Two former transporters in the group provided the following estimated spill/overfill rates:

1 out of 25 deliveries have "minute" spills of 2 to 3 gallons

1 out of 100 deliveries have several tens of gallons of spillage.

They reminded us that most deliveries take place at the evening and drivers get paid by the load -- which encourages fast deliveries. They introduced a new meaning to the term "midnight dumping."

Although tank fittings were generally believed to be a small source of releases, they do pose leakage problems during overfill and spill situations which do not result in visible losses at the fill pipe connection (as discussed above).

A number of contractors were cited as taking installation short-cuts believing that vent lines and bung holes only handle "air." Some noted short-cuts were use of PVC pipe for vent lines, failures to tighten vent line joints, failure to glue joints, failure to tighten bung holes or use proper fixtures.

IV. REVIEW OF EPA FAILURE ANALYSIS

The installers were asked at the meeting's end to comment on some of the probabilities of failure that EPA is presently using in its analysis. The mark-up sheet follows. In general, they did not believe non-corrosion induced seam leaks or tank/fitting ruptures were real failure events. They also believed FRP tank failures estimates were much too high. More failures due to pipe corrosion or loose fittings was predicted. They emphasized that all tanks with holes did not necessarily leak.

PROJECTION OF EQUIPMENT FAILURE ON 1,000 TANKS IN A 30-YEAR PERIOD

CAUSE OF FAILURE	ICF	PEI
External Tank Corrosion	770	770
Internal Tank Corrosion	150	10
Seam Leaks	43	---
Tank Breakage	14	NIL
Pipe Corrosion	280	400
Pipe Rupture	34	-0-
Loose Fittings	50	100
Tank Rupture (Steel, Single Wall)	60	10
FRP Tank Rupture	230	25
Double Wall Tank Rupture	84	10
Steel Pipe Rupture	96	-0-
Double Wall Pipe Rupture	120	-0-
Screw Fitting Rupture	150	10
Steel Tank Installation Damage	30	30
FRP Tank Installation Damage	40	40
Pipe Tank Installation Damage	10	10
Fitting Installation Damage		100

Sign-up Sheet

Name	Company	Telephone
David O'Brien	USEPA-OUST	(202) 382-7815
Robin Parker	Jacobs Engineering	(202) 783-1560
Sandra Parkison	PEI	(918) 743-9941
Edward Ettl (WI)	Badger Oil Equipment	(414) 258-2777
Leland M. Freeman (TX)	SE & M, Inc.	(512) 573-7449
William Thompson (DE)	Callis-Thompson, Inc.	(302) 398-3253
Bob Renkes	PEI	(918) 743-9941
Orville Kubat (CO)	Kubat Equipment & Ser. Co.	(303) 777-2044
George Watkins (GA)	Watkins Service Co.	(404) 768-7867
Jerry Thomas (CA)	C.E. Thomas Co.	(213) 321-8420
B.D. Cooper (IA)	P.E.S., Inc.	(319) 377-6357
M.W. Farmer (PA)	M. W. Farmer & Co.	(717) 326-1541

QUESTIONS

1. Piping (used for product transport between the tanks and from the tanks to the dispensers)

   - Why does piping leak? What are the most common modes of failure you have seen (e.g. loosejoints, corrosion, breakage, other)?

   - What is your experience concerning the success/ failure of FRP piping?

   - What is the relative frequency at piping failures as compared to tank failure? Is there any experience to how often it will fail (at 100 stations over 20 years, for example).

   - What are the typical sizes of releases you have seen from piping?

     - Are there larger releases from pressure versus suction lines (even with systems that have red jacket type devices on them?)

   - Are the impacts from piping release often significant? Less or more significant than from tanks? Suction piping less significant?

   - What will the world be like 20 years from now if the federal proposal was implemented? Does FRP piping solve the problem?

2. Fittings (vents, bung holes, and fill pipes on top of the tank)

   - Why and to what extent are fittings a source of leakage from the tank system?

   - What is the relative frequency of fittings failures as compared to tank or piping failures? (How often will fittings fail at 100 stations over 20 years?)

   - What typical sizes and impacts are the leaks from loose or failed fittings? Have you seen significant impacts that were based on failed fittings?

   - Are fittings problems controllable and avoidable? What will be the situation concerning fittings 20 years from now?

3. <u>Tanks</u> (actual storage vessel excluding the fittings)

- What are the primary causes of tank failures? What are the most common failures of steel versus FRP tanks you have seen?

- What is the relative failure of tanks versus piping or fittings failures? How often do unprotected tanks fail (e.g. at 100 stations over 20 years, for example)?

  - Have you seen protected tank failures; for what reasons; how often do you estimate they have failed/will fail?

- What are the impacts/sizes of leaks from failed tanks? Does this differ from steel versus FRP?

- Will present problems be the same or different 20 years from now if the federal proposal was implemented?

4. <u>Spills/Overfills</u>

- What is their experience concerning spills or overfills?

  - Frequency

  - Sizes

  - Impacts

- What equipment works or doesn't work?

  - Overfill shut-off devices?

  - Spills containment basins?

- Are shut-off devices <u>and</u> containment devices needed?

- Should EPA allow 10 years for equipment to be applied to existing tanks?

- How difficult and costly is it to apply various equipment?

SERVICE STATION TESTING COMPANY INC.
P.O. Box 791032
San Antonio, Texas 78279-1032

July 21, 1987

Ms. Cecily Beall
MIDWEST RESEARCH INSTITUTE
5201 Leesburg Pike
Suite 209
Falls Church, VA 22041

Dear Ms. Beall:

Thank you for the opportunity to participate in your study. I hope the information herein will facilitate the E.P.A. in their current quest to determine underground storage tank policies. Please keep in mind that the data we have provided is totally unbiased, as we do not sell nor install tank equipment.

In gathering this information, we thoroughly read over 600 test files each containing eight to twenty pages of documentation covering two to five tank tests each. We determined the number of leaks and in what part of the tank or tank system they were found and categorized them on a data sheet. After all the files were reviewed, columns were then totaled giving us the actual number of tight and non tight components. Using a computer to compile this data, we converted them into percentage form and generated pertinant graphs to relay the gist of the findings. By using the categories listed in the data sheets, there are more analyze that can be evaluated beyond our summarization.

A basic tank system consists of the parts illistrated in Diagram 1 (see attached). In our study we categorized a leaking system in two categories -- "Tank or "Line". Under the tank category we included 1). the tank, 7). the vent, 8). riser pipes and 9). bung plugs. Under the line category we included 2). the product line piping, 3). unions 4). swing joints, 5). flex hose and 6). submerged pump.

In a nut shell, leaks occuring in the line category always resulted in operational leaks; whereby, hydrocarbons escaped from the system into the ground causing varying degrees of contamination. Leaks occuring in the tank category caused contamination only if the leak was in the tank itself or if

the tank was filled slightly above its full capacity (not knowing how often the tanks are overfilled during their lifetime, it is important to test the entire tank system to insure its tightness).

After gathering this data and reviewing it, one observation I was able to make was the unusally low number of actual bad tanks we found as compared to those found in other studies. Could this possibly be due to a terminology problem? (i,.e. Did the tanks leak or did the tank system leak? The terminology practiced at Service Station Testing Co. Inc. is as follows: 1. If the vent and product line are connected to the tank it is a tank system. 2. If the product line is isolated, it's a system with the product line isolated 3. If the vent is isolated it is a system with the vent line isolated and 4. If the tank top is excavated and all lines are isolated (positively) it is a tank test. The unusually high number of leaking tanks that previous studies have shown, most probably, include leakingsystems as compared with the low number of leaking tanks that we have indicated in our study.

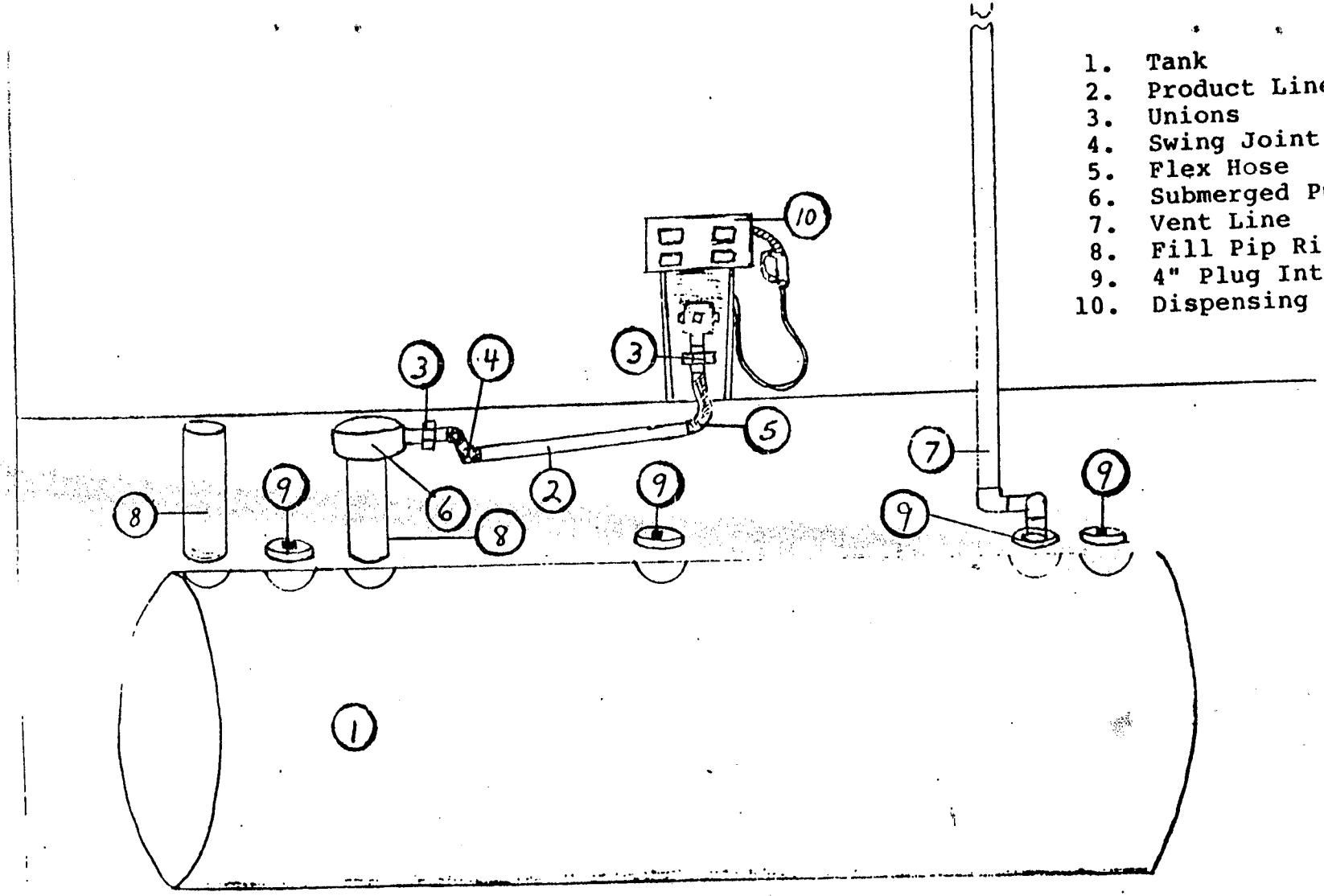
Please study the data sheets we have enclosed and draw your own observations and conclusions. I will be happy to answer your technical and procedural questions on system testing while Mr. Mize will be available to answer your questions on how the data was compiled.

Sincerely,

Don W. May, Jr.
President

attachment

/tlm



1. Tank
2. Product Line Piping
3. Unions
4. Swing Joint
5. Flex Hose
6. Submerged Pump
7. Vent Line
8. Fill Pip Riser
9. 4" Plug Into Tank Bung
10. Dispensing Unit

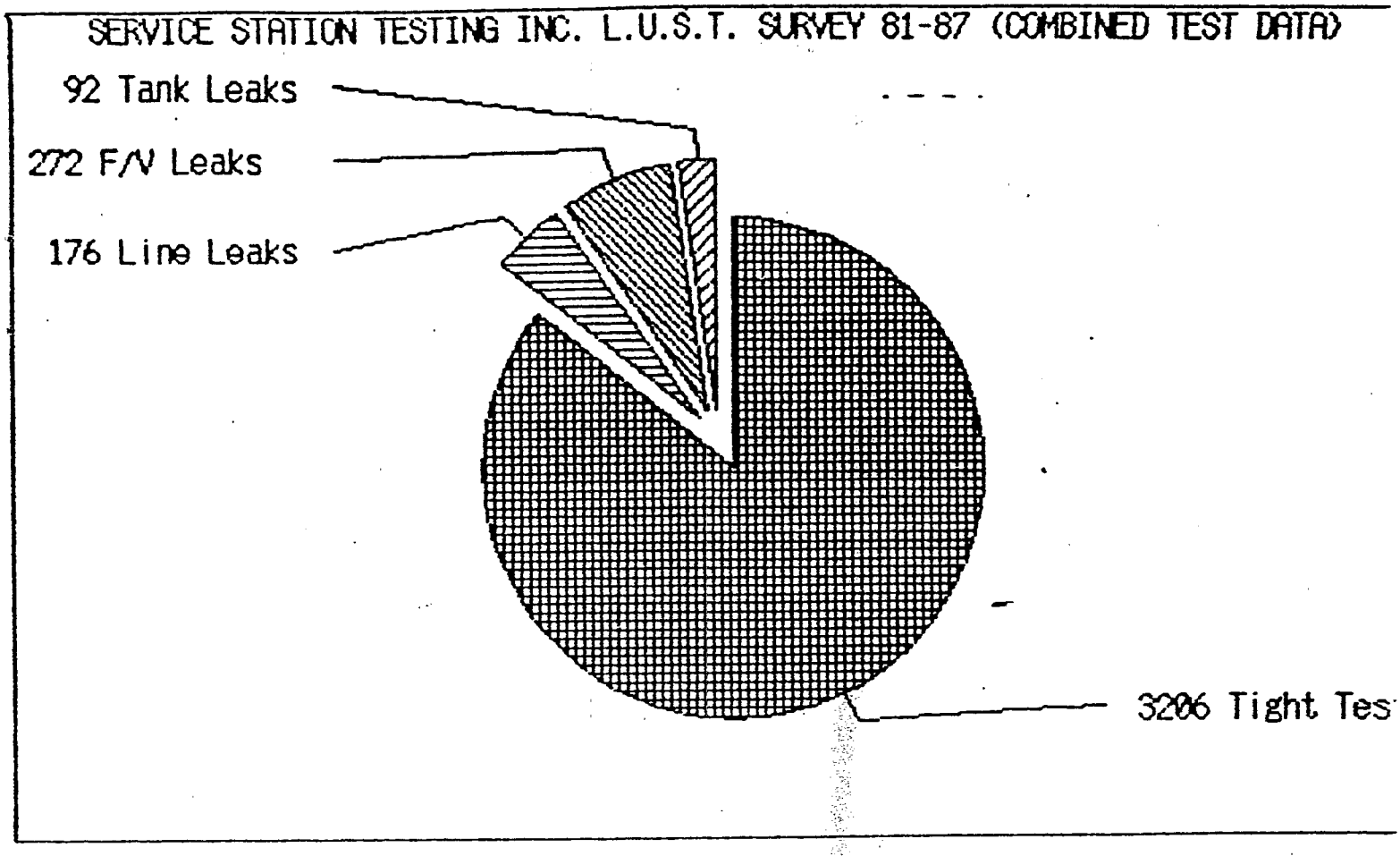
DIAGRAM 1

TANK SYSTEM TEST RESULTS

Geographical Region	TANK TEST RESULTS				LINE TEST RESULTS		GRAND TOTALS		
	TOTAL TANKS	TANK	LEAKS PITTING/VENT	TOTAL	TOTAL LINES	LEAKS	TOTAL LEAKS	TIGHT TESTS	TOTAL TESTS
Colorado	205	6	87	93	189	10	103	291	394
Texas	331	17	35	52	325	40	92	564	656
Austin (TX)	544	18	53	71	510	50	121	933	1054
San Antonio (TX)	841	51	97	148	801	76	224	1418	1642
TOTAL	1921	92	272	364	1825	176	540	3206	3746

LINE TEST RESULTS							
LINE TYPE		TOTAL LINES	LEAKS			FAILED LINE TEST	TIGHT LINE TESTS
SUCTION	REMOTE		PIPING	UNION	TOTAL		
474	1351	1825	96	80	176	156	1669

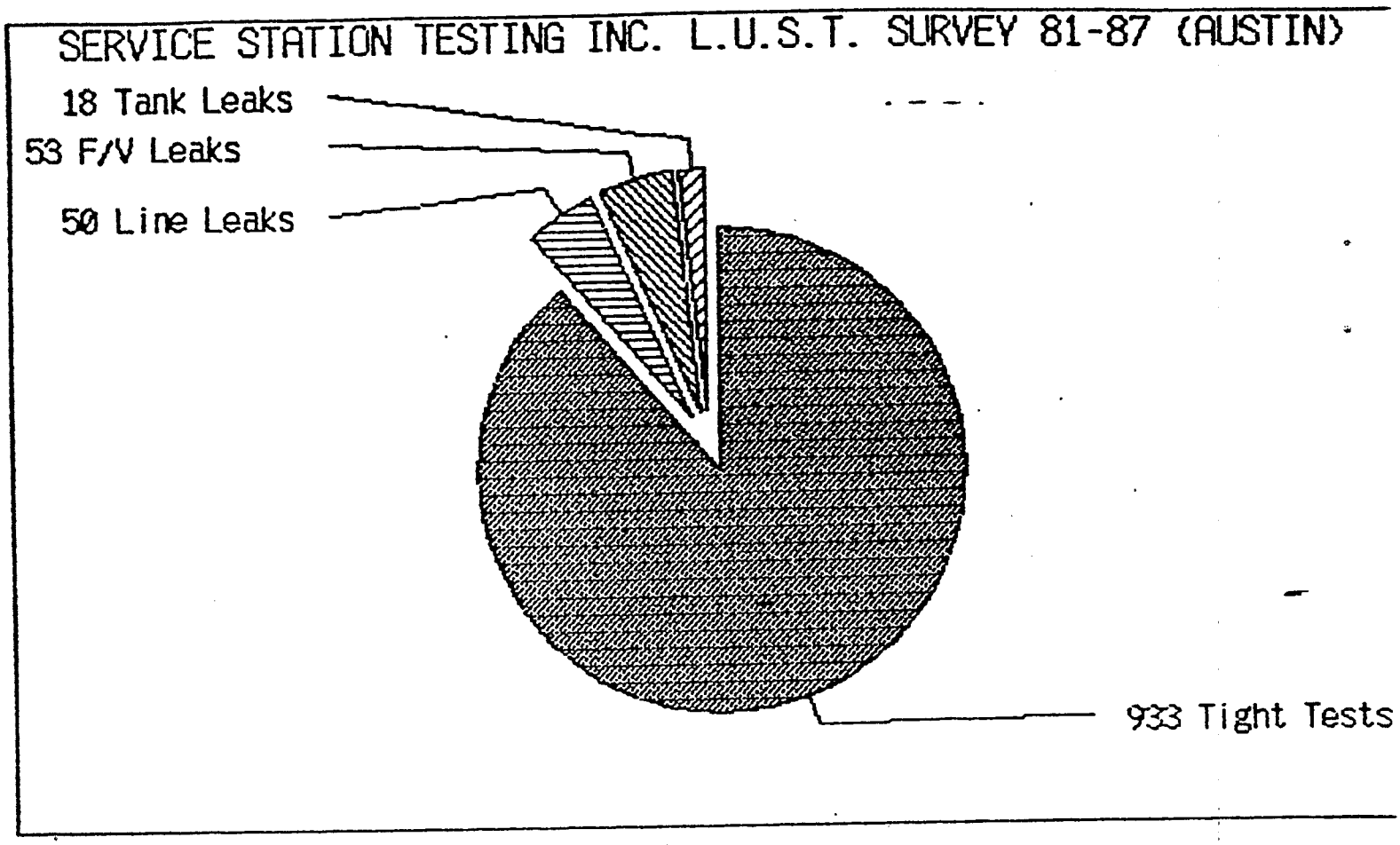
MATERIAL			TANK TEST RESULTS						
FIBERGLASS	FIBERGLASS STEEL	STEEL	TOTAL TANKS	LEAKS				FAILED TANK TEST	TIGHT TANK TEST
				TANKS	FITTING	VENT	TOTAL		
228	57	1636	1921	92	148	124	364	325	1596



.F/V (refers to fittings and vents)

PERCENTAGE

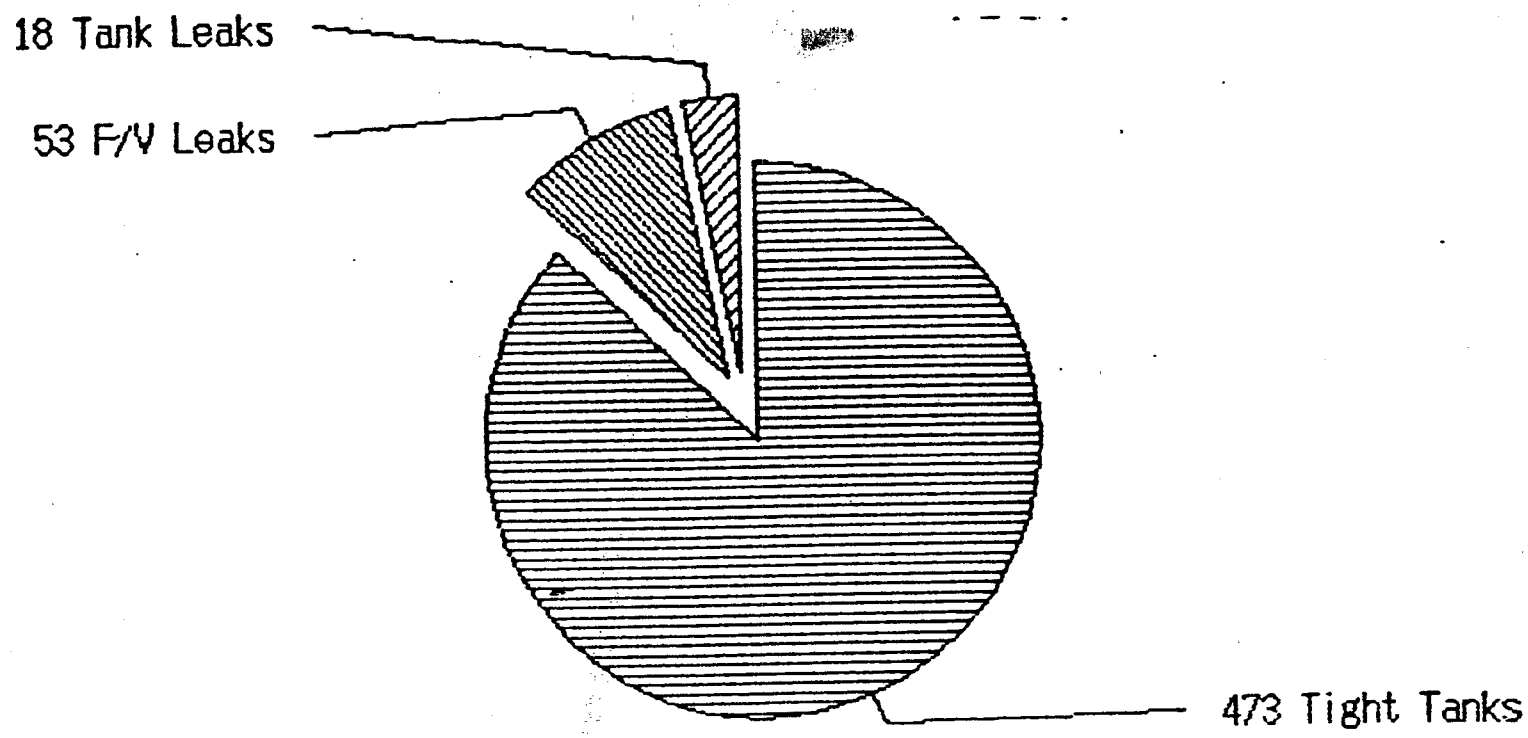
Tank Leaks	2.45%
F/V Leaks	7.26%
Line Leaks	4.69%
Tight Tests	85.58%



PERCENTAGES

Tank Leaks	1.7%
F/V Leaks	5.02%
Line Leaks	4.74%
Tight Tests	88.51%

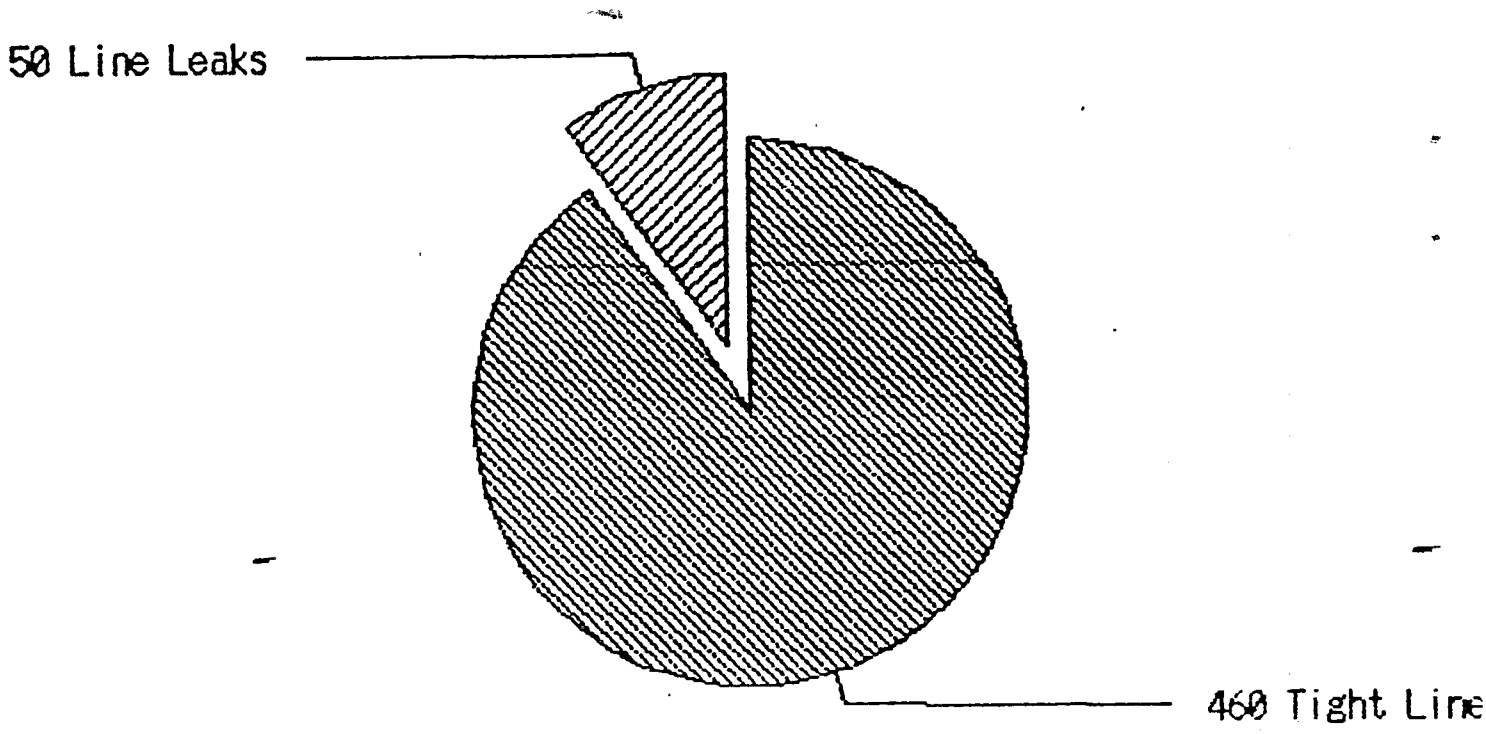
SERVICE STATION TESTING INC. L.U.S.T. SURVEY 81-87 (AUSTIN)



PERCENTAGES

Tank Leaks	3.3%
F/V Leaks	9.74%
Tight Tanks	86.94%

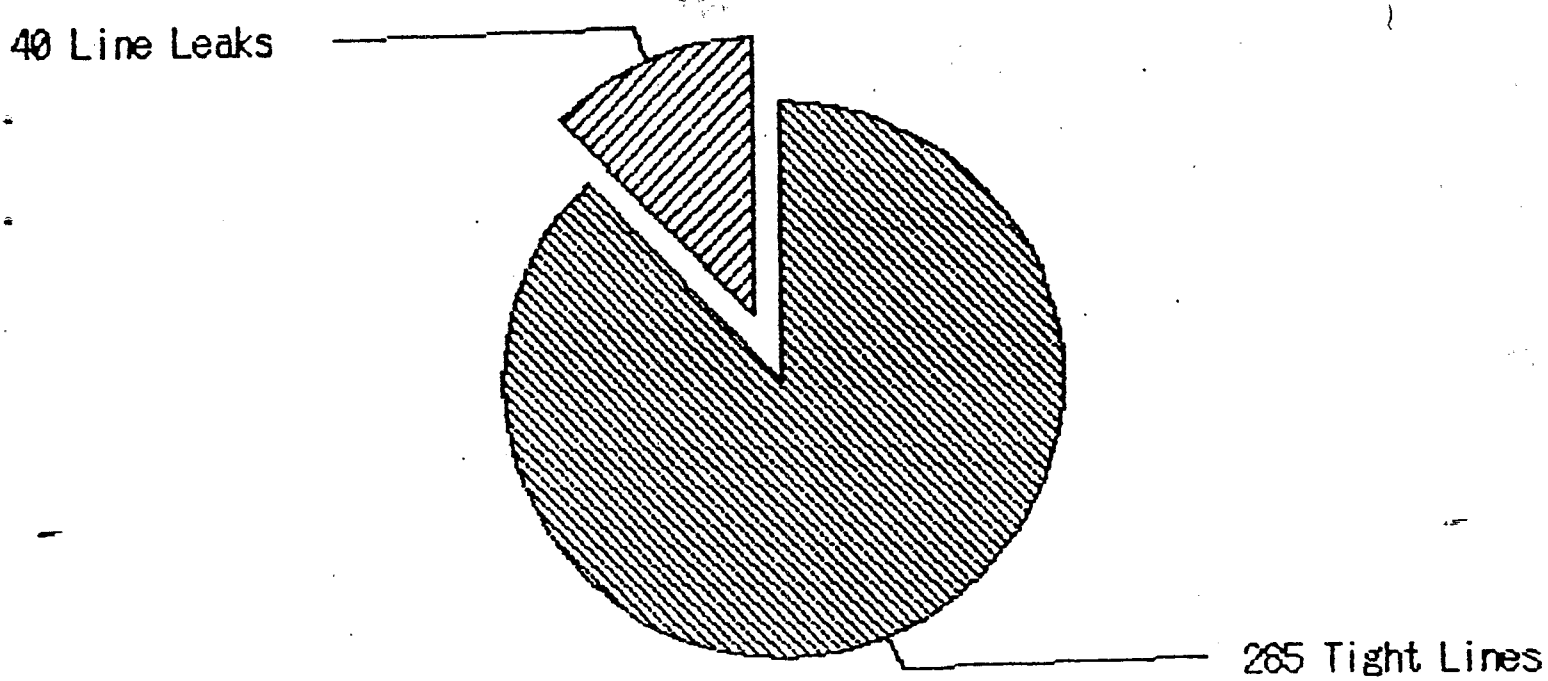
SERVICE STATION TESTING INC. L.U.S.T. SURVEY 81-87 (AUSTIN)



PERCENTAGES

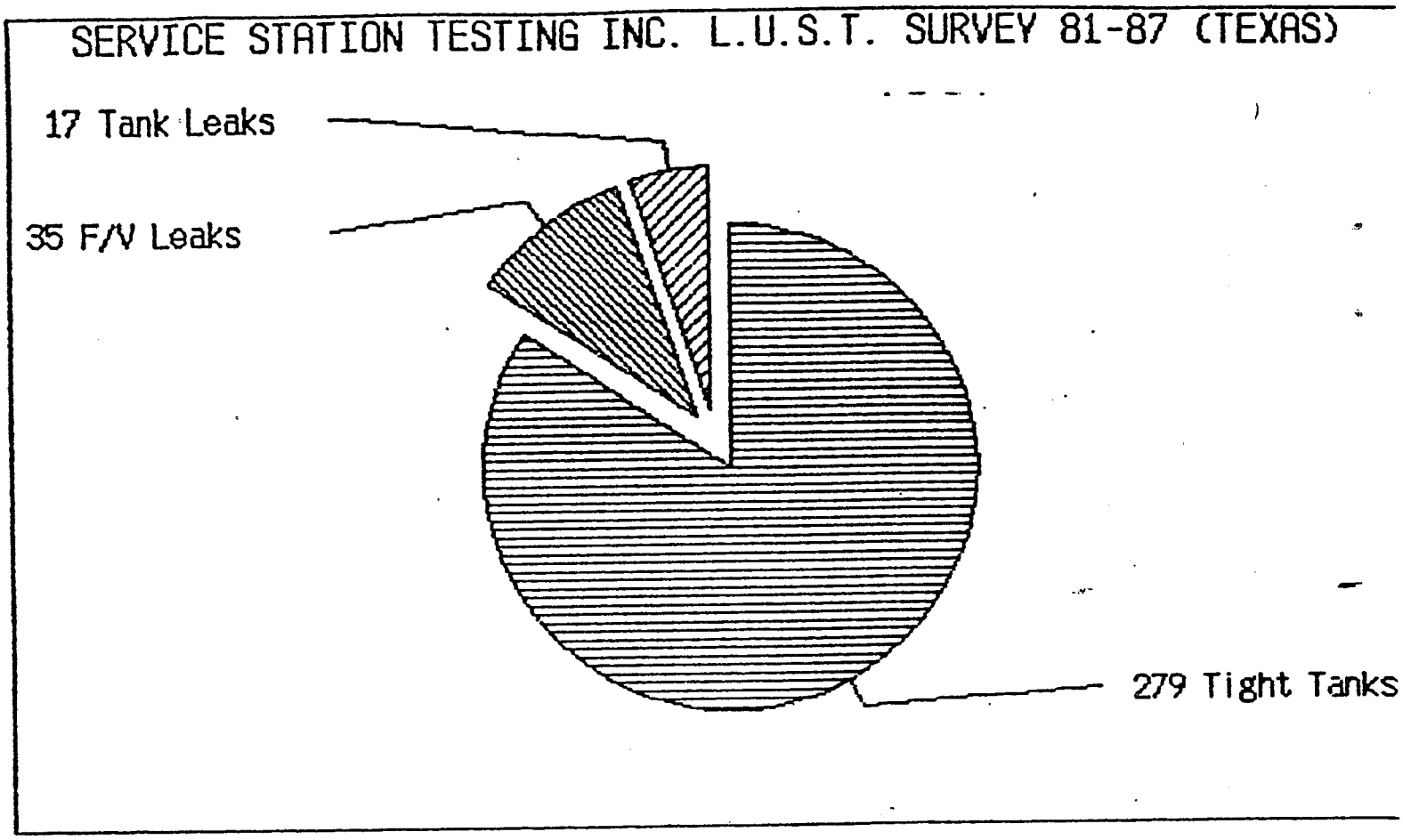
Line Leaks	9.8%
Tight Lines	90.19%

SERVICE STATION TESTING INC. L.U.S.T. SURVEY 81-87 (TEXAS)



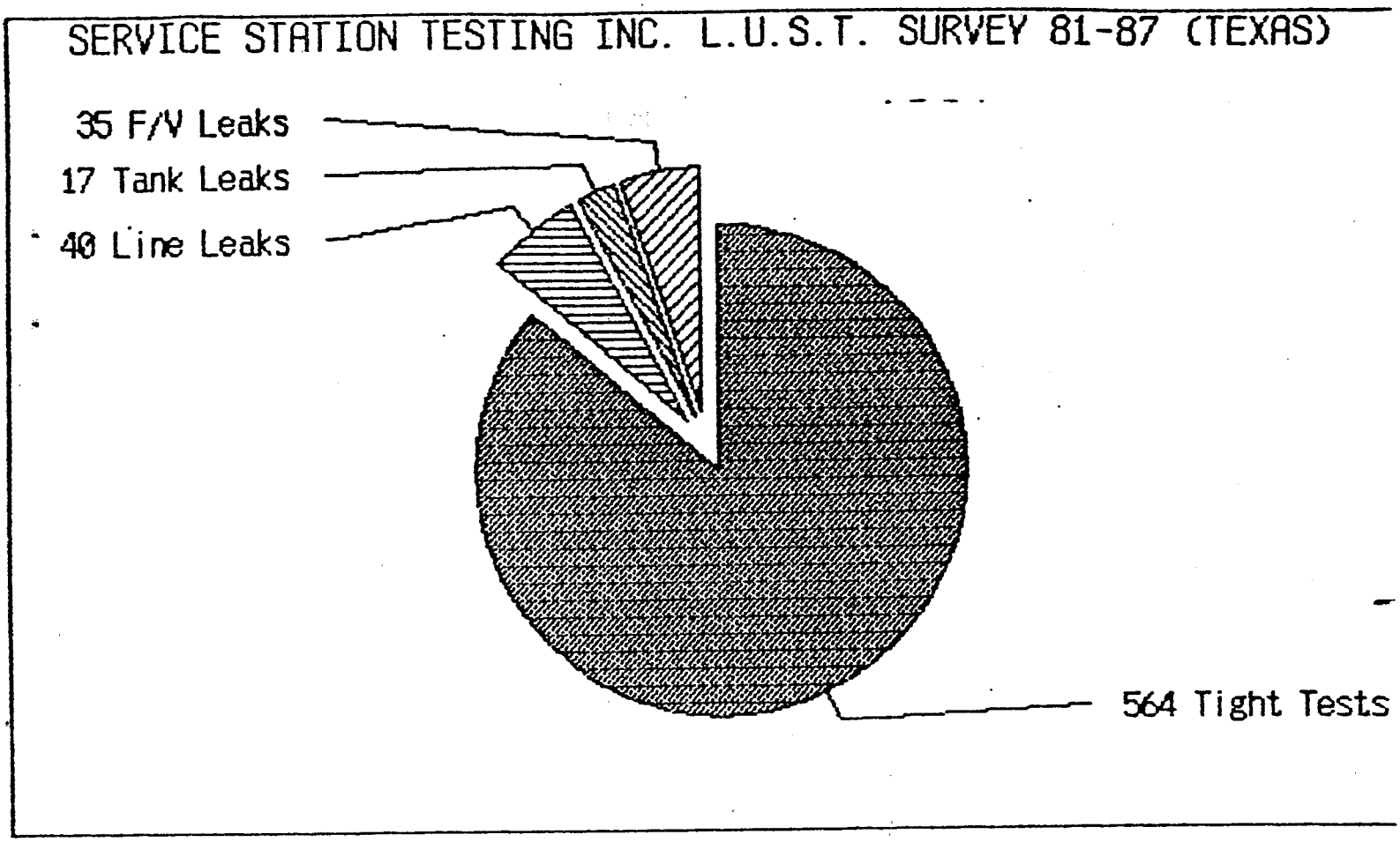
PERCENTAGES

Line Leaks	12.3%
Tight Lines	87.69%



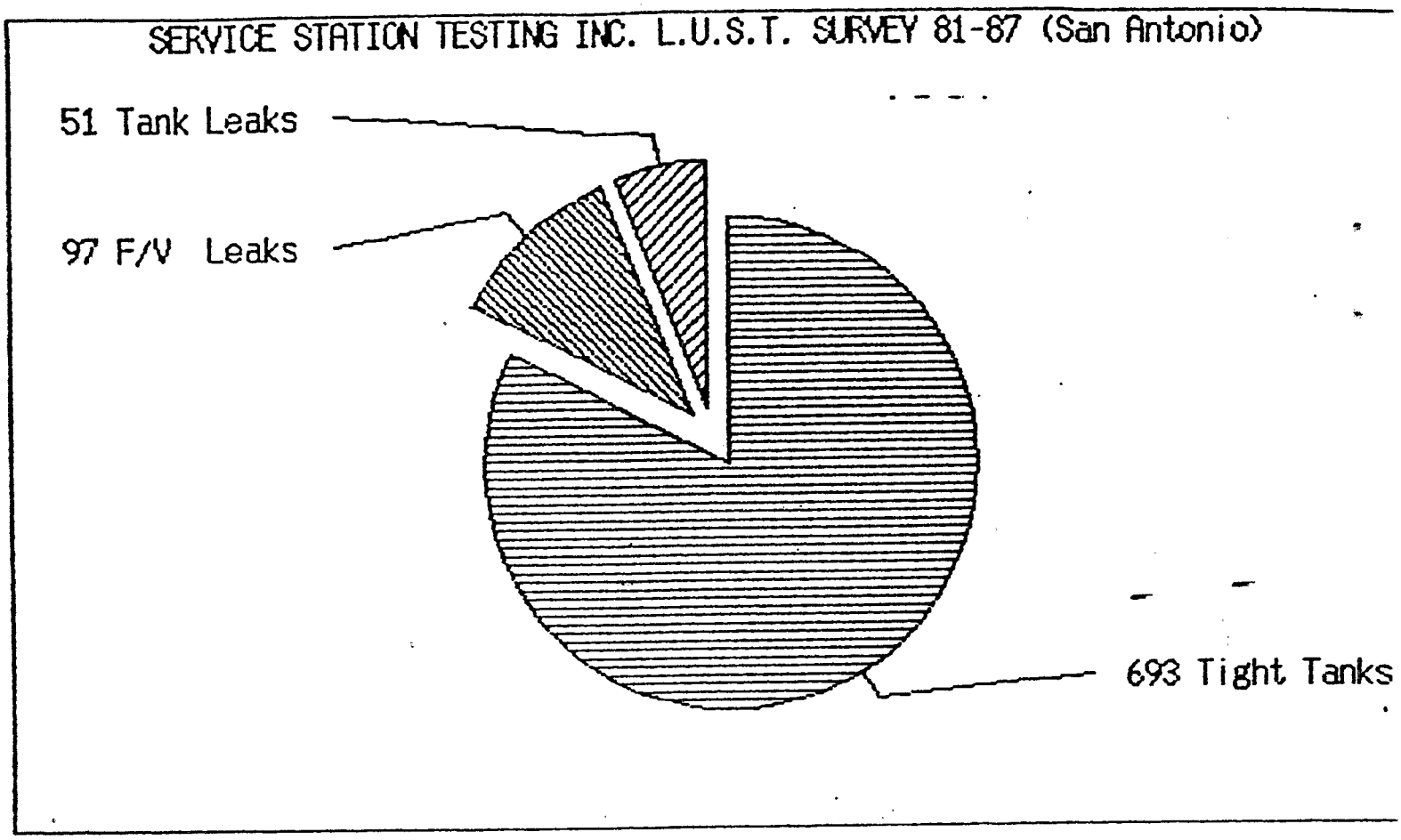
PERCENTAGES

Tank Leaks	5.13%
F/V Leaks	10.57%
Tight Tanks	84.29%



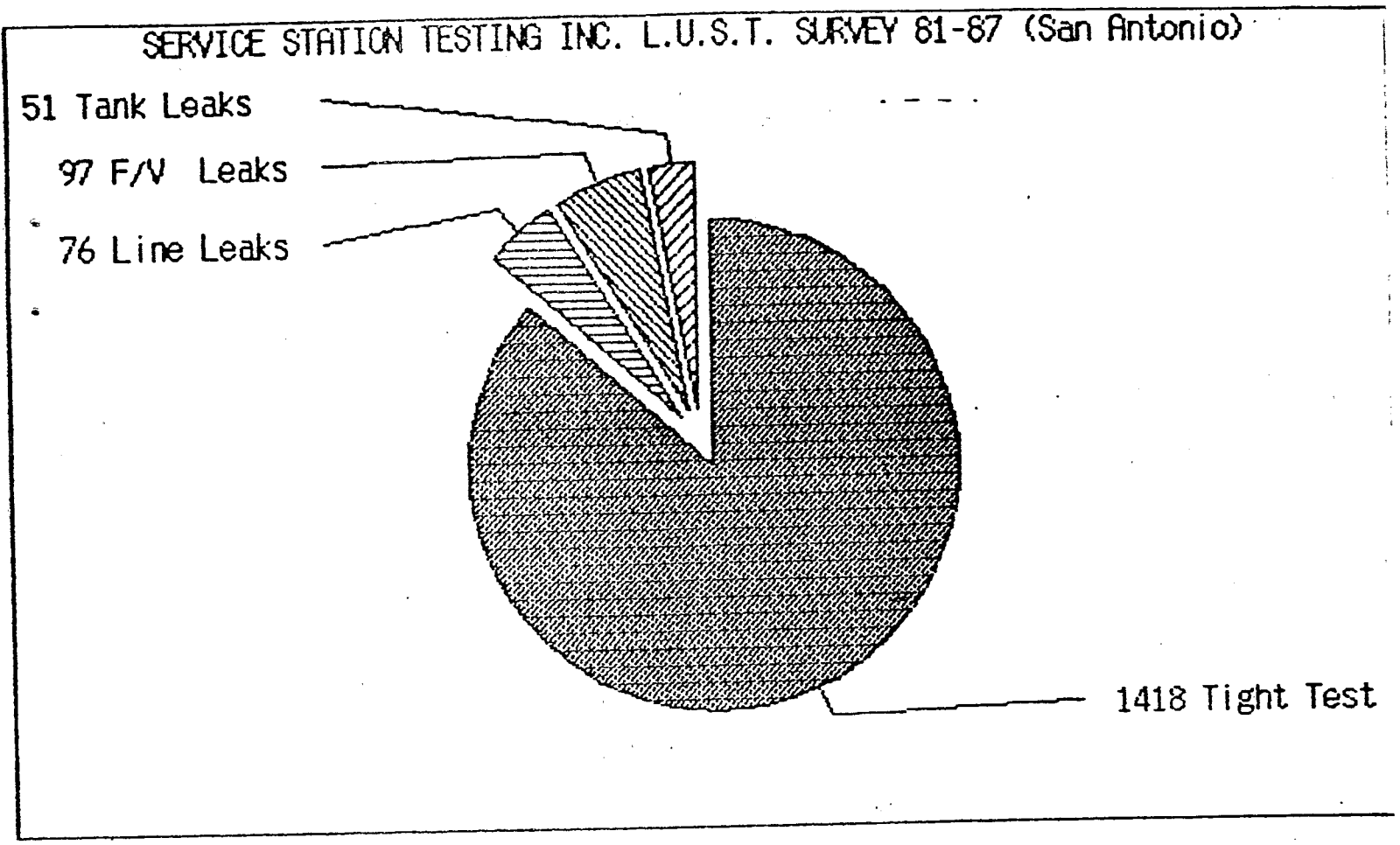
PERCENTAGES

Tank Leaks	2.59%
F/V Leaks	5.33%
Line Leaks	6.09%
Tight Lines	85.97%



PERCENTAGES

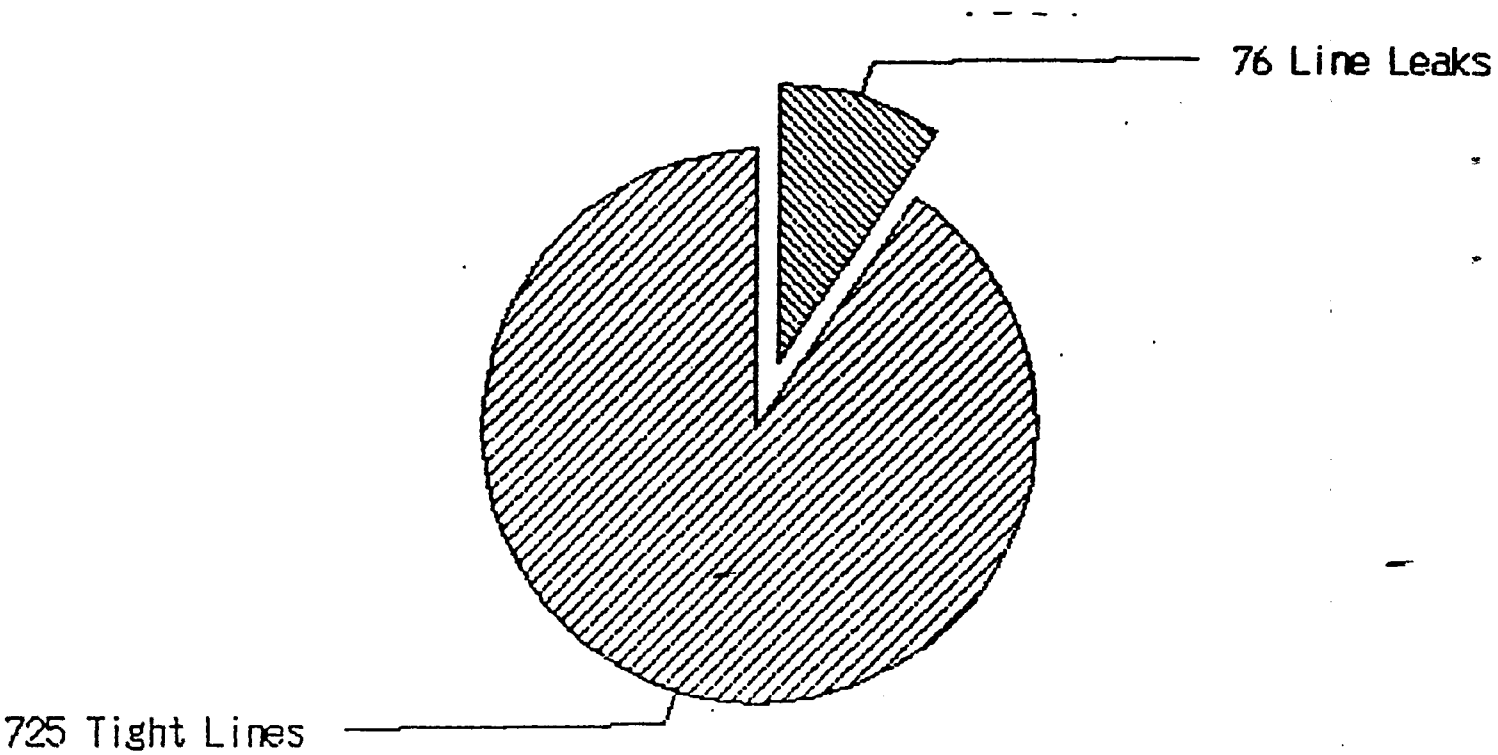
Tank Tests	6.06%
F/V Leaks	11.53%
Tight Tanks	82.4%



PERCENTAGES

Tank Leaks	3.1%
F/V Leaks	5.9%
Line Leaks	4.62%
Tight Tests	86.35%

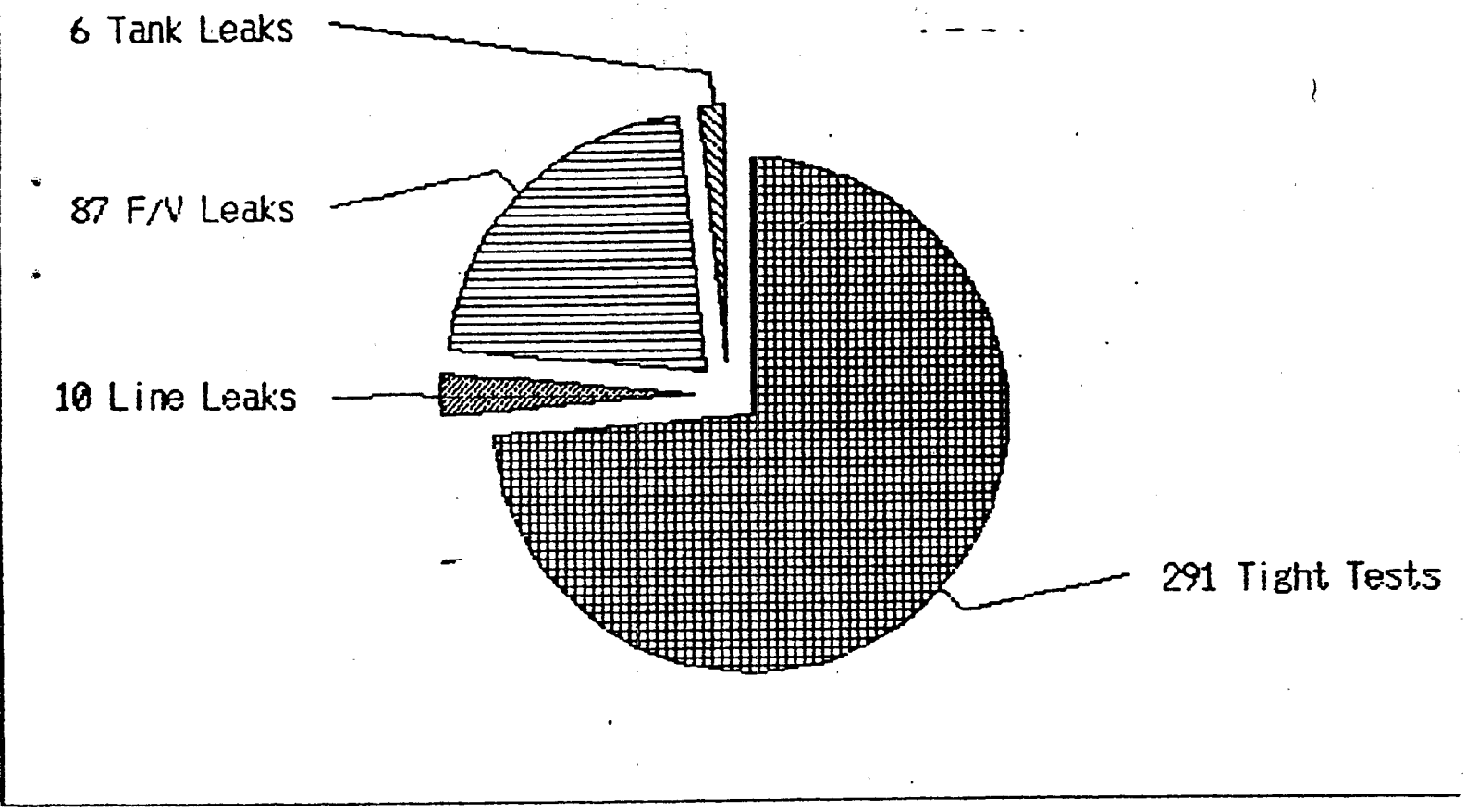
SERVICE STATION TESTING INC. L.U.S.T. SURVEY 81-87 (San Antonio)



PERCENTAGES

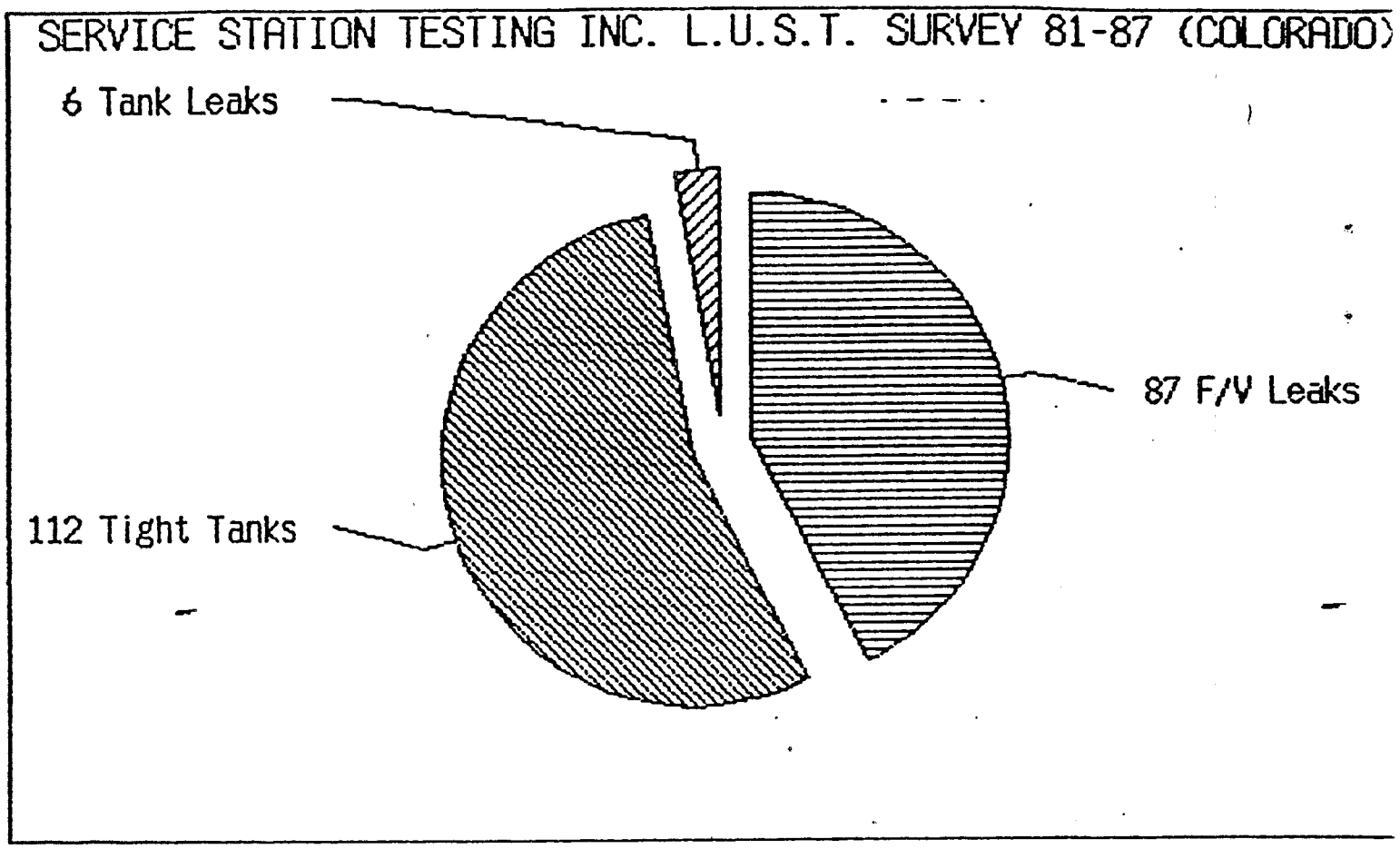
Line Leaks	9.48%
Tight Lines	90.51%

SERVICE STATION TESTING INC. L.U.S.T. SURVEY 81-87 (COLORADO)



PERCENTAGES

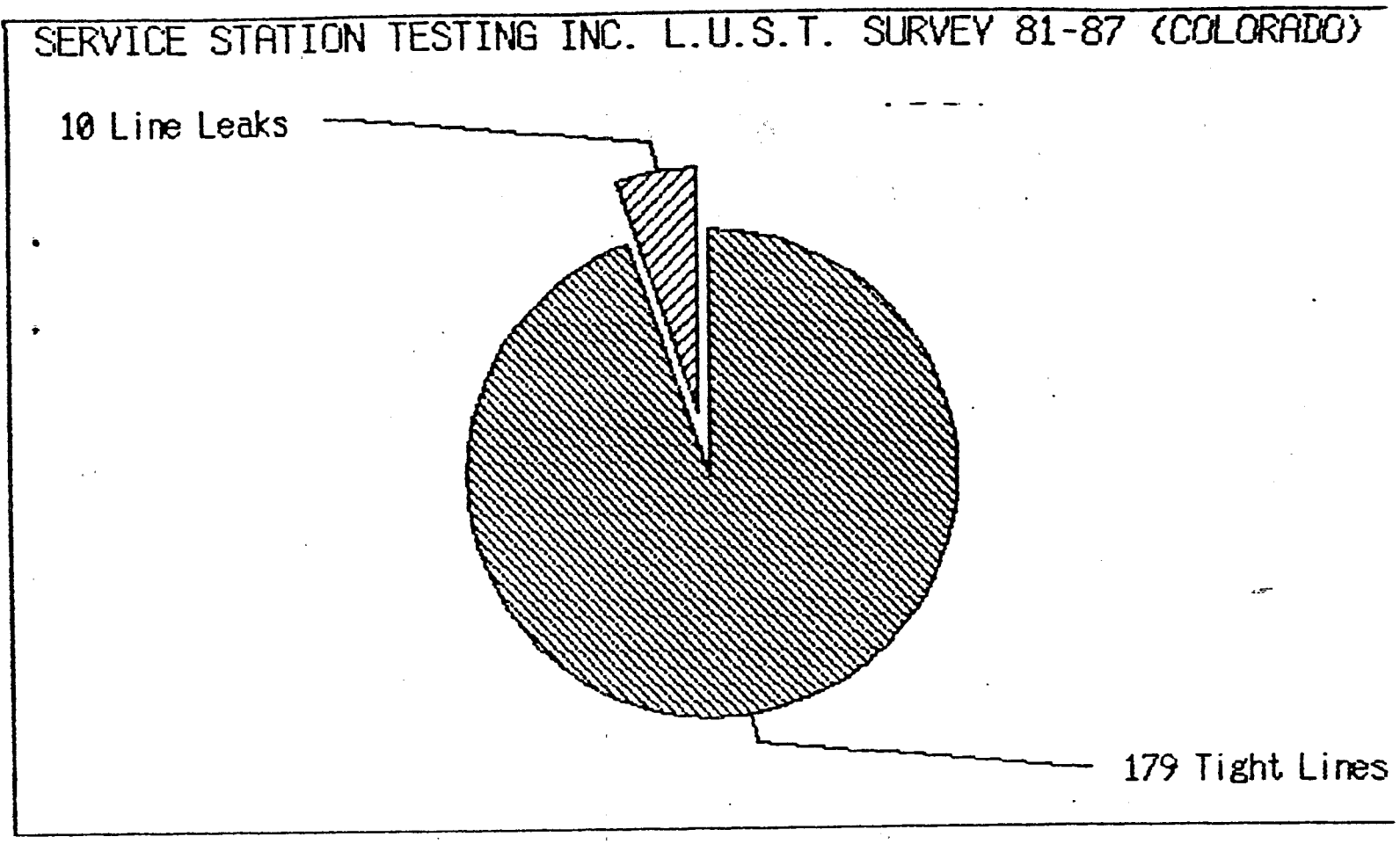
Tank Leaks	1.52%
F/V Leaks	22.08%
Line Leaks	2.53%
Tight Tests	73.85%



PERCENTAGES

Tank Leaks	2.29%
F/V Leaks	42.43%
Tight Tanks	54.63%

SERVICE STATION TESTING INC. L.U.S.T. SURVEY 81-87 (COLORADO)



PERCENTAGES

Line Leaks	5.29%
Tight Lines	94.7%

SERVICE STATION TESTING, INC.

P.O. BOX 791032 SAN ANTONIO, TEXAS 78279-1032
Phone (512) 344-3537

DON W. MAY, JR.
President

September 15, 1987

Ms. Cecily Beall
MIDWEST RESEARCH INSTITUTE
425 Volker Boulevard
Kansas City, MO 64110

REF: PURCHASE ORDER - 92343

Dear Cecily:

Please find enclosed the survey, as requested, in compliance with Purchase Order #92343. If you have any questions, please feel free to contact me.

Sincerely,

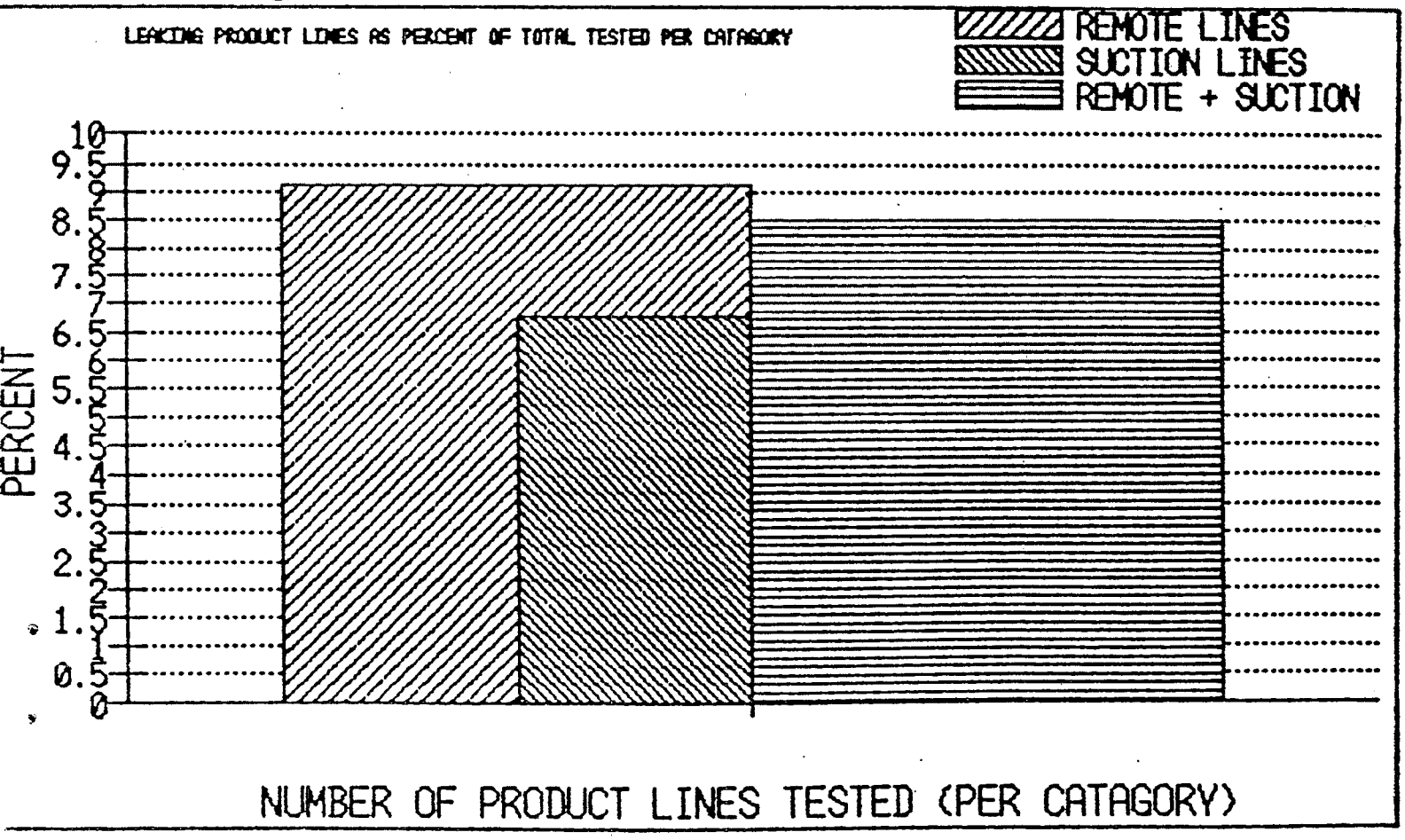
Donald W. May, Jr.
President

DWM/tlm

enclosure

SERVICE STATION TESTING CO. INC.
L.U.S.T. SURVEY
LINE TIGHTNESS TEST RESULTS

	REMOTE LINES	SUCTION LINES	TOTAL LINES
	1351 REMOTE LINES	474 SUCTION LINES	1825 TOTAL LINES TESTED
LEAKING	124 (9.1%)	32 (6.8%)	156 (8.5%)
TIGHT	1227 (90.8%)	442 (93.2%)	1669 (91.5%)



SERVICE STATION TESTING INC.
L.U.S.T. SURVEY
"COMPARISON OF STEEL TANK TIGHTNESS TEST RESULTS BY AGE OF TANK"

NSTALLED TANK AGE	TEST RESULTS TIGHT SYSTEMS * #	%	LEAKING TANKS #	%	LEAKING FITTINGS #	%	LEAKING VENTS #	%	TOTAL TANK SYSTEMS * TESTED
NEW	67	90.5%	0	0.0%	7	9.5%	0	0.0%	74
1	34	91.9%	0	0.0%	2	5.4%	1	2.7%	37
2	18	66.7%	2	7.4%	6	22.2%	1	3.7%	27
3	16	80.0%	0	0.0%	2	10.0%	2	10.0%	20
4	7	53.8%	3	23.1%	1	7.7%	2	15.4%	13
5	15	75.0%	0	0.0%	2	10.0%	3	15.0%	20
6	22	81.5%	1	3.7%	2	7.4%	2	7.4%	27
7	10	62.5%	0	0.0%	4	25.0%	2	12.5%	16
8	25	86.2%	0	0.0%	3	10.3%	1	3.4%	29
9	7	53.8%	0	0.0%	1	7.7%	5	38.5%	13
10	44	84.6%	2	3.8%	6	11.5%	0	0.0%	52
11	16	80.0%	2	10.0%	2	10.0%	0	0.0%	20
12	30	76.9%	6	15.4%	0	0.0%	3	7.7%	39
13	27	79.4%	1	2.9%	3	8.8%	3	8.8%	34
14	41	85.4%	3	6.3%	0	0.0%	4	8.3%	48
15	70	81.4%	7	8.1%	5	5.8%	4	4.7%	86
16	78	87.6%	4	4.5%	5	5.6%	2	2.2%	89
17	11	57.9%	1	5.3%	2	10.5%	5	26.3%	19
18	29	82.9%	2	5.7%	2	5.7%	2	5.7%	35
19	15	55.6%	1	3.7%	3	11.1%	8	29.6%	27
20	68	77.3%	4	4.5%	8	9.1%	8	9.1%	88
21	32	71.1%	1	2.2%	6	13.3%	6	13.3%	45
22	16	76.2%	1	4.8%	4	19.0%	0	0.0%	21
23	16	61.5%	2	7.7%	5	19.2%	3	11.5%	26
24	21	84.0%	0	0.0%	3	12.0%	1	4.0%	25
25	34	85.0%	2	5.0%	1	2.5%	3	7.5%	40
26+	40	100.0%	3	0.0%	0	0.0%	0	0.0%	43
UNKNOWN	523	83.3%	44	7.0%	33	5.3%	28	4.5%	628
TOTALS	1332	81.1%	92	5.6%	118	7.2%	99	6.0%	1641

Systems as used here include the tank, fittings attached directly to the tank, and the tank vents. product lines are excluded except for the fitting attaching the line to the tank.

L.U.S.T., Leaking underground storage tanks