SECTION 1

INTRODUCTION

The National Underground Storage Tank Survey was designed to provide estimates of the number of underground motor fuel storage tanks and the number of establishments with such tanks, the number and percent of tank systems that leak, and characteristics of tanks and tank establishments. Tank and establishment characteristics were analyzed in a search for possible correlations with leak status (whether a tank is leaking) and leak rate. The survey sample was a national probability sample of establishments in the U.S. (except Hawaii and Alaska) that had underground motor fuel storage tanks (not abandoned).

The survey consisted of a series of information-gathering procedures which included an in-person interview, inventory data collection, tank tightness testing, and secondary data abstracting. This report presents national estimates for statistics based on data collected in the interview phase of the survey, analysis of the inventory data collection, and results of the tightness testing phase.

The tank and establishment characteristics data presented in this report were collected through in-person interviews conducted by Westat field interviewers using the "Underground Storage Tank Survey Establishment Operator's Questionnaire" (see Appendix F for a facsimile of this questionnaire). The results reported here are based on interviews conducted during visits to 890 establishments. As a part of the tank tightness test fieldwork (at a subsample of establishments), certain tank and establishment characteristics were also collected by the Midwest Research Institute tank tightness test field crews. This

information was checked against interview data and discrepancies resolved by telephone recontact and checking the hard data from both sources. The tank system leak data in this report were collected by on-site tank system and manifolded tank system tests conducted by Midwest Research Institute field crews using a modified PetroTite procedure.

I. DEFINITION OF KEY TERMS

For the purposes of this survey, an establishment is defined as any site or location where underground storage tanks are being used to store and dispense motor fuel for business, commercial, government, and, in a few instances, farm purposes. The term "tank system" refers to an individual underground storage tank vessel plus the lines and equipment that are connected to that vessel. At some establishments, two or more tanks are linked together by piping in "manifolded tank systems." Manifolded tank systems often present special data collection problems. For inventory reconciliation and sometimes for tank tightness testing, it was necessary to collect data at the "manifolded tank system" level rather than for the individual tank systems. For example, when two manifolded tanks have one meter, inventory data must be collected for the manifolded system as a whole in order to compare meter data to stick data. In physical tank tightness tests, tanks in manifolded systems were not isolated for testing when, for example, they were joined by inaccessible lines. In the interview procedure it was possible to collect data (such as age, size, construction material) on an individual tank basis.

Our analytical approach has been to report results at the smallest unit of analysis, whenever possible. Thus, interview-collected characteristics and national estimates of the numbers and types of tank establishments and tanks (in Section 9) are

reported for individual tank systems rather than for "manifolded tank systems." Similarly, leak status and leak rate analyses will be based on the smallest available unit tested. Thus, for tanks in manifolded systems that were separated and tested individually, leak rate and status will be reported for individual tank systems rather than for the tanks combined into a manifolded tank system leak rate and status. However, for those manifolded tank systems that were not separated for testing, the leak status and rate reported are the manifolded tank system test status and rate. The text for each table defines the unit of analysis used in the table.

II. TYPES OF TANKS COVERED BY THE UNDERGROUND STORAGE TANK SURVEY

The Underground Storage Tank Survey was limited, for practical and regulatory reasons, to underground tanks that store and dispense motor fuel prior to end use by business, commercial and government establishments. **This limitation excludes** tanks used to store materials other than motor fuels such as chemicals, waste-water, hazardous waste, heating oil, and used or waste oil. Also excluded by definition are motor fuel storage tanks that are at private residences, above-ground or partially buried tanks, and all motor fuel tanks at bulk storage facilities that do not dispense fuel to end users. Tanks that are abandoned or empty were also excluded from consideration. **Included** within the scope of the survey are tanks that are owned and operated by private businesses, public and government institutions, military facilities, and farms. The initial step of the data collection effort was to determine, for a random sample of establishments, whether they in fact had an active underground motor fuel storage tank as defined above. If so, the establishment (and its tanks)

were considered eligible for the survey, and the main questionnaire was administered.

As a result, the sample includes such establishments as gasoline stations, airports, marinas, rental car agencies, fleets of trucks or company cars, bus companies, fire stations, parks, police stations, and many other types of establishment.

III. LIMITATIONS OF THE DATA PRESENTED IN THIS REPORT

As in any research report of this type, there are limitations in the study's scope and methods which should be understood by all who interpret and use the results of the study. The major limitations are summarized below as caveats which must be kept in mind by the reader.

A. Sample Frame Limitations

Because of practical and economic considerations, the sample was drawn from those establishments most likely to have the types of underground tanks described above (Subsection II). All establishment types and industries were covered except small (less than 20 employees) businesses in non-fuel-related industries. As a result, the study would not have counted any underground motor fuel tanks in small businesses, private homes, and less relevant industry sectors. In other words, it is possible that the number of underground motor fuel tanks in the nation is somewhat greater than our estimate. However, we would expect roughly similar leakage experience in uncovered business establishments, based on the relatively constant percentage of tanks leaking across the different sectors studied.

B. Owner/Operator Responses

The tank and establishment characteristics data presented in this report were collected by Westat interviewers during an in-person interview with establishment owners and operators. The accuracy of these data is limited by the knowledge of the responding owner/operator.

A substantial number of owner/operators responded "don't know" to interview questions about certain tank characteristics such as the age of the tank or the material of construction. Because the information may prove useful in regulatory development, we have included information on the percentage of "don't know" responses when this was substantial.

C. Inventory Data

Reconciliation of inventory records received from respondents was evaluated as a secondary, more economical method of detecting tank system leaks and estimating tank system leak rates. Inventory data were analyzed by Warren Rogers Associates, Inc. (WRA), using proprietary inventory reconciliation analysis software. Alternative methods were also explored. Some limitations to the usefulness of the inventory data are related to the ability of the owner/operator to accurately collect it. Because many tank managers do not normally maintain such inventory records they often produced error-prone data, which could not be analyzed. This occurred frequently in establishments which had fairly inactive tanks (fuel was dispensed only once or twice a week) and when the volume of fuel in a tank was very low. Very accurate measurements were needed for the WRA analysis. A less demanding analytical protocol might

have been able to use a higher proportion of the inventory data received.

D. Line, Vessel, and Equipment Leaks

Based on tank test methods used in this study, it was generally not possible to distinguish between leaks occurring in the tank vessel and leaks occurring only in lines or equipment such as fill pipes, manways, vent pipes, distribution lines, joints and bungs. Leak tests of distribution lines in isolation from their tanks were possible for about one-third of the tested tanks found to be leaking. (A distribution line test was always attempted but could not be completed in many cases.) The distribution line leak data are analyzed in Section 8. Elsewhere in this report, no distinction is made between tank vessel leaks and distribution line leaks or other non-vessel leaks. A leak anywhere in the system is reported as a tank system leak. Also, for manifolded systems of more than one tank where the tanks were not separated for testing, the entire system was tested and a reported leak could be in any of the tanks or in any associated line, pipe, fitting, joint, or other equipment.

E. Test Conditions Versus Operational Conditions

The tank tightness test conditions include some circumstances which are not always present during normal tank operations. Specifically, during the test tanks were overfilled (i.e., tanks were filled as were the associated fill pipe and additional testing apparatus to permit measurements) such that the net pressure at the tank bottom was 4 psig. The test procedure compensates for hydrostatic pressure when the water table is above the bottom of the tank by increasing the height of

overfill. As a result of the overfilling, tanks that leak only near or at the top of the tank or in lines, pipes, or joints not normally filled with fuel might not always (or might never) be leaking in normal operations if the tank is kept less than full. The impact of increased leak rate because of test pressure is less of a problem than leaks at non-operational locations because the test pressure is small, and test leak rates have been adjusted downward to correct to typical operating pressures. (Section 8 discusses the typical fill levels reported in the interview phase and their effects on leak status statistics, and also describes the leak rate adjustment procedures.)

F. Interpretation and Adjustment of Tank Tightness Test Data

Many factors affect the reliability of tank tightness test data. The most important factor is temperature effect. Because the volume of fuel in a tank varies with temperature change, it was necessary to measure temperature changes directly and adjust results using a correction and smoothing process. These adjustment procedures required careful engineering and statistical review and data editing using engineering judgment to rule out suspect data. Some introduction of error is possible in such engineering judgments, but careful discarding of suspect data increased the overall validity of the findings. (Section 7 describes the data reduction procedures applied to the raw data.)

G. Untestable Tanks and Unreliable Test Data

The primary purpose of the tightness testing phase of the survey was to estimate the number and proportion of leaking tanks and to estimate the leak rates of those tanks. The degree to

which the test data fulfill the objectives of the survey is limited by the number of tanks for which responses were obtained. For approximately 10 percent of the tanks selected for testing, the tests were unsuccessful because the tank was untestable or the resulting test data were unreliable. Reasons for untestability included plumbing and piping problems and other installation factors, such as physical constraints on the placing of the test equipment in the tank. Reasons for unreliable tests included trapped vapor pockets in the tank vessel or lines, and unexplained temperature variations. For an additional five percent of the selected tanks, the leak rate could not be measured due to the great size and speed of the leak (although leak status was determined). Generally, leaks at a rate of three or more gallons per hour under test pressure could not be quantified by the test procedure.

IV. Overview of the Report

Chapter 2 presents the major findings from the interview and tank tightness test data as well as operational findings of interest in developing regulations. Chapter 3 describes the quality assurance program, with results given as appropriate in the subsequent chapters. Chapter 4 describes the sample selection and estimation procedures, Chapter 5 gives the field procedures for the questionnaire and inventory data collection, and Chapter 6 describes the tank tightness test data collection. Chapter 7 gives the tank testing data reduction process and quality assurance results, and Chapter 8 describes further statistical analyses applied which resulted in the final determination of whether a tested tank was leaking. The actual data are presented in tabular form in Chapter 9, together with the findings of some analyses designed to search for possible correlations between tank and establishment characteristics and

leak status of tanks. Chapter 10 presents the findings on inventory reconciliation techniques.

The Appendices provide further details supporting these discussions.