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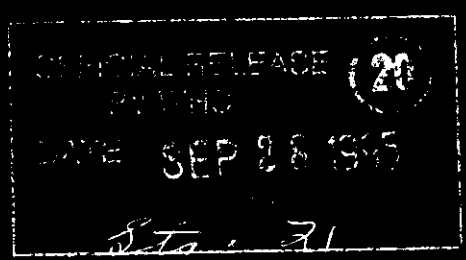
7. Abstract

This work plan addresses the methodology for defining a tank waste database that will provide a best basis estimate of waste characteristics for each underground storage tank. The resulting database is expected to be in place in a network accessible electronic form by September 1996.

8. RELEASE STAMP



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Revision 0

WORK PLAN FOR DEFINING A STANDARD INVENTORY ESTIMATE FOR WASTES STORED IN HANFORD SITE UNDERGROUND TANKS

September 1995

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DQO	Data quality objectives
DST	Double-shell tank
HTCE	Historical tank content estimates
NEPA	*National Environmental Protection Act of 1969*
SST	Single-shell tank
TCD	Tank Characterization Database
TCR	Tank Characterization Report
TRAC	Track Radioactive Components
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TRU	Transuranics
TWRS	Tank Waste Remediation System
WSTRS	Waste Status and Transaction Record Summary
WHC	Westinghouse Hanford Company

WORK PLAN FOR DEFINING A STANDARD INVENTORY ESTIMATE FOR WASTES STORED IN HANFORD SITE UNDERGROUND TANKS

1.0 INTRODUCTION

Safe storage and eventual remediation of stored waste is a major function of the Tank Waste Remediation System (TWRS). Key waste management activities involve monitoring of the stored waste, the management of tank farm operations, identification of potential safety issues associated with waste storage, resolution of already identified safety issues, and activities that will eventually retrieve the waste and process the waste to a form suitable for long-term disposal.

These activities require knowledge of the chemical and radionuclide inventories of tank waste as well as certain physical and chemical waste properties. It is imperative that waste characterization information sources used for waste disposal engineering studies, risk assessments, safety analyses, and other evaluations be derived from a consistent and accurate knowledge basis. A single standard characterization source term basis for waste in each underground storage tank is a necessary part of the TWRS safe storage and disposal efforts.

Following are desirable key attributes for a standard waste characterization source term.

- The system would provide consistent waste characterization information available in a usable fashion for all data users.
- The data would provide the best values based on present-day information sources. The technical basis for the reported data would be documented.
- The data would be available on a hierarchical basis; e.g., a global (total inventory) basis, on a tank-by-tank basis, and on a waste phase basis.
- The data would be updated periodically to reflect current information using configuration control procedures.

2.0 SCOPE AND OBJECTIVES

This work plan addresses the methodology for defining a tank waste database system that will provide a best basis estimate of waste characteristics for each underground storage tank. The resulting database is expected to be in place in a network accessible electronic form by September 1996.

2.1 SCOPE

The scope of this task is to build source terms that provide consistent data for the following:

- Assessment of safety status of waste/tanks.
- Risk assessments associated with storage and/or processing of tank wastes.
- Safety analyses
- Information for preparation of *National Environmental Policy Act of 1969* (NEPA) documentation.
- Information for permitting of facilities.
- Information needed to design, develop and implement waste treatment/disposal systems (e.g., safety basis, shielding basis, design basis, etc.)
- Information for national databases such as the Integrated Database and the Federal Facility Compliance Act Database.

The characterization database must provide information that can be used for the above listed multiple purposes. The tank waste data must represent, to the maximum extent possible, realistic information (e.g., chemical and radionuclide concentrations and inventories) derived by the compilation and evaluation of all data sources, including tank sampling data, process records, inventory models, and other information.

2.2 OBJECTIVES

An important objective defined in this plan is to identify the specific data requirements of the data user, and to provide the data in a usable form. Thus, the user may require the most likely inventory estimates, or potential extreme values. Information may be needed for various waste phases (e.g., treated supernate or salt cake), and it may be required for specific waste types, as well as on a tank-by-tank basis.

Following are several examples of potential best basis information to be provided for individual tanks, waste types, and waste phases. This list may be revised as progress in defining the database is achieved:

- Chemicals (e.g., molarities, inventories)
- Radionuclides, especially low-level/high-level waste drivers, e.g., ^{137}Cs, ^{99}Sr, ^{99}Tc, transuranics (TRU), ^{129}I).
- Safety-related parameters (e.g., criticality, radiation, gases, FeCN, etc.)
- Water soluble/insoluble phases and associated washes.
- Soluble/insoluble phases from process development testing of NaOH leaching (Enhanced Sludge Washing).
- Physical properties.

Another major objective of this work plan is to develop methodology to revise source terms when new data are made available including the following:

- Define a method for validation of data sources.
- Provide change control and responsibility/authority.
- Integrate with other on-going efforts (e.g., Waste Tank Summary Reports [Hanlon 1995] and Operational Waste Volume Projections).

3.0 INFORMATION SOURCES FOR CHARACTERIZATION DATABASE

Vast amounts of characterization information for stored tank wastes presently exist in the form of raw lab data, letter reports and documents. The major sources of information have been obtained from sampling the tank wastes, and by estimating tank contents using historical bases such as process chemical flowsheets, transfer records, etc. The total chemical and radionuclide inventories in tank wastes have also been estimated using historical bases (see Section 4.4.3).

Waste characterization information obtained from tank samples often varies significantly for a given tank because of the different time frame for sampling events, the types of samples taken (e.g., core, grab, auger), and the area of the tank that was sampled. Obtaining samples that are representative of the tank contents is a unique challenge. This is particularly true for single-shell tanks (SSTs) since waste types have not been well segregated and the tank may contain several heterogeneous layers. Double-shell tanks (DSTs), however, generally contain well segregated waste types and large volumes of liquid waste that are quite homogeneous.

Los Alamos National Laboratory scientists, in association with personnel from ICF-Kaiser Hanford Company, Westinghouse Hanford Company, and Ogden Environmental, as initiated by the Characterization Project in the TWRS, are currently developing the Historical Tank Content Estimate documents. These documents are being prepared from three separate elements: the Waste Status and Transaction Record Summary (WSTRS) reports (Agnew 1994b, c), the Tank Layer Models (Agnew 1994d, e), and Defined Waste document (Agnew 1994a). The WSTRS is prepared from existing historical records such as the TRAC (Track Radioactive Components) computer code transactions file (Jungfleisch 1984) and information in Anderson (1990), and is verified, as far as possible, from additional historical records. The WSTRS data concerning waste volumes and solids level measurements are used to provide a Tank Layer Model of the type and amounts of sludge and salt cake predicted to be in each tank. The third element, the Defined Waste report, is generated from historical process chemical flowsheet and essential materials purchase records. Combination of WSTRS, Tank Layer Model, and Defined Waste report provides an estimate of the types and inventories of waste components in each SST and DST and a framework for understanding and interpreting sample results. Estimates thus obtained will be compared to waste composition and inventory data defined by analysis of actual waste samples when such analytical data become available. The Historical Tank Content Estimate reports were recently issued (Brevick et al. 1994a and b, Brevick 1995a). The methodology for sampling and analyzing tank wastes in order to better qualify values associated with the historical data models is provided in Simpson and McCain (1995).

3.1 EXISTING DATABASES

Several electronics databases exist that summarize tank content information on a tank-by-tank basis. These databases generally do not provide a best basis characterization estimate--rather they compile the available information from sampling events, and in certain cases, for historical estimates. Selected databases are listed below.

- Tank Characterization Database (TCD) (PNL 1994)
- Wastren/Van Vleet (Van Vleet 1993)
- Braun Database (Forehand 1995)
- ICF-Kaiser Hanford Company Database (Brevick 1995b)
- Disposal Process Development Data (Lumetta 1995)
- TWRS Flowsheet Inventory (Shelton 1995a, b)
- Waste Tank Summary Report (Hanlon 1995)
- Radionuclide Inventories for Low-Level Waste (Schmittroth 1995).

3.2 TANK CHARACTERIZATION REPORTS

Fifty-three Tank Characterization Reports (TCRs) have been written to date for the 177 tanks. The TCRs are presently considered the official basis for characterization of tank waste. These reports describe the history and estimated inventory contents of SSTs and DSTs. When applicable, safety issues are included and reported. Evaluations are based on tank sampling events and tank information using the historical tank content estimates (HTCE). The data in the TCRs are limited to those requested for existing data quality objectives (DQO) documents. The TCRs support the requirements of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1994), Milestone M-44-08, 09, 10, 11 and 12. TCRs for all tanks will be completed by September 30, 1999.

The existing TCRs represent important primary source documents for generating a best basis inventory estimate for Hanford Site SSTs and DSTs. As the database described in this work plan is further developed, it is anticipated that future TCRs will rely mainly on this new database for reporting tank inventories.

4.0 TASK DESCRIPTIONS AND DELIVERABLES

The proposed tasks required for deriving the characterization bases for waste in each storage tank, implementing the database, and maintaining/updating the database are defined in this section. The tasks are grouped into functional areas to provide further definition. A summary of the process is shown in Figure 1 and involves evaluation and reconciliations of the existing information described in Section 3.0. A schedule for completion of the tasks defined in this section is shown in Figure 2. Table 1 shows the study deliverables by phase of the study. Figure 3 provides an abbreviated task schedule and associated estimated costs (fiscal year 1996 dollars) on a monthly basis for completion of the tasks.

4.1 DEFINE TASK SUPPORT

To successfully coordinate such a large and encompassing task, it is important to recognize the resources required for this task and to commit those resources early on in this effort. The following sections describe specific resource needs and associated responsibilities.

4.1.1 Assign Review Team

Assign appropriate personnel to perform periodic reviews of interim deliverables. Interim deliverable reviews will occur at certain phases of the effort. Such reviews are conducted to assure that the products being generated are consistent with the expectations of the users. The review team shall be representative of those organizations and functions that will use the Inventory Estimate. As this work plan is executed, additional data users may be identified (Section 4.2), but at a minimum, the review team will have representation from the following organizations:

- Characterization Project
- Low-Level Waste Project
- Retrieval Project
- Storage and Disposal Project.

Figure 1. Process Summary.

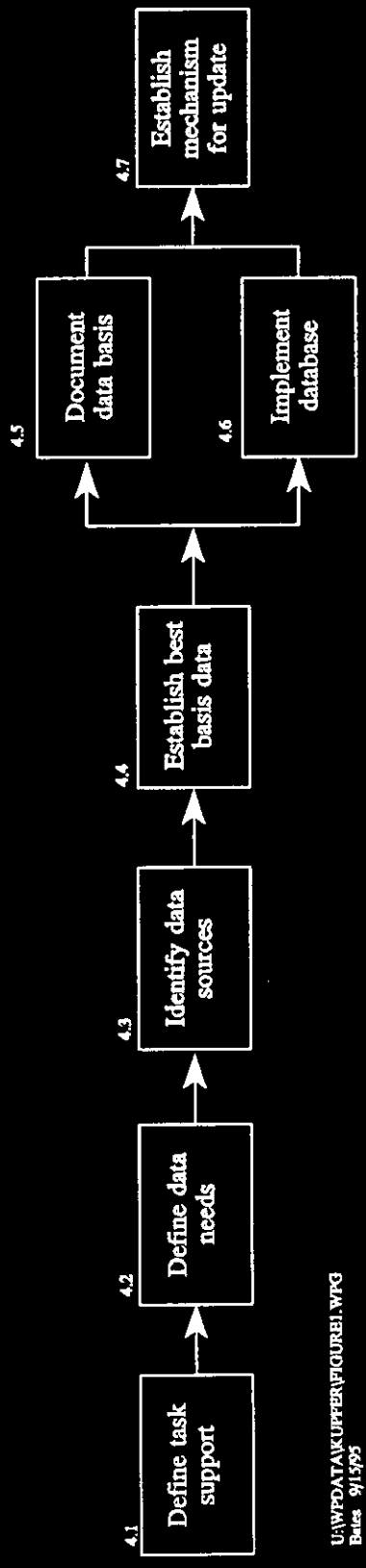


Table 1. Study Deliverables by Phase of Study.

Phase	Deliverable	Date
I	• Documentation of data requirements for user, and candidate data sources.	10/30/95
II	• Quarterly update on inventory development.	12/29/95
	• Documentation of tank waste (global) inventories and associated basis for inventories.	02/02/96
III	• Documentation of preliminary results of tank-by-tank (and phase) inventories and associated bases for 30 SSTs.	03/08/96
	• Provide preliminary format of electronic database.	03/08/96
IV	• Documentation of preliminary results of tank-by-tank (and phase) inventories and associated bases for 75 SSTs.	05/27/96
	• Provide format of electronic database.	05/27/96
V	• Documentation of preliminary results of tank-by-tank (and phase) inventories and associated bases for 149 SSTs and 28 DSTs.	07/29/96
	• Provide format of electronic database.	07/29/96
	• Define preliminary mechanism for update/revision of database.	07/29/96
VI	• Document final results of tank-by-tank (and phase) inventories and associated bases for 149 SSTs and 28 DSTs.	09/30/96
	• Complete implementation of electronic database.	09/30/96
	• Document mechanism for update/revision of database.	09/30/96

Figure 2. Task Schedule.

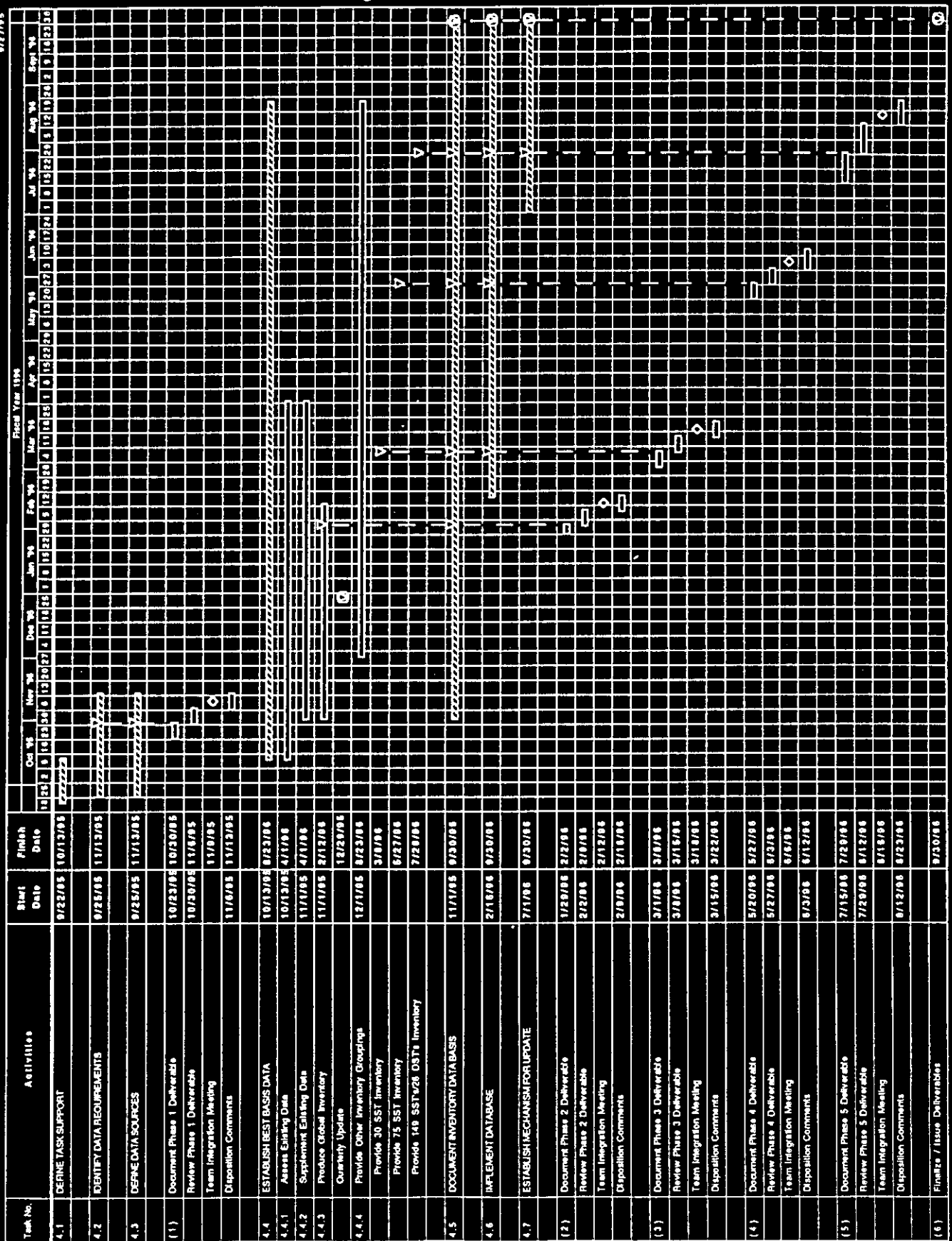
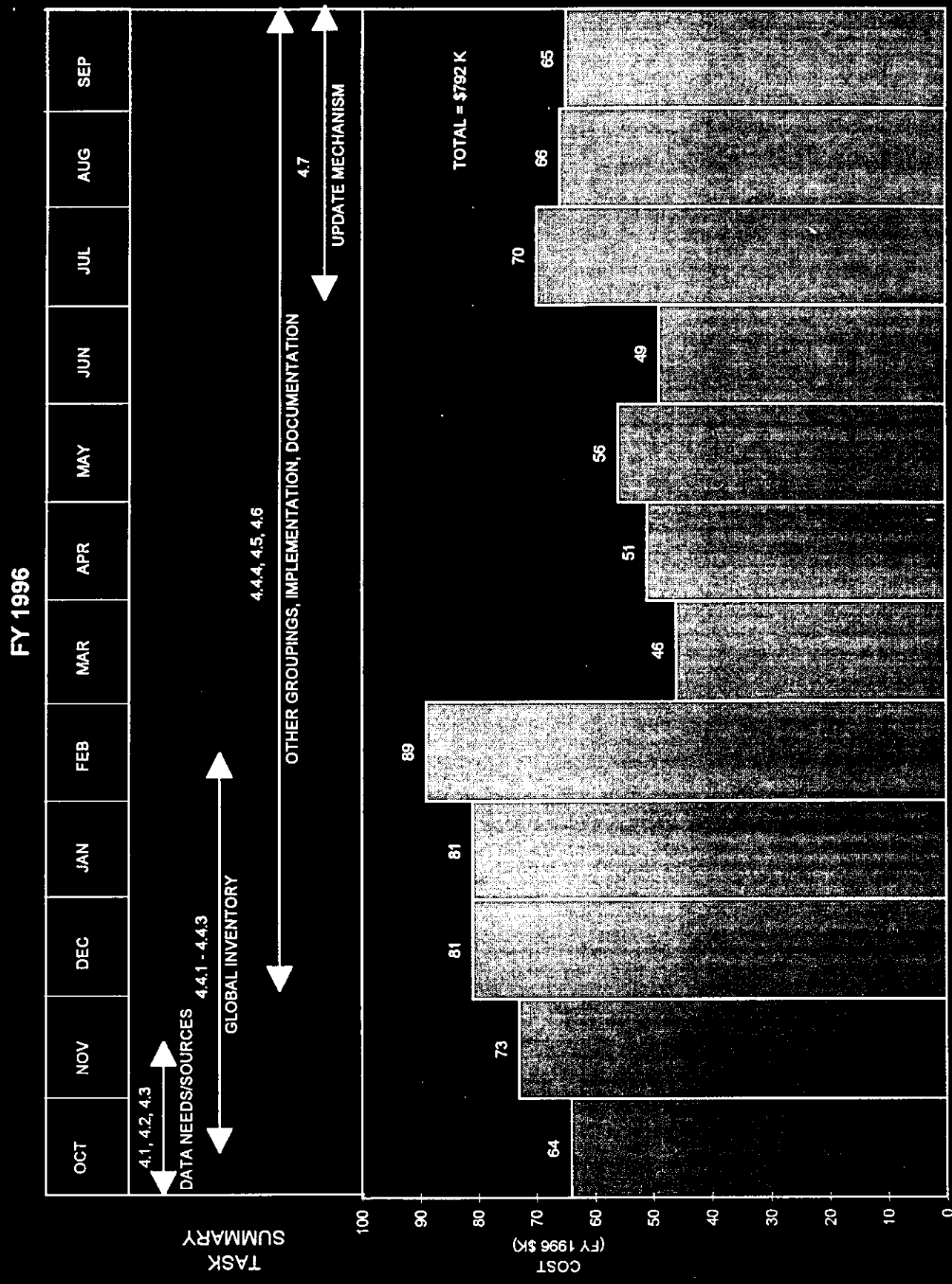


Figure 3. Estimated Costs for Implementation of Tank Waste Inventory Database.



4.1.2 Assign Assessment Team

Assign personnel to be responsible for task completion. For each of the tasks defined in this work plan, one individual will have lead responsibility for completion of the task and others may be assigned to assist in the task. Task leads will provide information in the agreed upon format per the schedule and will be requested to status their tasks at integration meetings held periodically with all assessment participants.

4.2 IDENTIFY DATA REQUIREMENTS

Each of the user representatives will be identified (Section 4.1.1.). Interviews must be conducted with each of these prospective Inventory Estimate users to assess their needs with regard to the following:

- Parameters to be reported (chemical inventories, radionuclide inventories, wash factors, waste volumes, physical properties, etc.). Many of these parameters will be identified from existing DQO documents.
- Parameter format (units, nominal value, ranges, upper bounds, etc.)
- Inventory breakdown (by tank, phase, waste type, etc.)
- Report format (text, tables, matrix, report content, etc.).

These user needs will establish the requirements for generating the Characterization Database.

4.3 DEFINE DATA SOURCES

To fulfill the needs of the users, data will be obtain from a variety of sources. All existing sources of data must be identified. Possible sources of data are discussed in Section 3.0 and include the following:

- Sample analysis results
- Process development test results
- Historical operating records
- Models (TRAC, Agnew, etc.)

- Databases (TCRs, TCD [PNL 1994], ICF-Kaiser Hanford Company [Brevick 1995b], Schmittroth [1995], Van Vleet [1993], Hanlon [1995], Privatization best basis, etc.).

4.4 ESTABLISH BEST BASIS DATA

This is the core task of this work plan and encompasses all work required to generate the inventory estimate that meets user needs. Figure 4 summarizes this Data Evaluation Process.

4.4.1 Assess Existing Data

Data obtained from existing sources may or may not be acceptable for user needs. Each source must be screened to assess the acceptability of the data. Where models are a source of data, it may be necessary to understand the assumptions and uncertainties associated with the model. When two sources provide conflicting values for the same parameter, the methodology for distinguishing between conflicting data must be established and documented. This methodology may be a statistical approach combined with an engineering approach (which relies on process knowledge experts). Throughout this screening process, all assumptions and recognized uncertainties should be documented.

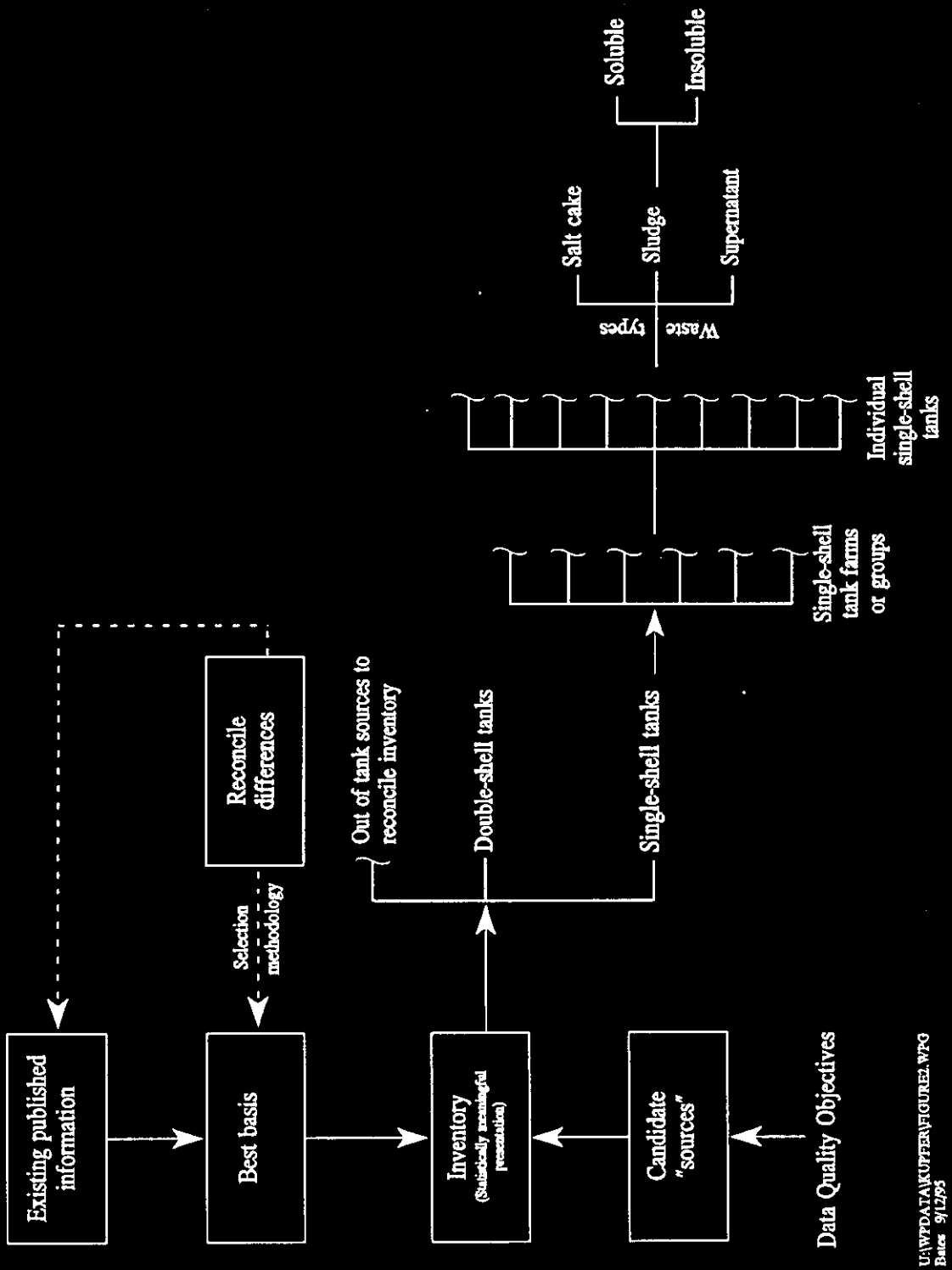
4.4.2 Supplement Existing Data

It may be necessary to supplement data not found in existing data sources (Section 4.3). A method for providing this information must be established and the bases and assumptions must be well documented.

As an example, the basis for estimating the radionuclide content in many individual SSTs is considered deficient. In the past, tank-by-tank radionuclide inventories have been estimated using the TRAC computer code (Jungfleisch 1984). For various reasons (e.g., incomplete historical data input, incorrect assumptions concerning the solubility of various waste components) the TRAC code predictions are quite uncertain. Only limited radionuclide data have been provided by core sample analyses.

Agnew (1994a, b, c, d, e) has developed a historical model for estimating the inventories of four major radionuclides in every SST. The Agnew model will be used by the inventory task team to obtain an expanded radionuclide inventory for wastes in each individual SST as well as in waste types and water-soluble and insoluble waste phases. As necessary, solubility and partitioning assumptions made by Agnew will be augmented and altered based on the known chemistry of various radionuclides of interest. Data from the Agnew model will be reconciled with data from tank waste samples according to methodology described in Section 4.4.1.

Figure 4. Data Evaluation Process.



Other missing analytical information may be incorporated into the database on a tentative basis if deemed desirable or necessary by the data user. For example, missing data may be estimated for tank wastes that are very similar (e.g., process history) to other known waste types. However, good engineering bases must be provided and documented, and the data must be identified as a tentative estimate.

Examples of missing data may include the following:

- A key chemical component
- Important physical property such as density
- Partition factors (e.g., water or NaOH soluble and insoluble components).

4.4.3 Produce Global Inventory

To obtain reliable and consistent tank-by-tank inventories of various chemicals and radionuclides in each of the 177 Hanford underground tanks, an essential first task is to establish the total inventory (so-called "global" inventory) of such chemicals and radionuclides in all 177 tanks. Information concerning the global inventory is derived from key historical records, including essential material purchase records, various chemical flowsheets used in reprocessing irradiated Hanford reactor fuels, ORIGEN (Oak Ridge Isotope Generation) calculations of radionuclide isotope generation and decay, and estimates of amounts of certain radionuclides, e.g., ^{14}C, ^{99}Tc, ^{129}I, etc., not introduced into the tanks. Extensive use of some or all of these historical data was made in the 1980's to write the TRAC computer code (Jungfleisch 1984) and to prepare the Hanford Defense Waste Environmental Impact Statement (EIS 1987). More recently, Agnew (1994, 1995) has made use of at least some of the historical data to prepare a new estimate of the amounts of chemicals in each of the 177 tanks. Schmittroth (1995) has also published new ORIGEN code calculations of radionuclide isotope generation and decay in irradiated Hanford reactor fuels and wastes.

Close inspection of the different reports and documents (e.g., EIS, TRAC, Agnew, Schmittroth, etc.), which purport to state the Hanford tank global inventory, reveals many discrepancies and uncertainties. Such errors arise for several reasons, including misinterpretation of historical data, omission of some of the historical data, and calculation errors. Whatever their cause, a concerted effort is needed to resolve errors in tank inventories to establish a reliable and consistent global inventory of chemicals and radionuclides.

4.4.4 Produce Other Inventory Groupings

Once an acceptable global inventory has been produced, the other elements of the inventory estimate can be generated. It is anticipated that user will require radionuclide and chemical inventories on a tank basis and possibly on a waste phase basis. In any case, the summation of the sub-group inventories will not exceed the upper limits established by the global inventory. Key areas of difference between the summation of tank-by-tank inventories versus global inventories (see Section 4.4.3) will be reconciled by identification of materials unaccounted for.

4.5 DOCUMENT DATA BASIS

The basis for the inventory estimate product will be documented. All resources, references, assumptions and methodologies used to arrive at the final database product shall be included.

Errors thought to be associated with any particular datum will be identified. As mentioned in Section 4.4.1, a yet-to-be defined statistical approach will be used to distinguish between conflicting data and, if needed, establish confidence limits on some data. Also, as pointed out in Section 4.2, it is anticipated at this time that the database format will include not only nominal inventory values, but also, where appropriate, upper bounds and data ranges.

4.6 IMPLEMENT DATABASE

For the convenience of the data user, the best basis estimate inventory database will be stored in an electronic format. This will enable users to retrieve stored information and import directly into compatible software packages where the information can be manipulated by the user. A structure will be identified where the database can be stored electronically. This structure could come from existing databases or be developed as part of this task. The information will be organized and stored in a format that satisfies the data needs of the user. A mechanism will be identified that allows users to access the information while restricting their ability to change the information.

It is anticipated that the best basis characterization information will be entered into the existing TCD (PNL 1994). Close coordination of personnel in WHC with Pacific Northwest Laboratory personnel responsible for maintaining the TCD will be required regarding needed updates to the best basis characterization data.

4.7 ESTABLISH FORMAL MECHANISM FOR UPDATE/REVISION OF BEST BASIS ESTIMATES

For the best basis characterization database to remain a useful tool, it must be periodically updated and modified to reflect the current information available on tank contents. As sample analysis results and modeling data become available, they must be scrutinized in much the same fashion as existing data were scrutinized in support of this effort (see Section 4.4.1). Acceptable data must then be incorporated into the database. This task will define the process to be followed for updating the database. Responsibilities, authorities, screening methodology, quality assurance practices, and database configuration control procedures will also be discussed. This information will be documented in a Characterization Database Change Control Procedure.

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