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Indexing Contamination Surveys

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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Indexing Contamination Surveys

The responsibility for safely managing the Tank Farms at Hanford belongs to Lockheed Martin Hanford Corporation which is part of the six company Project Hanford Management Team led by Fluor Daniel Hanford, Inc.. These Tank Farm Facilities contain numerous outdoor contamination areas. These outdoor contamination areas are surveyed at a periodicity consistent with the potential radiological conditions, occupancy, and risk of changes in radiological conditions.

This document describes the survey documentation and data tracking method devised to track the results of contamination surveys; this process is referred to as indexing. The indexing process takes a representative data set as an indicator for the contamination status of the facility. The data is further manipulated into a single value that can be tracked and trended using standard statistical methodology.

To report meaningful data, the routine contamination surveys must be performed in a manner that allows the survey method and the data collection process to be recreated. Three key criteria are necessary to accomplish this goal:

- Accurate maps
- Consistent Documentation
- Consistent Consolidation of Data

Meeting these criteria provides data of sufficient quality to be tracked. Tracking of survey data is accomplished by converting the individual survey results into a weighted value, corrected for the actual number of survey points. This information can be compared over time using standard statistical analysis to identify trends.

At the Tank Farms, the need to track and trend the facility's radiological status presents unique challenges. Tank Farms consists of thousands of square meters of contaminated outdoor areas, including more than 177 underground tanks, miles of underground pipeline, and dozens of above ground support facilities. Many of these Tank Farm facilities date back to the second world war. The Tank Farm Facilities are exposed to weather extremes, plant and animal intrusion, as well as all of the "normal" challenges associated with handling radiological waste streams from chemical processing facilities.

Routine radiological surveys performed at Tank Farms were sufficient to define the radiological characteristics of Tank Farms, but did not provide a radiological status adequate for continuing comparisons. This made it difficult to track the ongoing radiological conditions of the Tank Farms. Tracking and trending of data began with a pilot process at Single Shell Tanks, a subset of the larger Tank Farm facility.

The pilot process at Single Shell Tanks focused on improving the routine radiological survey program. Improvements were made in consistency and overall data gathering. The pilot was carried out from May to December of 1997 in five tank farms, all of which were posted as contamination areas. The pilot was successful and provided excellent results in terms of consistently collected data.

An evaluation of the data provided lessons learned for facility wide implementation. The original method of data conversion gathered all data points, both ground and component surveys, and provided a single indexed contamination value for each facility. As planned for facility implementation, the process will result in two values for each facility, a removable contamination index and a total contamination index. The removable contamination value will only include removable contamination from above ground components, while the total will include both above grade components and direct ground surveys.

The Single Shell Tanks pilot resulted in an improved routine program providing useful data gathered in a consistent manner. This information resulted in having sufficient data to support changing the frequency of contamination surveys in some areas from weekly to monthly, resulting in significant cost savings. The improvements in the routine program included improved efficiency in collecting and documenting data.

Process

The indexing process is a successful method of converting large amounts of radiological survey data into a single number which is then compared with previously processed data. This is a method allowing data tracking and trending. The process has three phases:

- Defining the data set,
- Collecting the data, and
- Evaluating and analyzing the data

Defining the Data Set

An outdoor facility, such as a tank farm, might have hundreds of components in the farm that have varying potential to be contaminated, as well as thousands of square meters of surface area. The number of points to be checked on any given survey is driven by both the Department of Energy Radiological Control Manual, Article 551, which requires the number of survey points be sufficient to characterize the area and by facility considerations.

This "sufficient" number of survey points reflects the data set that will be used for each area. The selection of what components should be involved in each data set requires an understanding of how the components become contaminated. An item in a tank farm has three typical methods of becoming contaminated: failure of a gasket or other confinement system, work activities, or

ecological transport by plants, animals, or wind. Above ground components are generally contaminated by failure of the confinement system or work activities; the ground is generally contaminated by work activities or ecological transport. There are, of course, exceptions, but these are the general patterns.

Two indexed values are defined for each area: the removable contamination component and the total contamination component. The removable contamination component is taken from the data set of select above ground components, and the total contamination value is taken from a combination of above ground components and ground surveys. For Tank Farms the data set is defined by risk. Components with the highest risk of becoming contaminated were selected as the representative data set within the larger population of components to be surveyed. These type components are essentially standard across the facility, therefore allowing for data comparison. This should be a key consideration when selecting the data points to be in the data set.

It is important to remember that the survey points in the data set will not define the complete list of items surveyed during a routine survey, but instead will define those points that will be used as indicators to track the overall contamination status of the facility.

Some facility areas are small and may not be large enough to provide sufficient survey points to define an indexed value that wouldn't have an excessive response to a single data point. A minimum of 25 data points for removable contamination surveys is suggested. Where less than 25 data points are defined, the areas may be grouped to allow collection of sufficient data points, if the physical proximity justifies such a decision.

For the total contamination index value, the data set includes the removable components and ground survey data. A minimum of 64 ground survey points in each area is recommended. For the sake of consistent data collection, three ground survey points are taken in the vicinity of each potential source term with the balance taken inside the contamination area perimeter. If background radiation levels precludes a direct contamination survey, the number of ground survey points taken inside the contamination perimeter should be increased as needed to obtain the total number of points.

Some areas may be disturbed by large work projects that change the radiological configuration of the facility. These areas should be excluded from the indexing process during the period the work is underway.

Collecting the Data

The key to data collection is consistency. The designated points must be surveyed at the established periodicity and documented in a legible, retrievable manner. Key tools are accurate maps and lists of the areas and components to be surveyed. The importance of accurate maps in performing routine radiological surveys is critical. Maps need to show the components in the

facility that would routinely be surveyed as well as the tracking data set. For Tank Farm facilities, this drives the maps to list risers, pits, ventilation lines, monitoring cabinets, and buildings. The maps should also show the components, the fenced boundaries, and contain sufficient information to allow employees to find the listed components.

In addition to a map, a list of the components in the area, both those in the data set and those that would be routinely surveyed, needs to be available. A preprinted survey form is preferred for this process. The data packages resulting from preprinted surveys are prepared more efficiently and provide more consistent data. Because of this, survey forms should be preprinted with survey maps and routinely surveyed locations prior to being given to the technicians for completion. The preprinted survey form should be structured so the listed survey locations do not limit the ability of the technician to survey items beyond the listed components or the trending data set. This survey form, when completed by a technician, contains the data necessary for entering into the indexing data base and producing tracking and trending data.

Evaluation of the Data

The core methodology of indexing requires the data be categorized by contamination level, each contamination level assigned a weighting factor, and the number of data points in each category, as weighted, compared to the total number of data points. The weighting factors, and category range can be subjectively determined. A consistency of application is assumed.

For establishing an indexing process for an area, the following would be defined:

- the number of ranges to be used,
  for this example four ranges will be used
- the value of the ranges,
  for this example the values of the ranges will be <detectable (det), <det-10,000 dpm, >10,000 dpm to 50,000dpm, and >50,000 dpm.
- weighting factors for the ranges,
  for this example the ranges will be weighted as 1, 5, 15, and 25 respectively.

This results in the following formula:

$$\frac{(A \times 1) + (B \times 5) + (C \times 15) + (D \times 25)}{(A + B + C + D)} = \textit{Indexed Value}$$

Where:

A is the number of survey points that are <det
B is the number of survey points that are between <det and 10,000 dpm
C is the number of survey points that are >10,000 dpm to 50,000 dpm, and
D is the number of survey points that are >50,000 dpm

There is no single absolute as to what weighting factors or what ranges to apply. The only criterion is that when comparing indexed values, the same ranges and weighting factors need to be applied to the raw data.

For the current indexing process at Tank Farms, the levels shown in the examples are used. Further analysis of the Tank Farm data may result in the adjustment of ranges or weighting factor values.

Analyzing Data

The methodology defined above results in a single numerical value. The range of this value will vary by the number of points, the weighting factors assigned, or actual changing conditions. For example a single contamination point where only 10 readings were taken would result in a far higher indexed value than two positive indications in 30 data points. To minimize variability of range due to a single data point, a minimum number of 25 data points is recommended for removable contamination, and 64 for direct surveys.

The data produced is easily converted into charts (Attachment 1) and tables (Attachment 2).

Implementation

The implementation process requires maps and preprinted survey forms be developed and incorporated into the routine radiological survey process. These radiological surveys, when completed, provide the data used for tracking and trending.

These completed survey reports are forwarded to the technical staff where the data is entered into a computer data base used to generate the indexed values. The indexed values are then graphed and provided to the area radiological control manager on a quarterly basis for distribution within the facility. Examples of sample index tables and charts are attached.

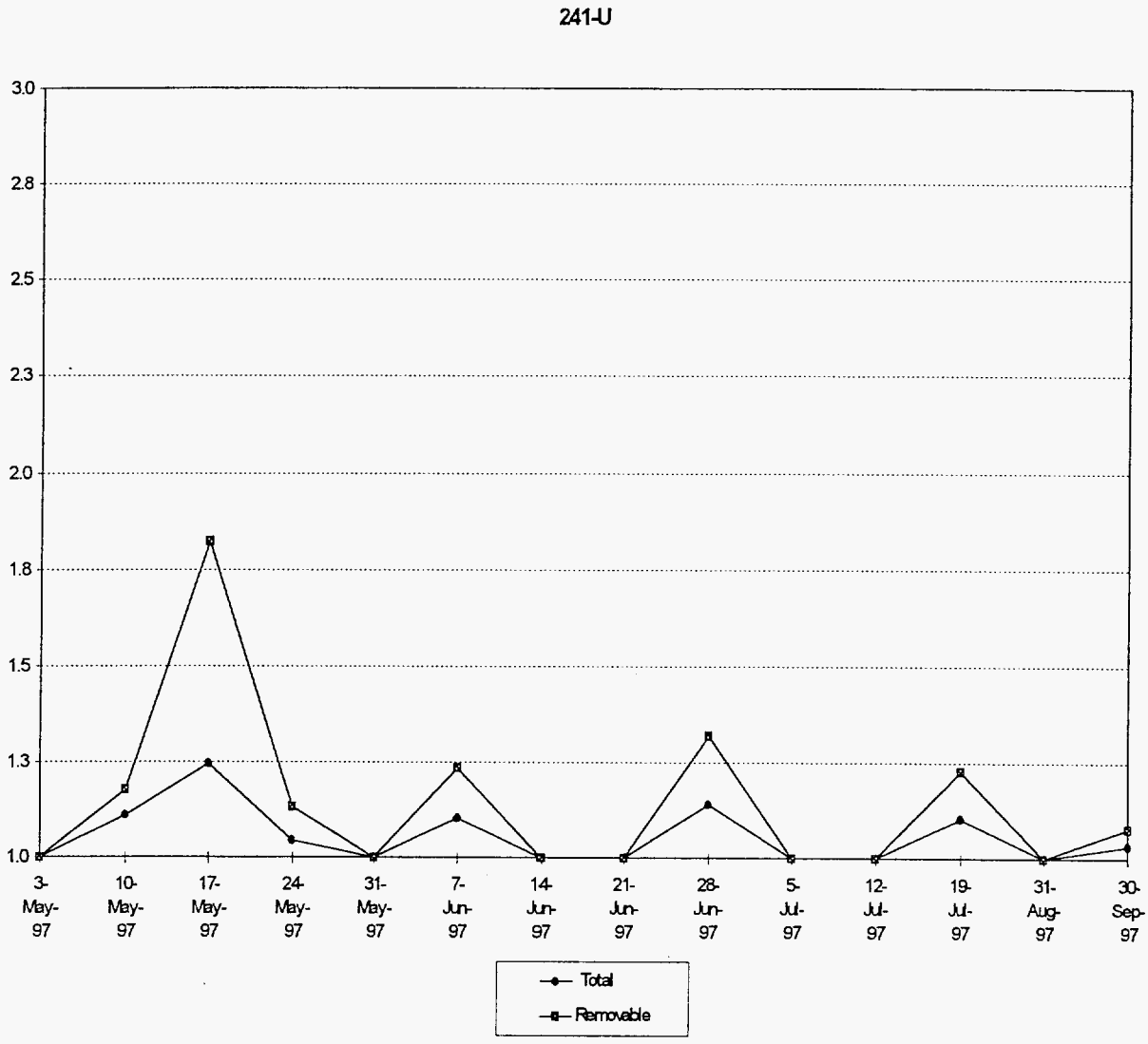
References

1. DOE RCM-1, *DOE Radiological Control Manual*, Revision 2, dated December 1994.

2. HNF-PRO-435, *Required Radiological Surveillances*, Revision 0, dated September 8, 1997.

3. HNF-IP-0718, *Health Physics Technical Procedures and Practices*, Section 3.1.11, Radiological Survey Report, Revision 0, dated June 26, 1996.

Attachment 1: Sample Indexing Chart



The chart above reflects actual data from 241-U Tank Farm. An indexed value of one indicates that all surveys performed were below the detection limits of the instruments. Surveys performed on 3 May, 31 May, 14 June, 21 June, 5 July, 12 July, and 31 August found no contamination. The indexed value for total contamination removable contamination is clearly higher than that for total. This indicates the contamination is primarily removable.

The consistent collection of data allows the distinct data points causing a "spike," such as May 17, to be evaluated and, if necessary, rechecked. In this specific case, a review found that the spike was a variation in survey technique, not a major shift in radiological conditions.

Attachment 2: Sample Indexing Table

The following are sample index tables that show the data points as collected from radiological surveys performed in 241-U Tank Farm. The upper table reflects removable contamination and the lower table reflects total contamination. The tables are maintained in an Excel spread sheet. The tables, as shown provide the data that is contained in the chart on attachment 1.

241-U Removable	3-May	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	5-Jul	12-Jul	19-Jul	31-Aug	30-Sep
# of Points	45	45	39	30	51	51	51	49	50	52	52	53	52	52
<Det	45	43	31	29	51	48	51	49	46	52	52	50	52	51
Det to 10K	0	2	8	1	0	3	0	0	4	0	0	3	0	1
>10K to 50K	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>50K	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Index Value	1	1.2	1.8	1.1	1	1.2	1	1	1.3	1	1	1.2	1	1.1

241-U Total	3-May	10-May	17-May	24-May	31-May	7-Jun	14-Jun	21-Jun	28-Jun	5-Jul	12-Jul	19-Jul	31-Aug	30-Sep
# of Points	73	73	131	94	79	115	51	124	114	52	52	117	116	116
<Det	73	71	123	93	79	112	51	124	110	52	52	114	116	115
Det to 10K	0	2	8	1	0	3	0	0	4	0	0	3	0	1
>10K to 50K	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>50K	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Index Value	1	1.1	1.2	1	1	1.1	1	1	1.1	1	1	1.1	1	1

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