Case Study in Corporate Memory Recovery: Hanford Tank Farms Miscellaneous Underground Waste Storage Tanks – 15344

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ABSTRACT

In addition to managing the 177 underground waste storage tanks containing 212,000 m^3 (56 million gal) of radioactive waste at the U. S. Department of Energy's Hanford Site 200 Area Tank Farms, Washington River Protection Solutions LLC is responsible for managing numerous small catch tanks and special surveillance facilities. These are collectively known as "MUSTs" - Miscellaneous Underground Storage Tanks. The MUSTs typically collected drainage and flushes during waste transfer system piping changes; special surveillance facilities supported Tank Farm processes including post-World War II uranium recovery and later fission product recovery from tank wastes. Most were removed from service following deactivation of the single-shell tank system in 1980 and stabilized by pumping the remaining liquids from them. The MUSTs were isolated by blanking connecting transfer lines and adding weatherproofing to prevent rainwater entry.

Over the next 30 years MUST operating records were dispersed into large electronic databases or transferred to the National Archives Regional Center in Seattle, Washington. During 2014 an effort to reacquire the historical bases for the MUSTs' published waste volumes was undertaken. Corporate Memory Recovery from a variety of record sources allowed waste volumes to be initially determined for 21 MUSTs, and waste volumes to be adjusted for 37 others. Precursors and symptoms of Corporate Memory Loss were identified in the context of MUST records recovery.

INTRODUCTION

During World War II and continuing until 1986, underground radioactive waste storage tanks were constructed at the Hanford Site to support nuclear reactor fuel reprocessing. The early tanks were concrete structures with a single internal metal liner. Beginning in 1968 all new tank construction included a secondary metal liner within the concrete structure to provide containment in the event of a primary liner leak. The tanks were built in tank farm groups of two to 18 units, with storage capacities ranging from 208 – 4789 m^3 (55,000 – 1,265,000 gal). Design refinements were incorporated in each later tank farm, however many of the earliest tank features are still evident in the final tank generation. The core similarities across the tanks have allowed basic construction, operating, monitoring, and record keeping practices to be uniformly employed since 1943.

The earliest tank farms received waste from the fuel reprocessing plants via simple underground pipeline networks. The tanks were located on a hydraulic gradient that allowed waste to cascade downstream into empty tanks as the upstream tanks filled. Later additional piping infrastructure was added to allow more complex routing and introduce waste recovery processes. A key feature was the introduction of diversion boxes to increase routing flexibility. These were below-grade concrete vaults to which most piping was routed. The piping terminated in wall-mounted pipe nozzles, and routing changes were made connecting short pipe jumpers between nozzles.

The diversion boxes were equipped with a floor drain to collect spills and water flushes. Some of the floor drains were routed to existing waste tanks. However, in many cases a separate steel catch tank was buried beside the diversion box to collect the liquids. These catch tanks are collectively known as "miscellaneous underground storage tanks", or MUSTs. They vary in capacity from 0.19 – 189 m^3 (50 – 50,000 gal), and include direct buried horizontal bell-end cylinders, vertical right circular cylinders, and slab tanks, and similar tanks located in process vaults and special surveillance facilities.

By November, 1980, the 149 single-shell waste storage tanks had been deactivated; by June, 2005, most of the existing underground piping network had been deactivated except for the pipelines supporting the 28 double-shell waste storage tanks. Concurrently the MUSTs associated with deactivated tanks and pipelines had been pumped, deactivated and isolated from the environment. Once the MUSTs were deactivated monitoring was reduced, and operating records archived. Most archived records were eventually transferred to the National Archives Regional Center in Seattle, Washington.

During this same period, the site experienced a succession of operating contractors. The combination of these gradual changes occurring over more than three decades resulted in MUST information becoming fragmented or untraceable. In April, 2014, the U. S. Department of Energy Office of River Protection posed a simple question, 'What is the basis for the published MUST waste volumes and their isolation status?' Efforts were initiated to recover current operating information for the MUSTs and historical information from the time they were deactivated and isolated.

Information gaps for individual MUSTs were frequently encountered. Collectively these tended to have similar characteristics in spite of different tank construction and operating histories, and location in the Hanford time continuum. This paper discusses the information gaps in terms of corporate memory loss, CML, and corporate memory recovery, CMR. It identifies the characteristics that predispose information to CML, and simple methods that can be implemented to ensure vital information is always recoverable.

DESCRIPTION

The Hanford Site issues a monthly waste status report, HNF-EP-0182, *Waste Tank Summary* [1], which lists the status of the MUSTs and special surveillance facilities traditionally managed by Washington River Protection Solutions LLC, or WRPS. Tables provide waste volumes and isolation status. At the time of the Department of Energy's request, 66 entries had published waste volumes; 19 did not. Of the 66 entries with published volumes, 28 were being reported from an operating waste surface level measurement device. This left 57 entries with a waste volume basis to be determined. Some table entries included combined volumes from multiple MUSTs. For example the 241-AX-151 Diverter Station entry included the combined heel volumes of four 0.24 m^3 (66 gal) receiver tanks and their associated 42.8 m^3 (11,300 gal) sump. This and similar compound entries were separated into their individual MUST components before continuing. After separation, the number of entries increased from 85 to 95, and the number with unpublished volumes increased from 19 to 33.

Information Resources

The preferred reference materials for determining MUST volumes were surface level measurements in the MUSTs coupled with tank calibration tables; and for isolation status, construction project as-built isolation drawings, field work packages, and field notes.

Information sources initially consulted included widely cited Hanford MUST references:

- WHC-EP-560, *Miscellaneous Underground Radioactive Waste Tanks*;
- WHC-SD-EN-ES-040, *Engineering Study of 50 Miscellaneous Inactive Underground Radioactive Waste Storage Tanks Located at the Hanford Site, Washington*;
- RPP-RPT-29878, *Catch Tank Level Trend Assessment*;
- RPP-RPT-42231, *Summary of Twenty-Five Miscellaneous Tanks Associated with the Single-Shell Tank System* [2,3,4,5].

These proved beneficial for technical orientation, but frequently cited each other or HNF-EP-0182, *Waste Tank Summary* reports as the information source. Information from circular references and from secondary references was dismissed whenever primary reference material was available.

The second group of information sources queried consisted of U. S. Department of Energy's electronic databases. These are listed in order of relative utility for the MUST volume determinations:

- Hanford Integrated Data Management System, or IDMS, database consisting of more than 7.8 million electronic records (some accounts state 16 million retrievable Hanford documents) including MUST drawings, correspondence, reports and photographs. The database does not include construction project records.

- U. S. Department of Energy Health, Safety and Security Occurrence Reporting and Processing System, or ORPS, database which includes Hanford Tank Farms' occurrence and off-normal event reports from 1990 to present. Occurrence reporting was first implemented at the Hanford site in 1972; occurrence reports covering MUSTs for the 1972 – 1989 period were recovered from the IDMS database.

- U. S. Department of Energy Office of Science and Technology's Information Bridge and Energy Citations databases, now combined as "SciTech Connect". In some cases these databases contain MUST reports that had been prepared by non-Tank Farm contractors.

The earliest MUST deactivation occurred in 1954 and the latest in 2005. Deactivation occurred by pumping the liquid heel from the tank, frequently performed as an expense-funded operating activity. A final waste level determination was completed after pumping, and is the source of several reported MUST waste volumes. The MUST isolation occurred after deactivation. Isolation included blanking or cutting and capping process lines connected to the tank, and sealing or covering rainfall and snowmelt pathways into the tanks. Isolation activities were capital-funded and performed in a series of construction projects beginning in 1979.

Once the construction project was completed and closed out, the construction records were boxed, a records inventory prepared, and the boxes shipped to the Seattle, Washington National Archives Regional Center for storage. As of November, 2014, the Seattle facility stored 87,680 boxes of Hanford records, including isolation construction project records. The Hanford Site's local Records Holding Area stores an additional 22,900 boxes. A searchable inventory database describing the general contents of most boxes stored at both locations is available.

The MUST isolation work was completed as part of seven construction projects. As of November, 2014, only the construction records for Project B-231 "Isolation of Catch Tanks and Diversion Boxes" have been recalled from the Seattle facility and reviewed. The recall included almost two dozen 0.03 m^3 (1 ft^3) records boxes; the boxes each required between one and six hours to review depending on the significance of the records. Since the boxes included records from several project individuals, duplicate records were frequently encountered. All files relevant to isolation status were digitized, organized by MUST, and stored for future reference.

MUST Waste Volume Outcome

The MUST waste volume effort yielded waste volumes for 21 of the 33 MUSTs without previously published waste volumes, leaving 12 to be determined by new field measurements. Additionally, as a result of the effort, the waste volumes of 37 MUSTs were changed, ranging from a 2.5X increase to a 41X decrease; in absolute terms the largest change was an 82 m^3 (21,600 gal) volume decrease attributed to a arithmetic error.

In addition, tank calibration tables were recovered or re-created for the MUSTs so waste level measurements made in the future can be converted into waste volumes for comparison with published values.

The MUST waste volumes, waste level measurements, tank calibration tables, waste volume calculations, and supporting primary references were packaged and published as a separate document [6], and the HNF-EP-0182, *Waste Tank Summary* tables updated with the new waste volumes.

MUST Isolation Outcome

To date, the effort to confirm MUST isolation construction project activities has met with limited success. With the exception of as-built isolation drawings and work lists identifying individual modifications to be made on some MUSTs, the primary reference completion records have been difficult to locate.

This limited return on effort is partly the result of extending the isolation activities over 27 years, and being parsed among the seven construction projects and between operating and construction crews. In some cases more than one construction project completed isolation modifications on the same MUST. It is likely that examination of the remaining six construction projects will yield the information necessary to give a complete picture of the MUST isolation work.

DISCUSSION

The MUST waste volume effort demonstrated that it is possible to successfully recover from CML by relying on focused research supplemented by re-engineering when necessary (*e. g.*, regenerating tank calibration tables) to establish sound technical bases for an important waste management parameter.

Corporate Memory Loss Precursors

During the MUST volume and isolation recovery activities technical and work management practices that are CML precursors were identified. These can be present in any long term, complex endeavor that generates records. The most commonly encountered ones are discussed in the following sections.

Limited Mission Role

Figures 1 and 2 illustrate a unique historical difference between MUSTs and the large single-shell waste tanks. The single-shell tanks were constructed and placed in service over a 22-year period in concentrated tank farm groups as large as 64 tanks in one year (1944) and never smaller than four tanks (1965). Built and operated in groups, the single-shell tanks shared similar design, construction and operating histories. Their construction and operating scale created a significant volume of data that is still available today.

In contrast the MUSTs were typically placed in service in ones and twos over a 48-year period. Unlike the single-shell tanks, each is unique or nearly so; there are few collective features or operating similarities that can be generalized and applied across all of the MUSTs. They collected drainage and spills from pipelines rather than directly supporting the single-shell tanks or waste management processes. Consistent with their perceived minor role, little time was allocated to generating or maintaining copious amounts of documentation.

The MUSTs' small population, individuality, and minor role in waste management were CML precursors (refer to Figure 1).

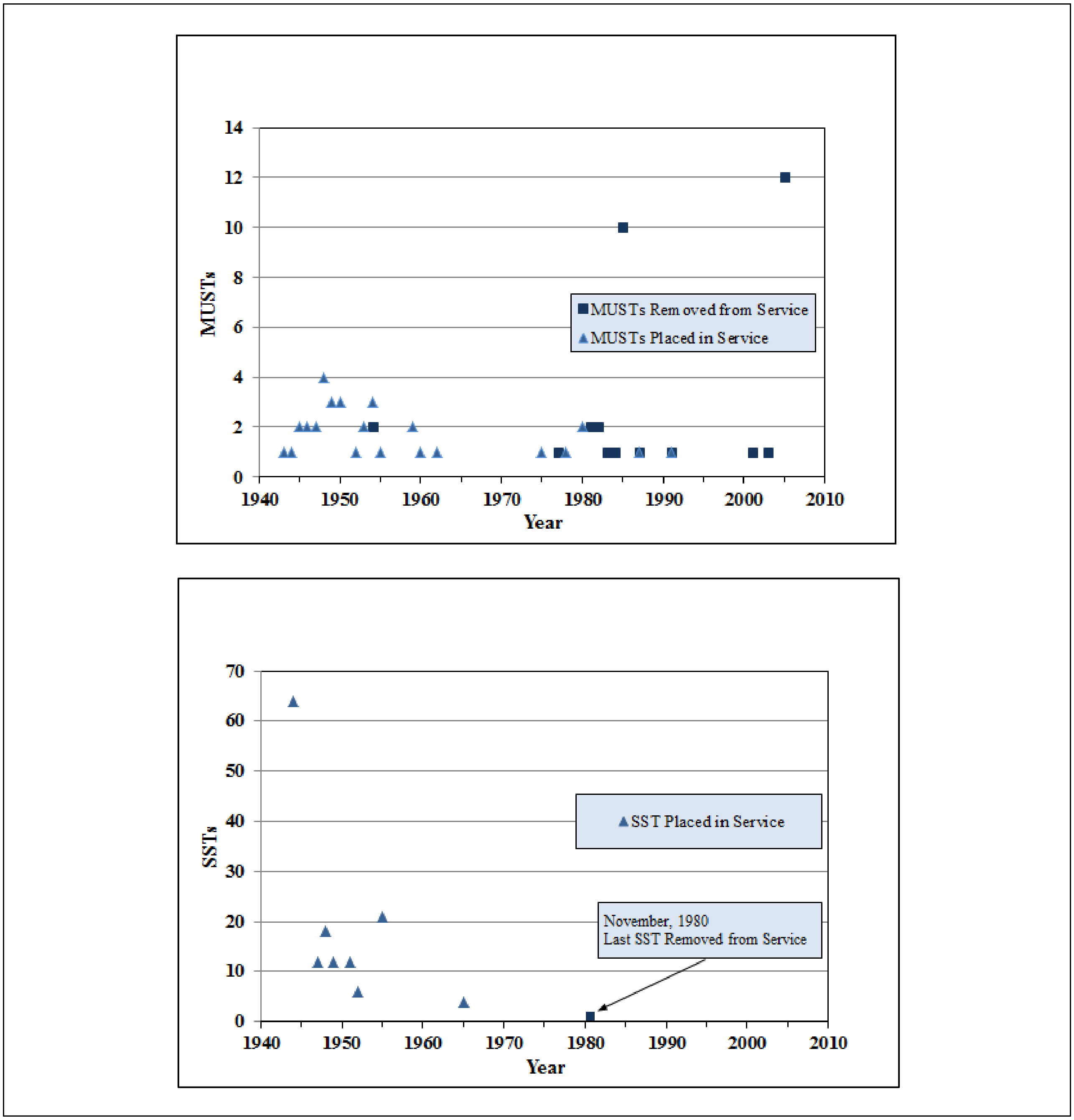

Fig. 1. In-Service Comparison - MUSTs and Single-Shell Waste Tanks

Corporate Memory Loss – Aiding Corporate Memory Recovery

During information recovery activities CML was particularly evident in the content of technical reports, particularly by how the report scope was bounded.

CML: Subpopulation Reports

Technical reports that parse small samples from a large population for generalized analysis are symptomatic of CML. For example, the stated purpose of one report was to provide status information for 25 MUSTs identified in the Single-Shell Tank Resource Conservation and Recovery Act (RCRA) Part A Permit Application [7,8]. However the permit application listed 36 MUSTs; the reason that a smaller population was parsed for the report is unclear. One tentative conclusion is that relevant data were difficult to locate. Artificially bounding and treating a subset of the greater population and excluding the remainder can be symptomatic of CML.

CML: Subpopulation Construction

Most of the MUSTs were deactivated between 1954 and 2005, and isolated over a 27 year period from 1979 – 2005 by seven construction projects. Project scope was sometimes transferred across project boundaries; and in several cases, more than one project performed part of the isolation work on the same MUST. The documentation for individual projects crosscuts the MUSTs and is filed by project number. It is voluminous and now stored at the National Archives Regional Center in Seattle, Washington. Interrogation of the material is resource-intensive and the return on the search effort is often marginal. Reliance on others' previous work is an enticing option, but results in development of circular references and over-reliance on secondary and tertiary references.

The following examples demonstrate some simple, near-effortless technical principles that will help control CML and aid future CMR:

CMR: Sequential Report Numbers and Similar Titles

Sequential numbering of reports on the same or similar topics and adherence to similar titles improve the chances for useful hits when broadening searches in large databases. For example, construction "extent-of-condition" engineering reviews were recently performed on Hanford's double-shell tanks. Note that both principles were applied.

- RPP-RPT-55981, *241-AW Tank Farm Construction Extent of Condition Review of Tank Integrity*;
- RPP-RPT-55982, *241-AN Tank Farm Construction Extent of Condition Review of Tank Integrity*;
- RPP-RPT-55983, *241-AP Tank Farm Construction Extent of Condition Review of Tank Integrity* [9,10,11].

CMR: Links to Supporting References

Packaging one-of-kind references used by technical reports in a sequentially-numbered companion volume, particularly references discovered by chance or in unexpected locations, or by non-intuitive means, aids CMR. The main report should guide readers to the reference location in the companion volume, and for references longer than a few pages, the page number. The use of both is illustrated here.

- RPP-ASMT-53793, *Tank 241-AY-102 Leak Assessment Report*;
- RPP-ASMT-53794 *Tank 241-AY-102 Leak Assessment Supporting Documentation: Miscellaneous Reports, Letters, Memoranda, and Data* [12,13].

- RPP-RPT-58156, *Basis for Miscellaneous Underground Storage Tanks and Special Surveillance Facilities Waste Volumes Published in HNF-EP-0182 Revision 320 "Waste Tank Summary Report for Month Ending August 31, 2014,* Calibration Table: ECN-630520, Rev. 0, *Incorporation of Catch Tank Specification Limits in SD-WM-TI-352, N1743,* page 6 [14].

CONCLUSIONS

Corporate Memory Recovery efforts allowed an historical basis for published waste volumes to be re-established for the Hanford Tank Farms' MUSTs. The U. S. Department of Energy electronic databases and Hanford records obtained from the Seattle, Washington National Archives Regional Center were used for this purpose.

During the six month effort instances of CML were apparent – properties that make MUSTs prone to CML were identified and the precursors generalized to other populations. The MUST experience suggests that effective CML countermeasures can be inexpensive to deploy, and be simply designed to improve the probability of locating the historical information embedded in extremely large information databases. To aid CMR, unique references can be reproduced and attached to the technical work they support, or provided in a similarly titled and numbered companion document.

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