DOCUMENT RELEASE AND CHANGE FORM

Prepared For the U.S. Department of Energy, Assistant Secretary for Environmental Management
By Washington River Protection Solutions, LLC., PO Box 850, Richland, WA 99352
Contractor For U.S. Department of Energy, Office of River Protection, under Contract DE-AC27-08RV14800

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Responsible Manager	Mendoza, Ruben E	*Garfield, John S for Mendoza, Ruben E per telecon*	04/27/2021

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RPP-PLAN-63133
Revision 0

Single-Shell Tank Structural Integrity Work Plan

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EXECUTIVE SUMMARY

This document was prepared to fulfill Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) Interim Milestone M-045-91J. The milestone requires submittal of a primary document that identifies the activities necessary to support future structural integrity assessments of the single-shell tank system. Structural integrity assessment requirements are identified in Washington Administrative Code (WAC) 173-303-640(2),[1] "Assessment of existing tank system's integrity."

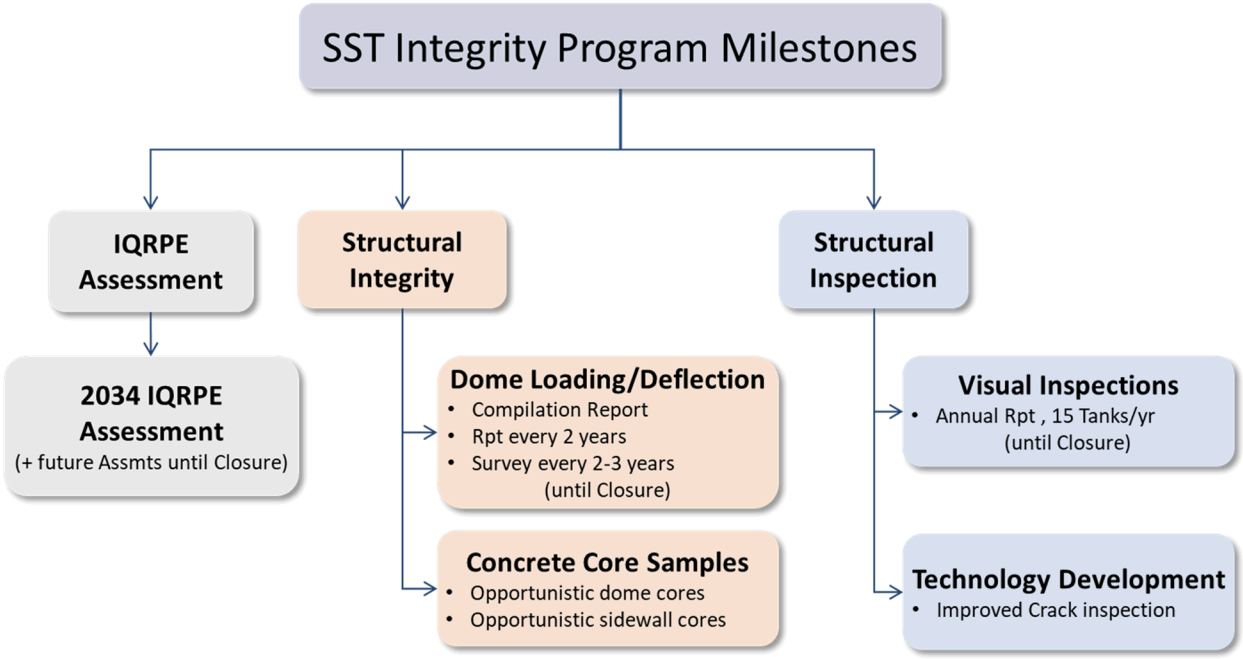

Figure ES-1. Single-Shell Tank Structural Integrity Activities

[1] WAC 173-303-640, "Tank Systems," *Washington Administrative Code*, as amended.

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TERMS

Abbreviations and Acronyms

CY	calendar year
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
FY	fiscal year
IQRPE	Independent Qualified Registered Professional Engineer
ORP	U.S. Department of Energy, Office of River Protection
SSTIP	Single-Shell Tank Integrity Project
SST	single-shell tank
TPA	Tri-Party Agreement
WAC	Washington Administrative Code

Units

in.	inch

1.0 INTRODUCTION AND PURPOSE

Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement [TPA]) interim milestone M-045-91I required submittal of a work plan and schedule for additional single-shell tank (SST) structural integrity assessment activities to be performed between completion of the calendar year (CY) 2018 SST structural integrity assessment (RPP-IQRPE-50028, *Single-Shell Tank Structural Integrity Assessment Report*) and the end date of the River Protection Project mission.

The CY 2018 structural integrity assessment was the second integrity assessment of the SST system. The first integrity assessment, completed in CY 2002, concluded that the SSTs were structurally adequate to support waste storage, retrieval, and closure (RPP-10435, *Single-Shell Tank System Integrity Assessment Report*). However, given the leak history of the SSTs and the condition of the tank liners, the assessment could not determine the leak integrity of any of the SSTs. The U.S. Department of Energy (DOE), Office of River Protection (ORP) subsequently declared the SSTs unfit for use (Rasmussen, 2002), and the CY 2018 SST integrity assessment was limited to determining the structural integrity of the SSTs.

The CY 2018 structural integrity assessment concluded that the SSTs are structurally sound such that the tanks will not collapse, rupture, or fail, and that the next assessment be completed in 16 years, in CY 2034. The assessment recommended continuing existing activities that monitor the structural integrity of the SSTs during the interim period and the structural analysis modeling refinements to be completed opportunistically.

This work plan identifies SST structural integrity-related monitoring activities (Figure 1-1) that will be used to collect information during the CY 2018 – CY 2034 period, to ensure adequate information is available to support the next Independent Qualified Registered Professional Engineer (IQRPE) assessment of SST structural integrity. Several key monitoring activities described within this plan have been incorporated into Appendix D of the TPA through approval of change M-45-19-01, “Establish New Interim Milestones for Submittal of Additional SST Tank Integrity Assessments,” and are referenced in this document. The combination of this work planned and the referenced Appendix D milestones constitutes the schedule of activities (Figure 1-2).

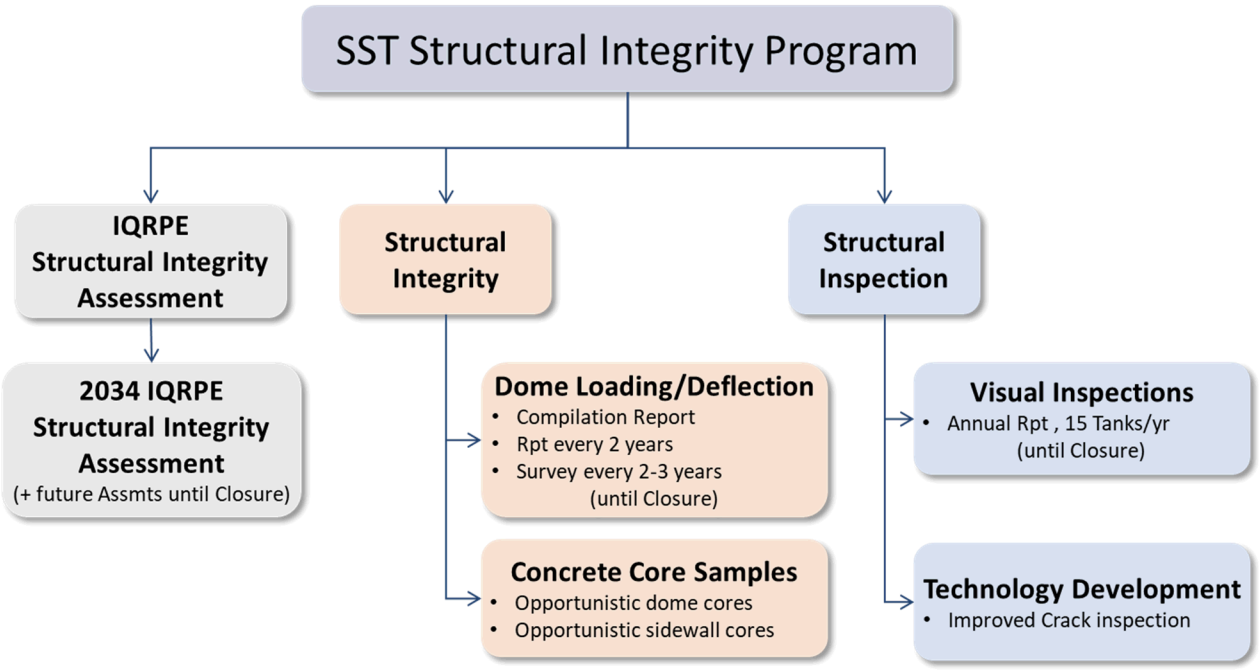

Figure 1-1. Single-Shell Tank Structural Integrity Milestone Activities

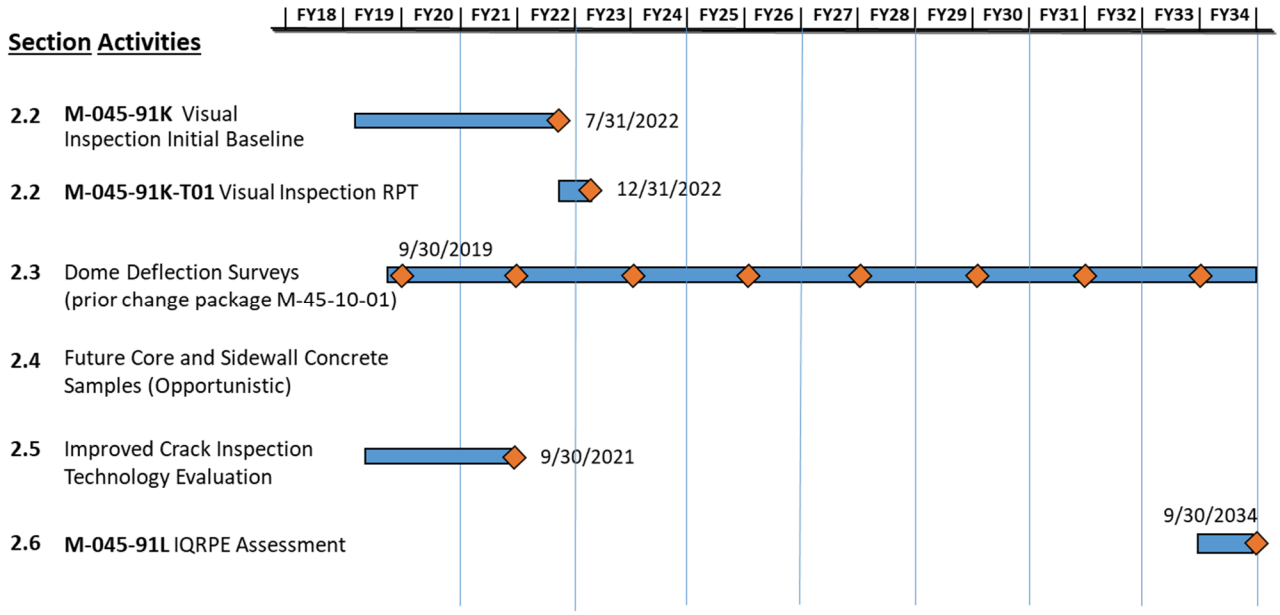

Figure 1-2. Single-Shell Tank Structural Integrity Activity Schedule

1.1 BACKGROUND

In 2010, in response to delays in the treatment mission and in accordance with TPA milestone M-045-91, ORP assembled a panel of recognized experts to review existing data and make recommendations to improve the understanding Hanford SST integrity. This expert panel on SST integrity (consisting of various subject matters experts in industry, national laboratories, and academia) developed 38 recommendations in four main areas of interest: confirmation of tank structural integrity, assessment of the likelihood of future tank liner degradation, leak identification and prevention, and mitigation of contaminant migration. In addition, the panel identified the "top 10" primary recommendations that form the foundation of a robust Single-Shell Tank Integrity Project (SSTIP).

A project implementation plan was also developed, and 17 of the 38 recommendations, including the panel's top 10 primary recommendations, were used to develop the basis for the M-45-10-01 change package for the TPA. The panel recommendations have been dispositioned, the M-45-10-01 change package milestones have been completed, and the results are summarized in RPP-PLAN-60765, *Single-Shell Tank Integrity Program Plan, Rev. 1*.

1.2 SUMMARY

New interim milestones have been drafted as TPA change number M-45-19-01 and are summarized in Table 1-1. This document provides a plan to implement these milestones and other key activities associated with the SST Structural Integrity Program.

Table 1-1. Single-Shell Tank Milestones

Number	Milestone	Due Date
2.1 **M-045-91J** Lead Regulatory Agency: Ecology	DOE shall submit to Ecology a change control form that includes a primary document work plan for the activities necessary to obtain future SST structural integrity assessments. This work plan will include the ongoing integrity program activities as recommended by the 2018 integrity assessment, and a schedule for activities identified in the work plan.	8/30/2019
2.2 **M-045-91K** Lead Regulatory Agency: Ecology	Complete initial baseline visual inspections of all single-shell tanks in accordance with the work plan approved pursuant to M-045-91J.	9/30/2023
2.2 **M-045-91K-T01** Lead Regulatory Agency: Ecology	DOE shall submit to Ecology, as a secondary document, a report evaluating and documenting the initial baseline visual inspection of all SSTs remaining to be inspected following the completion of target dates M-045-91G-T05 and M-045-91G-T06.	3/31/2024
2.6 **M-045-91L** Lead Regulatory Agency: Ecology	Obtain a written assessment, reviewed and certified by an Independent Qualified Registered Professional Engineer (IQRPE) attesting to single-shell tanks (SSTs) structural integrity for such a period as the IQRPE believes he/she can reasonably certify. The analysis supporting the certification shall be performed in accordance with the requirements in WAC 173-303-640(2) relating to structural integrity and will include a review of previously issued SST integrity assessments. IQRPE certification of SST leak integrity is not required. The IQRPE assessment shall recommend revisions to the work plan and schedule for integrity assessment activities, if necessary, for the period between the IQRPE certification (9/30/2034) and the end date of the mission.	9/30/2034

DOE = U.S. Department of Energy.
Ecology = Washington State Department of Ecology.
IQRPE = Independent Qualified Registered Professional Engineer.
SST = single-shell tank.
WAC = Washington Administrative Code.

2.0 SINGLE-SHELL TANK STRUCTURAL INTEGRITY PROGRAM ACTIVITIES

The following planned SST Structural Integrity Program activities are based on requirements and recommendations from the 2018 IQRPE integrity assessment (RPP-IQRPE-50028).

2.1 STRUCTURAL INTEGRITY WORK PLAN

This document fulfills the following milestone for a work plan itemizing ongoing structural integrity program activities.

> **Milestone M-045-91J** – DOE shall submit to Ecology a change control form that includes a primary document work plan (this document) for the activities necessary to obtain future SST structural integrity assessments. This work plan will include the ongoing integrity program activities as recommended by the 2018 Integrity Assessment, and a schedule for activities identified in the work plan. Due date: August 30, 2019.

2.2 VISUAL INSPECTIONS

Annual SST visual inspections resumed in 2010, and visual inspection reports were completed for TPA targets M-045-91G-T05 in 2010 and M-045-91G-T06 in 2011 to verify structural integrity. Annual visual inspection reports are prepared (with the exception of fiscal year [FY] 2012) and released publicly and are available for use by the Washington State Department of Ecology (Ecology).

The SST visual inspections conducted since 2013 address structural integrity plus anomalies related to level changes and level monitoring equipment as itemized in section 3.4 of RPP-PLAN-46847, *Visual Inspection Plan for Single-Shell and Double-Shell Tanks*. The visual inspections are individual planned work activities occurring annually to examine and record the interior of tanks to assess the condition of the dome concrete and record water intrusion, look for the presence of cracks or spalling, assess the condition of visible portions of the tank liner, and inspect the waste surface and location of level monitoring equipment. Initial planning called for inspection of 12 tanks/year. Beginning with FY 2019, the number of inspections increased to 15 tanks/year (10 percent of the SST population). Except in unusual circumstances, such as an unexplained waste level rise in a tank that causes the waste level to exceed the monitoring baseline threshold, or the re-inspection of tanks with visible concrete wall or dome cracks, there is no intention to repeat inspections of known intrusions ahead of the remaining SSTs that have not been inspected.

> **Interim Milestone M-045-91K** – Complete initial baseline visual inspections of all SSTs. Due date: September 30, 2023.

> **Target M-045-91K-T01** – DOE shall submit to Ecology a report documenting and evaluating the initial baseline visual inspection of all SSTs remaining to be inspected following the completion of target dates M-045-91G-T05 and M-045-91G-T06. Due date: March 31, 2024.

2.3 DOME DEFLECTION

Dome loading is controlled to provide defense-in-depth against dome collapse of the SSTs. Per the dome loading requirements, concentrated loads are managed (with discrete limits and

requirements on concentrated loads and vehicular access controls) to prevent loading above analyzed and established limits to maintain the structural integrity of the SST domes.

Performance of regular dome elevation surveys is also a requirement associated with the control of dome loading. The Tank Operations Contractor maintains the SST Dome Deflection Program. The goal of the program is to monitor the elevations of the tanks and tank dome deflections to determine if settlement of the tanks or excess deflection is occurring. Monitoring of the tank domes by survey is required to physically verify the structural integrity of the tanks, as deflection is a key indicator of structural integrity.

Biennial compilations of SST dome survey data are provided per the TPA milestone series**,** M-045-91E, "DOE shall provide to Ecology a compilation of the Single-Shell Tank farms dome deflection surveys every two years beginning 9/30/2013."

2.4 STRUCTURAL CONCRETE CORE SAMPLES

Future core sampling in the side walls or the dome will be conducted on an opportunistic basis as part of other activities. The approach to future concrete core samples is guided by two 2018 IQRPE integrity assessment recommendations and documented in RPP-PLAN-60765:

- Recommendation 2018-03: On an opportunistic basis, when other activities require the removal or cutting of concrete from a tank, a minimum of three but preferably at least six, concrete cores samples should be taken and tested for compressive strength. In order to do this efficiently, the Owner/Operator should maintain a programmatic and technical capability needed to acquire, package, ship, and test these cores.
- Recommendation 2018-07: Due to the cost and difficulty, additional full-depth sidewall cores are not recommended except as a potential part of Recommendation 2018-02, which addresses timely response to SST dome deflections that exceed ±0.24-in. Instead, opportunistic cores should be taken as described in Recommendation 2018-03.

2.5 IMPROVED INSPECTION TECHNOLOGY

Inspection technologies used to inspect the interior of SSTs has proven adequate to obtain the information necessary to enable an IQRPE integrity assessment; however, as technology advances, future evaluation of new approaches is appropriate. The benefits of the new approaches will be tested and documented as a basis for funding additional or improved interior dome cracking monitoring.

- **Camera technology** – The current cameras provide useful in-tank images of the tank structure, but do not have the optical resolution needed to detect narrow cracks. Improved camera technology will be evaluated with respect to crack detection on the concrete dome.
- **Laser scanning technology** – Three-dimensional laser scanning of the inside of the tanks will be investigated for crack detection in the concrete dome. The current dome deflection surveys provide information about possible deflection of the tank domes, but the survey locations for each tank are limited and the scatter in the survey data is almost as large as the allowable level changes. Obtaining three-dimensional laser scans of the inside of the tanks would:

- Provide more detail of the geometry of the tank dome and support a more informed evaluation of possible dome deflections.
- Become very useful if the dome deflection surveys or visual inspections indicate a more detailed evaluation is required.
- Provide more detailed information about the waste surface and visual images of the tank interior.

The practicability of conducting three-dimensional laser scans will be evaluated. The SST Program Plan targets selection, mockup, and in-tank testing of camera and laser scanning technologies as a basis for field implementation.

2.6 FUTURE INTEGRITY ASSESSMENTS

The 2018 SST structural integrity assessment was submitted per TPA interim milestone M-045-91I as RPP-IQRPE-50028. The report recommends that the next IQRPE structural integrity assessment occur in 16 years (by September 30, 2034).

> **Milestone M-045-91L** – Obtain a written assessment, reviewed and certified by an IQRPE, attesting to SST structural integrity for such a period as the IQRPE believes he/she can reasonably certify. The analysis supporting the certification shall be performed in accordance with the requirements in WAC 173-303-640(2) relating to structural integrity and will include a review of previously issued SST integrity assessments. IQRPE certification of SST leak integrity is not required. Due date: 9/30/2034

3.0 REFERENCES

Lyon, J. J, 2019, "Re: Single-Shell Tank Structural Integrity Assessment, RPP-IQRPE-50028," (Letter 19-NWP-009 to B. T. Vance, U.S. Department of Energy, Office of River Protection, and J. Eschenberg, Washington River Protection Solutions, LLC, January 16), State of Washington, Department of Ecology, Richland, Washington.

Rasmussen, J. E., 2002, "Submittal of M-23-24 Single-Shell Tank (SST) System Integrity Assessment Report," (Letter 02-OMD-036, to M.A. Wilson, Washington State Department of Ecology, June 27), U.S. Department of Energy, Office of River Protection, Richland, Washington.

RPP-10435, 2002, *Single-Shell Tank System Integrity Assessment Report*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-IQRPE-50028, 2018, *Single-Shell Tank Structural Integrity Assessment Report*, Rev. 0, Washington River Protection Solutions LLC, Richland, Washington.

RPP-PLAN-46847, 2019, *Visual Inspection Plan for Single-Shell and Double-Shell Tanks,* Rev. 3, Washington River Protection Solutions LLC, Richland, Washington.

RPP-PLAN-60765, 2019, *Single-Shell Tank Integrity Program Plan*, Rev. 1, Washington River Protection Solutions, LLC, Richland, Washington.

WAC 173-303-640, "Tank Systems," *Washington Administrative Code*, as amended.