DEPARTMENT OF ECOLOGY
State of Washington

Nuclear Waste Program

TANK CLOSURE 101: *Understanding Tank Closure Standards on the* HANFORD SITE

INSIDE

Why this
GUIDE TO TANK CLOSURE?

The intent of this guide is to educate the public about the issues engineers and scientists at Hanford must consider and the rules they will follow in making final closure decisions for underground storage tanks. You will have a say in how the closure process is developed.

Who is responsible for
HANFORD CLEANUP?

The Tri-Party agencies—the US Environmental Protection Agency (EPA), US Department of Energy (USDOE), and Washington State Department of Ecology (Ecology)—jointly manage the cleanup and closure of the Hanford tank farms.

Background on
HANFORD TANK FARMS

The Hanford Site has 177 single- and double-shell tanks containing hazardous chemicals and radioactive waste. The 149 single-shell tanks (SSTs) are in groups of 6 to 18 tanks known as "tank farms." A tank farm or group of tank farms is designated as a waste management area (WMA). Most of the tanks are about the size of an elementary school gym, with the largest tanks designed to hold about a million gallons.

The SSTs, some built as early as the 1940s, have exceeded their life expectancy. We estimate the tanks have leaked more than one million gallons of hazardous and radioactive waste into the ground. Waste in the soil under and between the tanks will be very difficult to recover. Some tank waste has already reached the Columbia River. In USDOE's draft Tank Closure and Waste Management Environmental Impact Statement, issued October 2009, they predict some waste may eventually reach the Columbia River in volumes that would be hazardous to human health if we fail to make decisions for cleanup soon.

TERMINOLOGY

Understanding terminology is critical to the decision-making process. These terms are used throughout this document and are explained when first used.

Waste Management Area (WMA) - a tank farm or group of tank farms and their associated equipment.

Interim Stabilization - actions that reduce the quantity of liquid waste remaining in the SSTs.

General Closure - rules that apply regardless of whether a tank closure is a clean or landfill closure.

Clean Closure - rules that apply if a tank and associated pipes, pumps, and so forth can be removed completely from the ground or cleaned to a protective level.

Landfill Closure - rules that apply if the tank, piping, and associated equipment are left in place and will require post-closure care, such as ongoing monitoring, cover repairs, or institutional controls.

Tank Farm - includes the entire system of tanks, pipes, pumps, and associated equipment within a fenced area. Contaminated areas outside of the farm may be included as part of the decision-making and closure process.

Unit - a tank, catch basin, or tank and its associated equipment.

Basis for

PERMITTING AUTHORITY

Ecology, under the authority of the Washington Administrative Code (WAC), will oversee tank closure at Hanford.

The Resource Conservation and Recovery Act (RCRA) provides the federal framework for managing hazardous wastes. The State of Washington is authorized to implement the dangerous waste program in lieu of the federal RCRA program, including corrective action requirements under the Hazardous and Solid Waste Amendments (HSWA) of 1984 to RCRA.

In WAC 173-303-646, Washington identifies its requirements for a corrective action program. Until a closure plan is completed, Ecology is requiring that corrective actions must be performed in accordance with WAC Chapter 173-340.

PERFORMANCE STANDARDS

Washington Administrative Code 173-303-610(2):

"Closure performance standard. The owner or operator must close the facility in a manner that:

(a) (i) Minimizes the need for further maintenance;

(ii) Controls, minimizes or eliminates to the extent necessary to protect human health and the environment, post-closure escape of dangerous waste, dangerous constituents, leachate, contaminated runoff, or dangerous waste decomposition products to the ground, surface water, ground water, or the atmosphere; and

(iii) Returns the land to the appearance and use of surrounding land areas to the degree possible given the nature of the previous dangerous waste activity."

Requirements for
INTERIM STABILIZATION

The SSTs at Hanford cannot be closed right now because facilities to safely treat, store, and dispose the tank waste are not yet available. An effort was completed (except for one tank) to remove as much liquid waste from the SSTs as is practicable; until we start to retrieve the remaining waste for closure.

Interim stabilization reduces the risk and amount of waste that could leak into the environment from a tank.

Requirements for
GENERAL CLOSURE

Dangerous waste treatment, storage, and disposal units are subject to a general closure performance standard and to unit-specific closure standards. Closure of all units must comply with general closure performance standards specified in the WAC. Closure must also achieve standards specific to the type of dangerous waste unit being closed. For example, tank systems must comply with tank system closure standards in WAC 173-303-640(8).

Although all units must meet the same general closure performance standard, there are two main types of unit-specific closure standards: **Clean Closure** and **Landfill Closure**.

Bottom of a tank where most of the waste was retrieved.

Some tanks have debris such as pipes or hoses that were left behind after previous activities. Sometimes there are bottles, rocks, or other random items that were tossed in over the years.

Requirements for
CLEAN CLOSURE

The performance standards for clean closure require removal or decontamination of all:

- dangerous waste
- equipment
- liners
- waste residues
- bases
- soils/subsoils
- other materials containing, or contaminated with, dangerous waste or waste residue.

Two conditions must be met for clean closure:

1. All waste and waste residues must be removed from the tank system. Then soil, groundwater, and other materials contaminated by dangerous waste must meet clean closure levels.

Clean closure levels for environmental media are set using unrestricted site use exposure assumptions. The concentrations of dangerous waste, waste constituents, and residues in the tank system and throughout any soils contaminated by dangerous waste must meet clean closure levels. Clean closure levels are set using unrestricted site use exposure assumptions under the Model Toxics Control Act (MTCA) Cleanup Regulation, WAC 173-340.

2. All structures, equipment, bases, liners, and other materials containing, or contaminated with, dangerous wastes, waste constituents, or residues must meet specific removal and decontamination standards approved by Ecology in consideration of the closure performance standard.

Decontamination

Ecology guidance on decontamination of structures, equipment, bases, and other related structures describes three options:

1. Meet the debris-specific, technology-based Alternative Treatment Standards for Hazardous Debris specified in 40 Code of Federal Regulations (CFR) Part 268.45
2. Propose to, and receive approval from, Ecology for a site-specific decontamination method and performance standard
3. Meet MTCA unrestricted cleanup levels in the debris (Clean Closure Guidance Section 5.3).

Continued on page 4...

Issues to Consider for CLEAN CLOSURE

How long will it take to close the tank farms?

Will it be possible to remove the tanks remotely with robots, for example, without exposing workers to radiation?

If not, how will workers performing tank removal be shielded?

If tank walls are breached, will the remaining structure remain sound?

Will materials removed during cleanup have to be packaged for treatment or shipment to a landfill?

How much 'new' waste will be created?

Will any of the soil be clean enough to move as is, or will it all require packaging of some sort?

What is the exhaust output (carbon footprint) of the equipment that will perform the work?

How many truck trips will be required, how much will trucks weigh, and how will roads be maintained?

Will another landfill site be needed at Hanford for the removed materials, and is there space?

How will we prevent blowing dust from leaving the area while excavation is under way?

Must we wash and cover trucks once loaded or unloaded? How much water would be required? Is there a source of water available?

Clean Closure, Continued from page 3

Contained-In Determination

Ecology also has the ability to determine that debris does not contain—or no longer contains—dangerous waste with respect to listed waste codes.

The contained-in policy for hazardous debris is determined on a case-by-case basis using historical information, concentration of dangerous constituents, potential routes of exposure and other applicable information.

No numeric standards are routinely used to define contained-in concentrations for hazardous debris. However, Ecology generally uses the MTCA unrestricted site use exposure assumptions and soil cleanup levels to determine that the debris no longer contains hazardous waste.

Debris that has been treated to meet land disposal restriction standards using extraction or destruction technology generally will be considered to no longer contain dangerous waste.

In some cases, particularly where tank systems have leaked, it may not be practicable to remove everything from an area. For example, if soil and system components are so toxic that human contact would be dangerous, the tank system may be closed as a landfill.

Because of the potential for leaks, owners/operators of tank systems that do not have secondary containment are required to prepare a plan for both clean closure and a contingency plan for landfill closure.

Protecting the Columbia River from Hanford contaminants now and in the future is critical for our environment and economy.

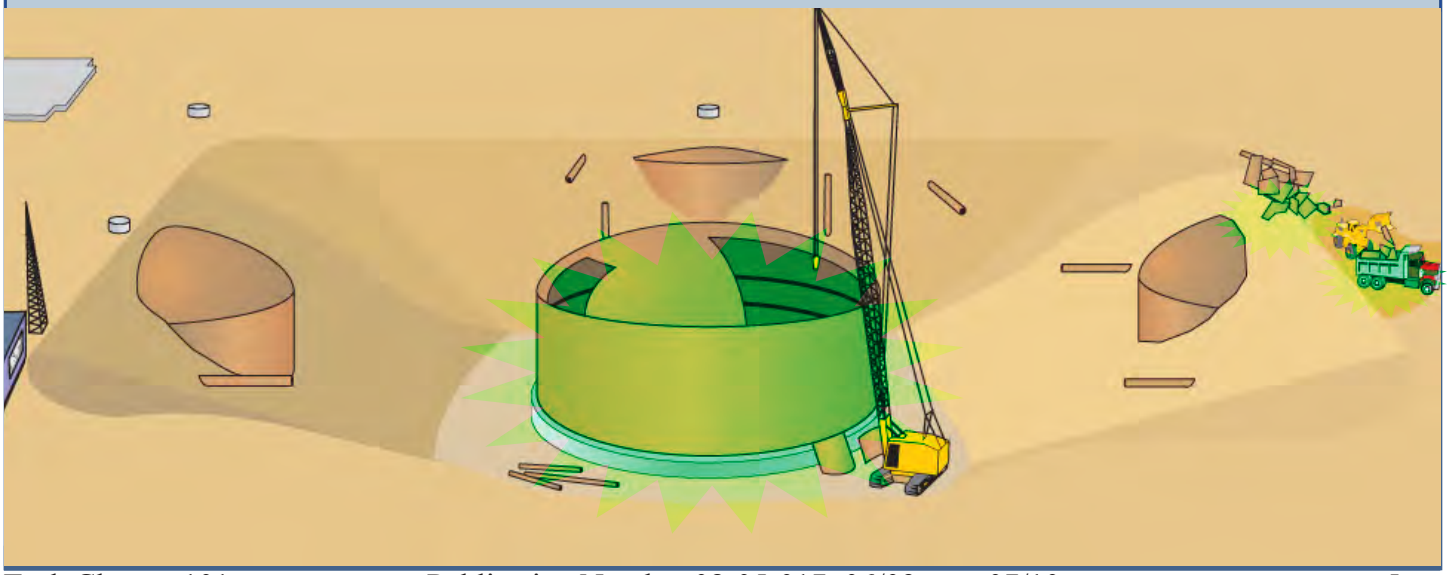
CLEAN CLOSURE CONCEPTS

These are an artist's depictions of what a clean closure of Hanford's tank farms might look like.

The tanks are extremely radioactive or "hot." So it is not reasonable to expect human workers to take them apart by hand. Risk of worker exposure to radiation would be far too high.

If we were able to disassemble tanks with machinery by remote control or using robots, as depicted below, we would still have to find a way to shield equipment operators. Properly maintaining heavy equipment requires almost daily maintenance, which could expose workers as well.

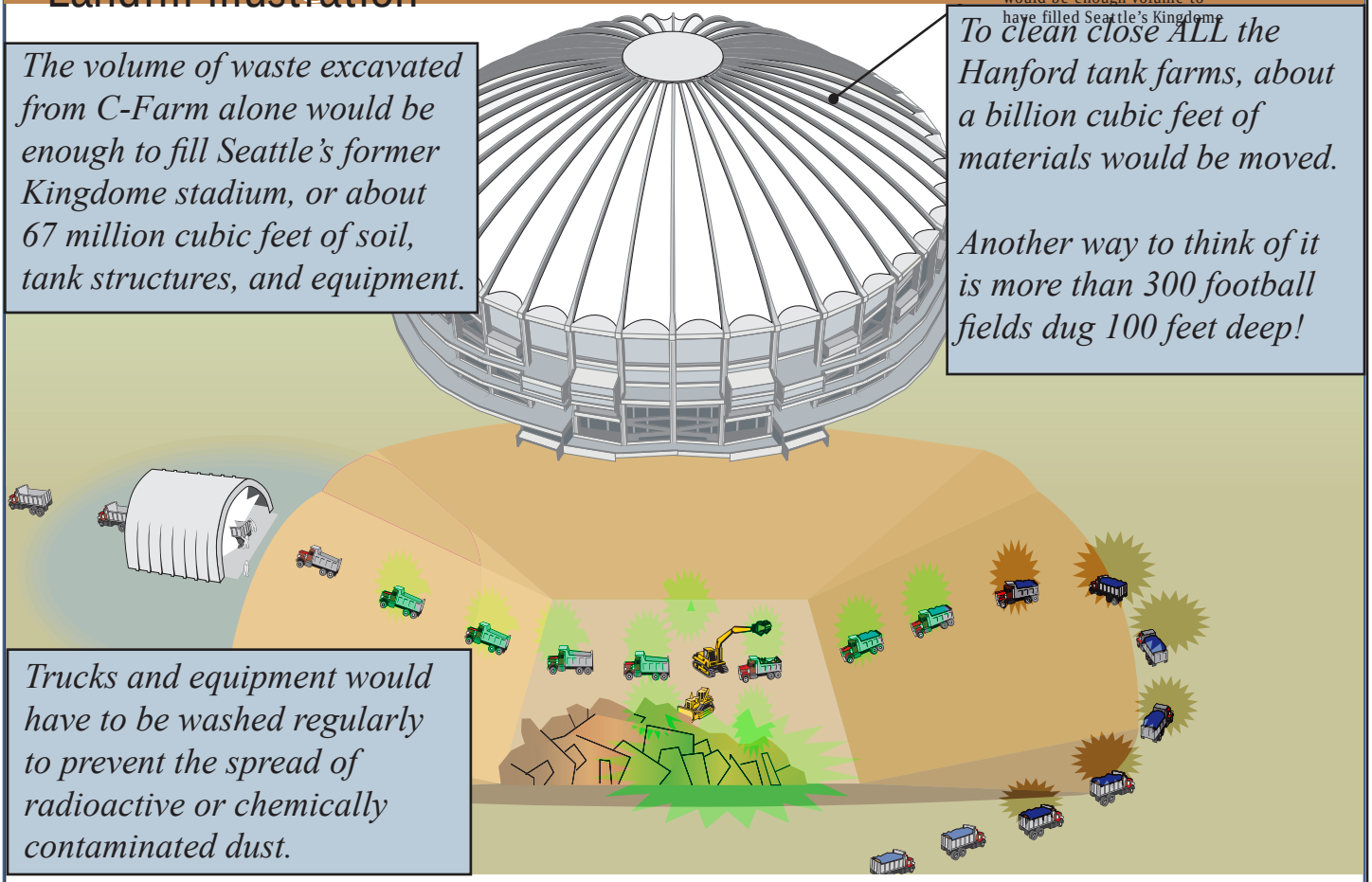
The hole would have to be excavated at a safe slope, creating a hole that extends the perimeter well beyond the tank farm barrier. Excavation would proceed very slowly, with each load of soil being tested to determine whether it is contaminated.



What might CLEAN CLOSURE LOOK LIKE?

Landfill Illustration

The volume of waste excavated from C-Farm alone would be enough to fill Seattle's former Kingdome stadium, or about 67 million cubic feet of soil, tank structures, and equipment.



To clean close ALL the Hanford tank farms, about a billion cubic feet of materials would be moved.

Another way to think of it is more than 300 football fields dug 100 feet deep!

Trucks and equipment would have to be washed regularly to prevent the spread of radioactive or chemically contaminated dust.

Will closure actions be ONE SIZE FITS ALL?

With 12 tank farms and 149 single-shell tanks, it is unlikely there will be a single closure method.

The closure method for each tank farm will be decided on a case-by-case basis. The extent of cleanup may vary from farm to farm. Soil cleanup volumes will vary from farm to farm.

For all closure activities, permit decisions will be based on risk, our physical ability to perform the work, time, and cost.

We are still asking several questions, such as:

If we can remove 20 to 30 tanks, pipelines, and ancillary equipment but have to leave everything else in place due to risk, does that really get us anywhere?

Are there commercially available methods for dealing with waste – for example, mining equipment?

How long are we willing to wait? How much are we willing to spend? Should we wait for a new technology? What is the risk of tank failure over time?

Is there any more risk to groundwater or is the damage already done?

Can we use a special-purpose barrier around individual tanks or entire farms to treat and remove contaminated soil or tanks?

Will removing the waste, or clean closure, solve any problems or simply create new ones?

Issues to consider if CLOSING TANKS IN PLACE

If we leave the tanks in the ground with some level of contamination, it will be considered a landfill closure.

What will prevent tank domes from future cave in?

Would tanks be filled with sand, grout, or concrete? How much would we need? Where would we get it?

Is in-situ vitrification (creating glass in place) an option?

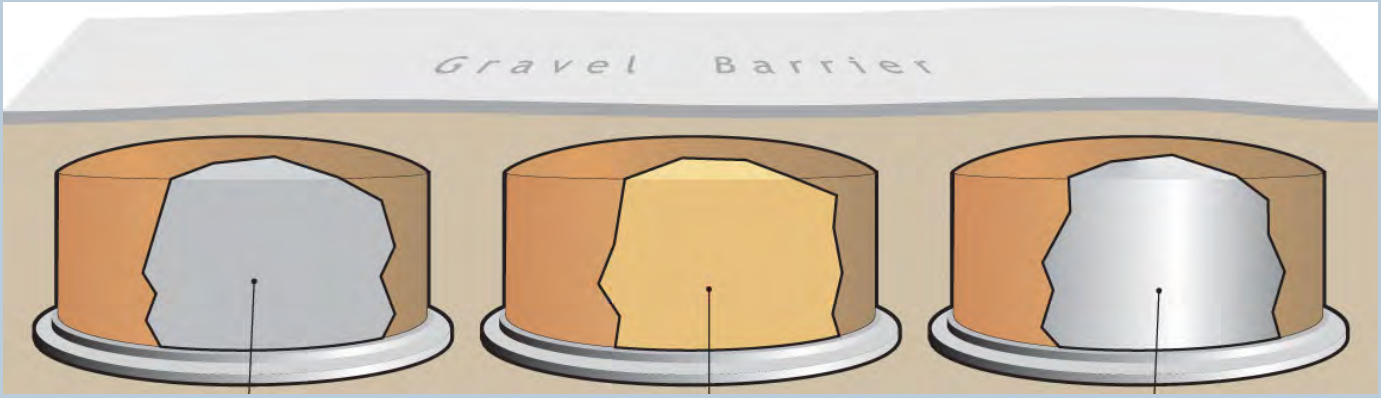
What types of surfaces will prevent water from entering tanks, causing the breakdown of structures over time?

If we create physical barriers, who will maintain or repair them 100 or more years from now?

How will we stop contamination in the soil around or beneath the tanks from moving deeper and contaminating groundwater?

What sorts of institutional controls will be used to prevent people in the distant future from breaching closed areas?

How will records be stored? Who will pass them on and alert future generations to the danger?



Requirements for
LANDFILL CLOSURE

Landfill closure was designed for dangerous waste treatment, storage, and disposal units where it is presumed that waste will remain on site after closure.

Examples of landfills outside Hanford include dangerous waste landfills and, under some circumstances, surface impoundments and waste piles.

The requirements for landfill closure also apply to dangerous waste tank systems when it is not practicable to remove or decontaminate all contaminated structures, equipment, containment systems, and other material—such as soil—affected by releases from the unit.

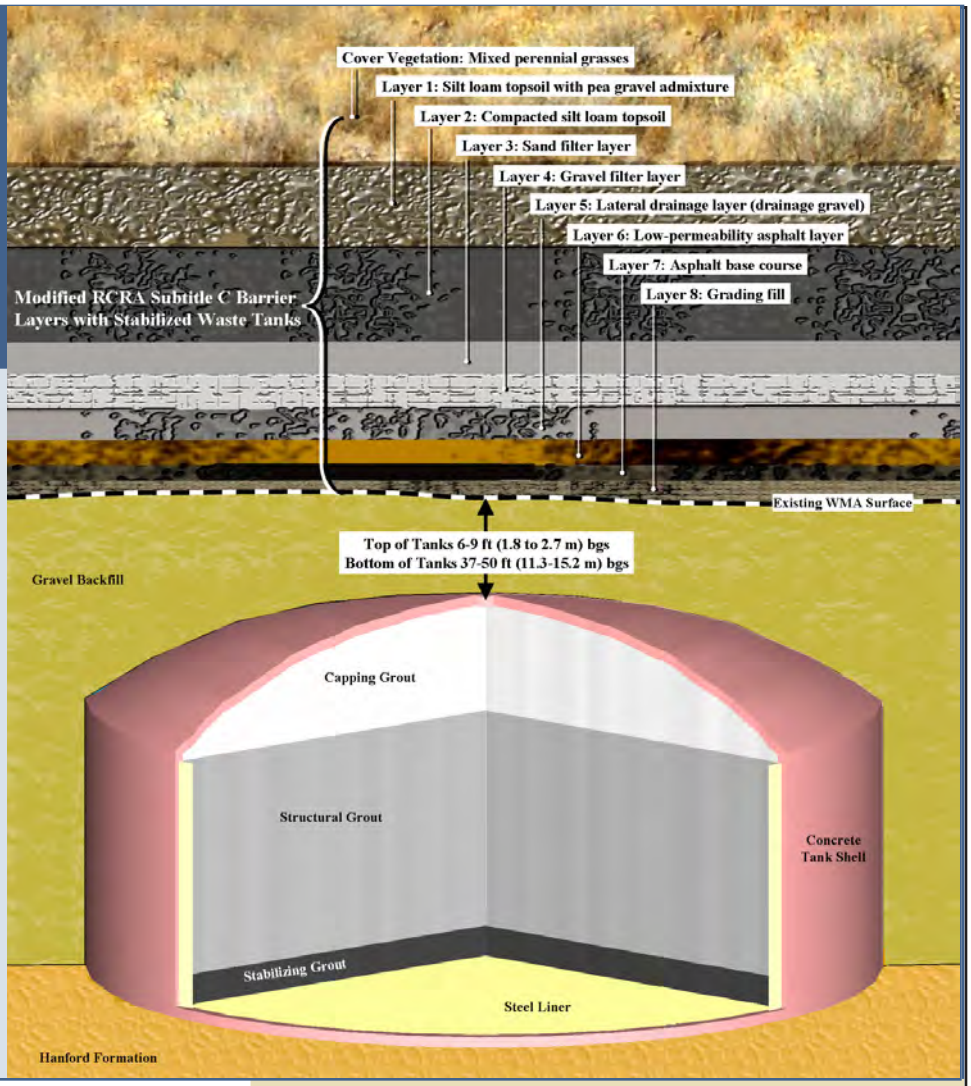
In addition to compliance with the closure performance standard, landfill closure requires that the affected area be covered with a final cover designed and constructed to:

- Provide long-term minimization of migration of liquids through the closed landfill
- Function with minimum maintenance
- Promote drainage and limit erosion and abrasion of the cover
- Accommodate settling and subsidence so that the cover's integrity is maintained
- Attain permeability of less than or equal to the permeability of any bottom liner system or natural subsoils present.

What might a TANK BARRIER LOOK LIKE?

This drawing depicts a proposed barrier over a closed tank that would be left in the ground.

No matter the closure endpoint, every effort must be made to restore closed waste management areas to the most natural conditions possible.



Can a closure **BE A HYBRID?**

Even if a tank system as a whole ends up being subject to closure as a landfill, it does not preclude removal of contaminated soil or systems to the degree practicable.

For example, the contaminated soil in the tank farms may be removed to some depth and replaced with clean soil to diminish the likelihood of exposure to potential intruders.

However, excavating to the base of the tank may create too much environmental damage or danger to human health to be considered practicable and protective.

Frequently used **ACRONYMS**

EPA – United States Environmental Protection Agency
USDOE – United States Department of Energy
Ecology – Washington State Department of Ecology
WAC – Washington Administrative Code
RCRA – Resource Conservation and Recovery Act
LDR – Land Disposal Restrictions
ROD – Record of Decision
CERCLA – Comprehensive Environmental Response Compensation and Liability Act - aka Superfund
TI – Technical Impracticability
SST – Single-shell tank
WMA – Waste Management Area
IC – Institutional Controls

Defining PRACTICABILITY

Some of the decisions regulators make are based on practicability. This is an area that's not easy to understand. The values of individuals or groups may differ with regard to what they think should be done for cleanup. So, what is practicability?

The Oxford English Dictionary defines "practicable" as "able to put into practice; able to be effected, accomplished, or done, feasible."

Definition from MTCA

Washington State, in MTCA, defines practicable as "capable of being designed, constructed, and implemented in a reliable and effective manner including consideration of cost. When considering cost under this analysis, an alternative shall not be considered practicable if the incremental costs of the alternative are disproportionate to the incremental degree of benefits provided by the alternative over other lower cost alternatives."

MTCA requires a "disproportionate cost analysis" to select the most practicable permanent solution to protect human health and the environment." A disproportionate cost analysis compares the costs and benefits of various alternatives, then selects the alternative where incremental costs are not disproportionate to the incremental benefits.

EPA Guidance on Technical Impracticability Determinations for RCRA Corrective Actions

Long-standing EPA policy defines technical impracticability (TI) for contaminated groundwater as a situation where achieving groundwater cleanup associated with final cleanup goals is not "practicable from an engineering perspective."

"Engineering perspective" refers to factors such as feasibility, reliability, scale or magnitude of a project, and safety. For example, a certain cleanup approach might be technically possible, but the scale of the operation might be of such magnitude that is not technically practicable.

In the Superfund context, EPA has stated that cost can be considered in evaluating technical impracticability, although it should generally play a subordinate role and should not be a major factor unless compliance would be inordinately costly (55 FR 8748, March 8, 1990).

The EPA *Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action* lists a number of factors that generally should be included in a TI evaluation[1]:

- Spatial area over which the TI decision would apply
- Specific groundwater cleanup levels, consistent with the groundwater use designation that is considered technically impracticable to achieve
- Conceptual site model that describes geology, hydrology, groundwater contamination sources, transport, and fate
- Evaluation of the "restoration potential" of the TI zone
- Cost estimates
- Description of an alternative remedial strategy

[1] Other information may be required by the state or federal cleanup program overseeing the corrective action.

Workers are constantly monitored for exposure to radiation or chemicals when cleaning contaminated soil at Hanford.

Project to
DEMONSTRATE CLOSURE OPTIONS

"How will we close a tank if we don't close a tank?" is a question that has plagued decision makers, the public, and stakeholders. It's a bit like deciding which came first: the chicken or the egg.

Because there are a number of unknowns, Ecology partnered with the other Tri-Party agencies in developing a demonstration project plan. The plan is being revised to focus on preparing documentation and work activities to support the Waste Management Area C (WMA-C) closure schedule.

The closure demonstration plan will focus on pipes and diversion boxes, the catch tank retrieval, and some documentation to facilitate development of the closure plan for WMA-C.

Project scientists and engineers from the Tri-Party agencies and USDOE contractors met over the course of several months to address revisions to the original demonstration plan and white paper. The purpose of the plan was changed to revise the scope of the demonstration project with the intent to improve the development of a WMA-C closure plan. Team members have revised the demonstration plan and the Closure White Paper. Work on the other parts of the plan must be completed soon, and the Tri-Party agencies have proposed new Tri-Party Agreement schedules to complete the requirements in the demonstration plan.

The Closure White Paper remains a part of the demonstration plan. It describes regulatory processes for closure of dangerous waste treatment, storage, and disposal units and the potential frameworks for closing such units for the tank farms. The white paper is intended to support closure efforts for WMA-C as part of the demonstration plan and, therefore, is focused on closure requirements for the dangerous waste tank system at Hanford.

With these documents, we hope to begin a public discussion and decision-making process that will lead to safe, final closure of all Hanford tank farms.

Player Roles and
RESPONSIBILITIES

Ecology – Washington State Department of Ecology
Ecology is the lead regulatory agency responsible for oversight and permitting for closure of WMA-C.

EPA – US Environmental Protection Agency
EPA is the non-lead regulatory agency supporting Ecology's authorized hazardous waste program. EPA also is participating in the project because of the agency's role under CERCLA.

ORP – US Department of Energy, Office of River Protection. As the site's owner/operator, ORP is responsible for closure of the tank farm systems in close coordination with other closure and cleanup activities for the Hanford Site.

Cleanup work within the tank farm areas will be performed by ORP contractors.

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