1	2	3	4	5	6	WBS	WBS DESCRIPTION
X	X	X	X	X	X	.01	**PROGRAM MANAGEMENT, SUPPORT & INFRASTRUCTURE (OPTIONAL)**
X	X	X	X	X	X	.01.01	**PROGRAM MANAGEMENT** Phases 1 to 6 • Personnel and resources to oversee and manage the program planning process, policy coordination, compliance issues, and integration of projects. This activity also includes management of pollution prevention, conservation, and environmental management issues and policies. • **UOM= LS**
X	X	X	X	X	X	.01.02	**PROGRAM SUPPORT** Phases 1 to 6 • Personnel and resources that provide support services to the program activities. This would include maintaining such service organizations as training, public affairs, community relations, engineering support, administrative support, procurement, quality control, legal, regulatory, medical, health and safety. Consulting costs are also included. • **UOM= LS**
X	X	X	X	X	X	.01.03	**PROGRAM INFRASTRUCTURE** Phases 1 to 6 • Costs associated with maintaining the company/organization infrastructure and ownership. This would include insurance, interest, fees, cost of money, warehousing, material handling, project utilities, equipment maintenance, motor pool, security, fire protection, first aid, and traffic control. • **UOM=LS**
X	X	X	X	X	X	.01.04	**CONSTRUCTION MANAGEMENT** Phases 1 to 6 • Includes the personnel and resources to directly oversee plan, and manage a construction project. • **UOM= LS**
X	X	X	X	X	X	.01.05	**GOVERNMENT-CONSTRUCTION MANAGEMENT** Phases 1 to 6 • Includes the government oversight and management of construction contractor activities. • **UOM= LS**
X	X	X	X	X	X	.01.9x	**OTHER** Phase 1 to 6 • Includes the remedial action's program management work not described by the above listed subsystems.

X	**X**	**X**	**X**	**X**	**X**	**.02**	**PROJECT MANAGEMENT & SUPPORT (Operable Unit/Solid Waste Management Unit)**
X	**X**	**X**	**X**	**X**	**X**	**.02.01**	**PROJECT MANAGEMENT/SUPPORT/ADMINISTRATION** Phases 1 to 6 • Personnel and resources for the management and control of project activities. Including scoping, planning, estimating, executing, tracking, controlling, reporting, analyzing, and closure of the project. Includes direct management of the project as well as the support and administrative functions need for successful project management. • **UOM= LS**
X	**X**	**X**	**X**	**X**	**X**	**.02.02**	**COMMUNITY RELATIONS** Phases 1 to 6 • Activities required to inform the public of project activities and appropriately involve the public in decisions related to the environmental management activities of sites. • **UOM= LS**
X	**X**	**X**	**X**	**X**	**X**	**.02.03**	**REGULATORY INTERACTION** Phases 1 to 6 • Submittals and interface activities with local, state and federal regulatory agencies. • **UOM= LS**
X	**X**	**X**	**X**	**X**	**X**	**.02.04**	**INSTITUTIONAL CONTROLS** Phases 1 to 6 • Measures taken to protect the public health and safety as an interim action at an HTRW site. This can include such measures as posting warning signs, placing fencing around the site, etc. • **UOM=LS**
		X	**X**			**.02.05**	**POST DESIGN SUPPORT** Phases 3 and 4 • Engineering and design activities for support of procuring construction contract/s. Including identifying long lead items, pre-bid and pre-award activities. • **UOM= LS**
						.02.06	**PROCUREMENT - EQUIPMENT & MATERIALS** Phases 2 to 4 • Personnel and resources used in the procurement of the project equipment and materials. • **UOM= LS**

1	2	3	4	5	6	WBS	WBS DESCRIPTION
	X	X	X			.02.07	**A/E SUPPORT DURING REMEDIAL ACTION** Phases 2 to 4 • Architectural and Engineering oversight and support during the remedial actions phase of the project or site. • **UOM= LS**
	X	X	X			.02.08	**CONSTRUCTION MANAGEMENT** Phases 1 to 6 • Personnel, resources, travel, and per diem for activities to manage the construction work. Includes on site construction oversight. • **UOM= LS**
			X	X	X	.02.09	**INDEPENDENT CONTRACTOR VERIFICATION OF CLEANUP** Phases 4 to 6 • Costs associated with obtaining an independent third party verification that cleanup objectives have been obtained. • **UOM= FTE**
X	X					.02.10	**ENFORCEMENT** Phases 1 to 2 • Activities related to the identification and enforcement of responsibilities of the potentially responsible party (PRP). Includes PRP searches, negotiation support, and documentation of finding. • **UOM= FTE**

X	**X**	**X**	**X**	**X**	**X**	**.02.9x**	**OTHER** Phase • Includes the remedial action's project management activities not described by the above listed subsystems.
X	**X**	**X**	**X**	**X**	**X**	**.03**	**PREPARATION OF PLANS**
X	**X**	**X**				**.03.01**	**WORK PLAN** Phases 1 to 3 • Project-specific work plans identifying the scope of work, schedule, resource requirements, execution and other associated activities. • **UOM= EA**
X	**X**	**X**				**.03.02**	**CHEMICAL DATA ACQUISITION PLAN** Phases 1 to 3 • Describes the chemical data management scheme, tracing the path of the data from receipt in the field or laboratory to the use or storage of the final reported form. The plan addresses standard record-keeping procedures, document control system, and the means of data storage and retrieval. It includes control mechanisms for detecting and correcting paperwork errors and preventing loss of data during data reduction, data reporting, and data entry to forms, reports and databases. • **UOM= EA**
X	**X**	**X**	**X**	**X**		**.03.03**	**SAMPLING AND ANALYSIS PLAN** Phase 1 – 5 • Describes how air, water, and soil samples will be collected and analyzed in accordance with technically acceptable protocols. The sampling and analysis plan consists of two parts: (1) a quality assurance project plan and (2) the field sampling plan. • **UOM= EA**
X	**X**	**X**	**X**	**X**		**.03.04**	**SITE HEALTH AND SAFETY PLAN** Phase 1 - 5 • Site specific plan that specifies the procedures that are sufficient to protect on-site personnel and surrounding communities from the physical, chemical, and/or biological hazards of the site. The plan outlines site hazards, work areas and lists control procedures, air surveillance procedures, levels of protection, decontamination and site emergency plans, arrangements for weather-related problems, and responsibilities for implementing the health and safety plan. • **UOM= EA**
X	**X**	**X**				**.03.05**	**POLLUTION CONTROL AND MITIGATION PLAN** Phase 1 - 3 • Developed to prevent or reduce the impact of a hazardous materials incident on people, property, and the environment. The plan addresses the following elements of response: recognizing the type and degree of the hazard present, determining its effect or potential impact on public health, property, and the environment, control measures to reduce or prevent contact of people with the hazardous materials, and cleanup measures for restoring the area to pre-release conditions. • **UOM= EA**

X	**X**	**X**				**.03.06**	**DATA MANAGEMENT PLAN** Phase 1 - 3 • Discusses how the environmental data will be managed. The plan addresses the type of database used, software programs, sample tracking, and how the data will be analyzed and displayed. **UOM= EA**
X	**X**	**X**				**.03.07**	**COMMUNITY RELATIONS PLAN** Phase 1 - 3 • Outlines the community relations history, issues of community concern, and specific community relations activities to be undertaken during the course of a response action. It is designed to provide for two-way communication between the affected community and the agencies responsible for conducting a response action. • **UOM= EA**
X	**X**	**X**	**X**	**X**		**.03.08**	**TRANSPORTATION AND DISPOSAL PLAN (WASTE MGT. PLAN)** Phase 1 - 5 • Addresses environmental mitigation procedures for hazardous substances that are transported from the site. The plan addresses handling/transportation and disposal of hazardous materials. • **UOM= EA**
X	**X**	**X**	**X**	**X**		**.03.09**	**SITE MANAGEMENT PLAN** Phase 1 – 5 • A master plan that addresses site specific actions and schedules for implementing response actions necessary to protect human health and the environment. • **UOM= EA**
		X				**.03.10**	**RISK ASSESSMENT PLAN** Phase 2 • Qualitative and quantitative evaluation of the risk posed to human health and/or the environment by the actual or potential presence and/or use of specific pollutants. The assessment includes contaminant identification, exposure assessment, toxicity assessment, and risk characterization. • **UOM= EA**
X	**X**	**X**				**.03.11**	**TECHNICAL PROJECT GOALS AND OBJECTIVES** Phase 1 – 3 • Definition of the scope of response actions to mitigate potential threats to human health and the environment, prevent further environmental degradation, and reduce risks significantly. This includes development of a conceptual site model, identification of data needs and data quality objectives, identification of preliminary remedial action objectives and potential alternatives, identification of treatability studies, preliminary identification of ARARs of STDs, identification of NEPA requirements, and identification of other regulatory requirements. • **UOM= LS**

X	**X**	**X**	**X**	**X**	**X**	**03.12**	**SUBMITTALS/IMPLEMENTATION PLANS** Phase 1 - 5 • Work incurred during remedial action for obtaining all necessary plans and permits. These include QA/QC plans, work plans, shop drawings, demolition plans, environmental control plans, pollution control plans, site safety and health plans, site security plan, materials handling/transportation/disposal plan and all local, state, and federal permits. • **UOM= LS**
X	**X**	**X**				**03.13**	**EMERGENCY RESPONSE PLANS/REPORT/APPROVAL** Phase 1 - 3 • Identifies procedures that will be followed in responding to a hazardous materials incident. This includes engineering evaluation and cost analyses, action memo preparation, and removal action plans and specifications. • **UOM= LS**
X	**X**	**X**	**X**			**03.14**	**INTERIM REMEDIAL PLANS/REPORTS/APPROVAL** Phase 1 - 4 • Includes interim remediation plans such as EE/CA and Phase I of the RI/FS. **UOM= LS**
X	**X**	**X**				**.03.15**	**DECOMMISSIONING PLAN** Phase 1 - 3 • Describes the method to be used in the preparation of decommissioning a radioactively contaminated facility and includes information on facility history, characterization, and status; alternative selection, decommissioning activities; program management; worker and environmental protection; waste management; and final survey plan. • **UOM= EA**
			X	**X**		**.03.16**	**POST RA/D&D MONITORING PLAN** Phase 4 and 5 • Plan to ensure the site remains in a safe condition. The plan includes discussion of final site configuration, periodic inspection and monitoring, maintenance of barriers to prevent intrusion, and prevention of activities that might impair those barriers. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.03.9X**	**OTHER** Phase 1 – 6 • Includes all other activities involved in the process of preparation of plans not described by the above listed categories

X	**X**	**X**				**.04**	**STUDIES/DESIGN & DOCUMENTATION**
	X					**.04.01**	**HAZARDOUS RANKING SYSTEM (HRS)** Phase 2 • The principal screening tool used by the EPA to evaluate risks to public health and the environment associated with abandoned or uncontrolled hazardous waste sites. The HRS calculates a score based on the potential of hazardous substances spreading from the site through the air, surface water, or ground water, and on other factors such as density and proximity of human population. This score is the primary factor in deciding if the site should be on the National Priorities List, and, if so, what ranking it should have compared to other sites on the list. **UOM= LS**
	X					**.04.02**	**HUMAN HEALTH RISK ASSESSMENT** Phase 2 • Provides for the qualitative and quantitative evaluation and development of the following: hazard identification (sources), dose-response assessment, pathway analysis, characterization of site and potential receptors, exposure assessment, risk characterization, limitations/uncertainties, and a site conceptual model, to define the risk posed to human health & the environment. • **UOM= LS**
	X					**.04.03**	**ECOLOGICAL RISK ASSESSMENT** Phase 2 • Provide a qualitative and/or quantitative appraisal of the actual or potential effects of a hazardous waste site on plants and animals other than people and domesticated species. However, information from ecological studies may point to new or unexpected exposure pathways for human populations, and health assessment may help to identify environmental threats. • **UOM= LS**
	X					**.04.04**	**RISK ASSESSMENT DOCUMENTATION** Phase 2 • Document baseline risk; involves preparing the baseline risk report which is defined as an analysis of the potential adverse health effects (current or future) caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these releases (i.e., under an assumption of no action). • **UOM= LS**
						.04.05	**REMEDIAL INVESTIGATION REPORT** Phase 2 • Effort to produce a document presenting the results of the remedial investigation (RI) or RCRA facility investigation (RFI). Provides for composition of draft reports, response to draft report comments and finalization of report. Discusses site background, investigation, site characteristics, nature and extent of contamination, fate and transport, and conclusions. • **UOM= EA**

	X					**.04.06**	**DEVELOP REMEDIAL ALTERNATIVES** Phase 2 • Development of remedial alternatives involves applying site specific factors to candidate treatment technologies. Includes establishing remedial action objectives and general response actions, identifying preliminary alternatives, identifying and screening of applicable technologies, developing alternatives, identifying requirements for treatability studies, assembling technologies into actions, and developing a conceptual site model. • **UOM= LS**
	X					**.04.07**	**SCREEN REMEDIAL ALTERNATIVES** Phase 2 • Process of evaluating remedial alternatives by applying specific criteria. • **UOM= LS**
	X					**.04.08**	**EVALUATE ALTERNATIVES** Phase 2 • Evaluation of the remedial alternatives by comparing alternatives in light of the identified criteria such as protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, reduction in toxicity/mobility/volume, short-term effectiveness, implementability, cost, and state and community acceptance. • **UOM= LS**
	X					**.04.09**	**REFINEMENT OF ALTERNATIVES** Phase 2 • Refine remedial alternatives to maximize the goals of the action, their ability to meet the established criteria, and improve the alternatives acceptance to the state and community. • **UOM= LS**
	X					**.04.10**	**DOCUMENT FS (CMS)** Phase 2 • Study to identify and evaluate options for remedial action. The feasibility study (FS) is generally performed concurrently and in an interactive fashion with the remedial investigation (RI). Activities include drafting the FS report, responding to comments, and finalizing the report. • **UOM= LS**
		X	**X**			**.04.11**	**ENVIRONMENTAL RESTORATION PROJECT DESIGN** Phase 3 and 4 • Provides for remediation design preparation including preliminary design, intermediate design, and final design. The remedial design stage includes the development of the actual design of the selected remedy including the preparation of detailed plans, drawings, and specifications for remedial actions. • **UOM= EA**

		X	**X**			**.04.12**	**DECONTAMINATION/DISMANTLEMENT PROJECT DESIGN** Phase 3 and 4 • Provides for decommissioning and dismantlement design preparation including preliminary design, intermediate design, and final design. The decommissioning and dismantlement design stage includes the development of the actual design of the selected remedy including the preparation of detailed plans, drawings, and specifications for decontamination and decommissioning. • **UOM= EA**
		X	**X**			**.04.13**	**FACILITY DESIGN** Phase 3 and 4 • Provides for facility design preparation including preliminary design, intermediate design, and final design. The facility design stage includes the development of the actual design of the facility including the preparation of detailed plans, drawings, and specifications for the facility. • **UOM= EA**
		X	**X**			**.04.14**	**VALUE ENGINEERING/SPECIAL STUDIES** Phase 3 and 4 • Value engineering during design is a function-oriented, multidisciplinary team approach used to eliminate unnecessary design costs without sacrificing performance or quality. It provides an effective method for defining a problem and a system for achieving the best value. Identification, classification and analysis of functions is used to provide a solution to a problem or need. Value engineering during construction, encourages the construction contractor to propose changes in construction to provide the most up-to-date construction solutions. The value engineering change proposal (VECP) is an incentive clause in the contract that provides the contractor and the federal agency a monetary benefit. • **UOM= LS**
X	**X**	**X**	**X**			**.04.9x**	**OTHER** Phase 1 – 4 • Includes all other activities involved in the studies/design & documentation not described by the above listed categories.
X	**X**	**X**	**X**	**X**	**X**	**.05**	**SITEWORK**
X	**X**	**X**	**X**	**X**		**05.01**	**MOBILIZATION** Phase 1 to 5 • Include the transport of equipment, personnel, facilities to site. Also include temporary construction of facilities and utilities. • **UOM= LS**

X	**X**	**X**	**X**	**X**	**X**	**05.02**	**CLEANUP/LANDSCAPING/REVEGETATION** Phase 1 to 6 • Usually included as a concluding activity in a project or program. Cleanup includes general area cleanup, removal of trash and debris, and washing or sweeping of roads and parking lots. Landscaping consists of land preparation for seeding, planting, sodding, revegetation of site, slope protection, fertilization, watering, and mowing and trimming as may be required at the site. • **UOM= M^2**
X	**X**	**X**	**X**			**05.03**	**CLEAR AND GRUB** Phase 1 to 4 • Clearing is the process of removing of vegetation such as trees, shrubs, brush, grass, and other plants. Grubbing is the removal of stumps, roots, and debris from soil by heavy equipment such as dozers, scrapers, and excavators. Clear and grub is usually necessary for preparing the site for construction, remediation, or other activities. • **UOM= M^2**
X	**X**	**X**	**X**	**X**		**05.04**	**DEMOLITION** Phase 1 to 5 • Demolition includes demolishing or dismantling of any structures or facilities such as buildings, roads, pavements, fencing, pipes, underground utilities, and other structures. This activity also include the removal of barriers and other structures. To reiterate, work is considered in non-hazardous area. Otherwise, use Facility D&D activities in section .31.XX • **UOM= M^2** Phase 6 • Not applicable
X	**X**	**X**	**X**			**.05.05**	**EXCAVTION AND EARTHWORK** Phase 1 to 4 • This includes excavation necessary for site improvements, preparation for construction, installation of pipes, installation of underground utilities, for roadways, foundation, and other requirements for cut and fill as necessary. This activity includes removal of large rocks or excavation of various types of soils, grading, backfilling, stripping top soil, soil compaction, and other miscellaneous activities. Methods include blasting, excavating with dragline, clamshell, and/or excavators. Other activities in the Sitework assume excavation is not included. Therefore use this activity when excavation and earthwork are necessary. • **UOM= M^3**

X	**X**	**X**	**X**			**.05.06**	**LOAD AND HAUL** Phase 1 to 4 • Include the loading and hauling of excavation cut and fill materials, debris and trash, stockpiled materials, and other materials that may be needed for transport to and from other locations such as disposal facilities or material plants. Also include handling and dumping fees. Dumpster trucks, loaders, and haulers may be used. Other activities in the Sitework assume load and haul is not included. Therefore use this activity when loading and hauling are necessary. • **UOM= M^3**
X	**X**	**X**	**X**			**.05.07**	**BORROW PIT/HAUL ROAD** Phase 1 to 4 • Borrow pit is where fill material for earthwork can be obtained from which meets certain specifications. Haul road is how the borrowed material is transported to construction site. • **UOM= M^3** Phase 5 to 6 • Not applicable
X	**X**	**X**	**X**			**.05.08**	**ACCESS ROAD** Phase 1 to 4 • Access to site is often a major concern in any project where heavy equipment must be moved or transported. This includes construction of access road for construction site or other facilities when such access is not possible or does not exit. The access road can consist of one lane dirt or gravel road to more complex multi-lane asphalt and concrete systems. • **UOM= M^2** Phase 5 to 6 • Activities include, after completion of the construction, inspection, clearing/cleaning, and maintenance of access roads, during normal use. • **UOM= M^2/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.09**	**ARTERIAL ROADS/DIVIDED HIGHWAYS** Phase 1 to 4 • Includes the construction of permanent arterial roads or divided highways for public or private use due to the change of traffic pattern because of the project construction or ongoing facility operations and maintenance. • **UOM= M^2** Phase 5 to 6 • Activities during Phase 5 and Phase 6 include, after completion of construction, the inspection, clearing/cleaning, repair, and maintenance during normal use. • **UOM= M^2/YR**
				X	**X**		

X	**X**	**X**	**X**	**X**	**X**	**.05.10**	**RESTRIPPING ROADWAYS AND PARKING LOTS** Phase 1 to 6 • This includes removing of top layer of the roadway or parking lots. This will allow for cleaning, touching up, and repainting of traffic control marking on the roadways or parking lots. • **UOM= M^2**
X	**X**	**X**	**X**	**X**	**X**	**.05.11**	**RESURFACING ROADWAYS AND PARKING LOTS** Phase 1 to 6 • This includes the placement of a new surface cover over the existing roadway or the stripped roadway. This may be required due of deteriorated condition of the surface, or because of changes to the markings. Existing concrete or asphalt surfaces will be resurfaced with asphalt or concrete, and gravel surfaces will be resurfaced with gravel. • **UOM= M^2**
X	**X**	**X**	**X**			**.05.12**	**RAILROAD TRACKS AND CROSSING** Phase 1 to 4 • Used when there is a need for the construction of railroad tracks or crossing as required for the transport of materials for the site. Activities include preparation of track bed, tracks, ties, materials, markings, and other required items. • **UOM=M** Phases 5 to 6 • These activities include inspection, clearing, repair, and maintenance of the tracks and crossing. • **UOM= M/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.13**	**BRIDGES** Phase 1 to 4 • Includes the fabrication of bridges necessary for the site or project construction and operations. Types of bridges include timber or wooden structures, concrete structures, iron or steel structures, and a composite material structure. • **UOM= M^2** Phase 4 to 6 • Activities in Phases 5 and 6 also include, after completion of construction, the inspection, cleaning/clearing, repairs, and maintenance of bridges during normal use. • **UOM= M^2/YR**
				X	**X**		

X	**X**	**X**	**X**			**.05.14**	**FENCING** Phase 1 to 4 • Construction of various types of fencing and gates for boundary placement, security, safety, for privacy or for other purposes. • **UOM= M** Phases 5 to 6 • Activities in Phases 5 and 6 also include the inspection, repairs, and maintenance of fences and boundary placements during normal operations. • **UOM= M/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.15**	**PARKING LOTS** Phase 1 to 4 • Includes construction of gravel, asphalt, or concrete parking lot as needed for site/facility construction and for personnel during operations and maintenance of the facility. • See also 33.xx.xx, Resurfacing of Roadways and Parking Lots. • **UOM= M^2** Phases 5 and 6 • Activities include, after completion of the construction, the inspection, clearing/cleaning, repairs, and maintenance of parking lots during normal use. • **UOM= M^2/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.16**	**RETAINING WALL** Phase 1 to 4 • Retaining wall is constructed to hold back soil or other loose material and prevent these materials from failing or sliding. • **UOM= M^2** Phases 5 to 6 • Activities during Phases 5 and 6 include inspection, repair, and maintenance of the wall. • **UOM= M^2/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.17**	**SIDEWALKS** Phase 1 to 4 • Constructed of gravel, asphalt, brick, or reinforced concrete to allow pedestrian traffic. • **UOM= M^2** Phase 5 to 6 • After the completion of construction, activities include routine inspection, clearing/cleaning, repairs, and maintaining the sidewalks during normal use. • **UOM= M^2/YR**
				X	**X**		

	X	**X**	**X**			**.05.18**	**SPRINKLER SYSTEM** Phase 1 to 4 • Constructed for the landscaping irrigation requirement or for dust suppression during construction and facility operation. Includes piping, pumping, sprinkler head, valves, reducers, and control system. • **UOM= M** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, and maintenance of sprinkler system during normal use • **UOM= M/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.19**	**STRUCTURES/CULVERTS** Phase 1 to 4 • Construction or placements of cast in place concrete pipes or barrels, or large corrugated metal pipes culverts. These culverts, usually installed under roadways are used for storm-water collection, directing the flow, and for transport of runoff. • **UOM= M** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, clearing/cleaning, repairs, and maintenance of structures and culverts during normal use • **UOM= M/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.20**	**GAS DISTRIBUTION** Phase 1 to 4 • Includes the construction and/or placement of underground pipeline from main distribution to required site locations for gas distribution. • **UOM=M** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, repair, and maintenance of gas distribution during normal use • **UOM= M^2/YR**
				X	**X**		

X	**X**	**X**	**X**			**.05.21**	**FUEL LINE DISTRIUTION** Phase 1 to 4 • Includes the construction and/or placement of underground pipeline from main distribution to required site locations for fuels other than gas distribution. • **UOM= M** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, repair, and maintenance of fuel line distribution during normal use • **UOM= M^2/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.22**	**FUEL STORAGE TANKS** Phase 1 to 4 • Installation and/or construction of storage tanks for fuel during site construction or facility operation and maintenance. • **UOM= EA (tank)** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, repair and maintenance of fuel storage tank during normal use • **UOM= EA/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.23**	**HEATING/COOLING DISTRIBUTION SYSTEMS** Phase 1 to 4 • Include the construction or installation of heating and cooling system from a central plant source to the construction site or for facility operations and maintenance. Distribution system consists of supply pipe for chilled water and a separate pipe for hot water. Also include is a separate return pipe from the site to the central plant. Includes support frames and structures, system instrumentation and controls, valves, fittings, flow measures, and other appurtenance. • **UOM= M** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, repair, and maintenance of heating and cooling distribution system during normal use • **UOM= M/YR**
				X	**X**		

X	**X**	**X**	**X**			**.05.24**	**STEAM AND CONDENSATE DISTRIBUTION** Phase 1 to 4 • Include the construction or installation of steam and condensate distribution system from a central plant source to the construction site or for facility operations and maintenance. Distribution system consists of supply pipe for steam and a separate pipe for condensate. Also include is a separate return pipe from the site to the central plant. Includes support frames and structures, system instrumentation and controls, valves, fittings, flow measures, access ways, and other appurtenance. • **UOM= M** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, repair, and maintenance of steam and condensate distribution during normal use • **UOM= M/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.25**	**TREATMENT PLANTS/LIFT STATIONS** Phase 1 to 4 • Treatment plants and lift stations are used for treatment and transportation of non-contaminated or non-hazardous fluids. This includes water or wastewater treatment unit construction or installations, piping, valves and fittings, instrumentation and control, supporting frames and structures, and other necessary appurtenances. • **UOM= M^2** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, repairs, and maintenance of treatment plant or the lift station during normal use • **UOM= M^2/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.26**	**WATER DISTRIBUTION** Phase 1 to 4 • Includes in the installation or construction of system to distribute potable or irrigation water to construction site or for the facility from a central location. Items include piping, valves and fittings, instrumentation and controls, pumps, manholes, and other required appurtenances. • **UOM= M** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, clearing/cleaning, repairs, and maintenance of water distribution during normal use • **UOM= M/YR**
				X	**X**		

X	**X**	**X**	**X**			**.05.27**	**WATER STORAGE TANKS** Phase 1 to 4 • Includes in the installation or construction of system to store potable or irrigation water for construction site or for the facility from a central location. Items include piping, valves and fittings, instrumentation and controls, pumps, and other required appurtenances • **UOM= EA** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, clearing/cleaning, repairs, and maintenance of water storage tanks during normal use • **UOM= EA/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.28**	**STORM SEWER** Phase 1 to 4 • Includes in the installation or construction of system to collect, redirect, or transport storm sewer and wastewater at the construction site or for the facility from a central treatment plant. Items include piping, valves and fittings, instrumentation and controls, pumps, manholes, and other required appurtenances. • **UOM= M** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, clearing/cleaning, repairs, and maintenance of storm sewers during normal use • **UOM= M/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.29**	**COMMUNICATIONS** Phase 1 to 4 • Construction and installation of underground or aboveground communication systems or phones, fax, video, or e-mails. Include the installation of cables and wires, hardware, switches, conduits, and other equipment. • **UOM= M** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, and maintenance of communication system during normal use • **UOM= M/YR**
				X	**X**		

X	**X**	**X**	**X**			**.05.30**	**LIGHTING** Phase 1 to 4 • Lighting includes the installation or fabrication of illuminating devices at the construction site, roadways, facilities, and other areas at the site. Items include switches, light bulbs, poles, and other fixtures. • **UOM= M** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, clearing/cleaning, repairs, and maintenance of sprinkler system during normal use • **UOM= M/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.31**	**OVERHEAD ELECTRICAL DISTRIBUTION** Phase 1 to 4 • Includes the installation or construction of devices for overhead electrical distribution to construction site or facility from a central location. This assumes there is no excavation for distribution line installations. Items include wires, poles, switches, transformers, and other related items. • **UOM= M** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, repairs, and maintenance of overhead electrical distribution during normal use • **UOM= M/YR**
				X	**X**		
X	**X**	**X**	**X**			**.05.32**	**UNDERGROUND ELECTRICAL DISTRIBUTION** Phase 1 to 4 • This includes the installation or construction of buried electrical power distribution enclosures, wires, cables, switches, fixtures, transformers, and other appurtenances from a central location to a construction site or to a facility. • **UOM= M** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, repairs, and maintenance of underground electrical distribution during normal use • **UOM= M^2/YR**
				X	**X**		

X	**X**	**X**	**X**			**.05.33**	**SANITARY SEWER** Phase 1 to 4 • Includes the installation and construction of system to collect and transport aqueous sanitary waste to a central treatment location from a construction site or a facility. Items include piping, pumps, instrumentation and control, valves and fittings, storage tanks, and other necessary appurtenances. • **UOM= M** Phase 5 to 6 • Activities include, after completion of the construction, the inspection, clearing/cleaning, repairs, and maintenance of sanitary sewers during normal use • **UOM= M/YR**
				X	**X**		
			X	**X**	**X**	**.05.34**	**RESTORATION OF BUILDINGS AFTER D&D** Phases 4 to 6 Activities include restoration of building for reuse after D&D. **UOM=M^3**
			X			**.05.35**	**CONSTRUCTED WETLANDS** Phase 4 • Uses natural geochemical and biological processes inherent in an artificial wetland ecosystem to accumulate and remove metals, explosives, and other contaminants from influent waters. The process can be a filtration or degradation. • Although this technology incorporates principal components of wetland ecosystems, including organic soils, microbial fauna, algae, and vascular plants, microbial activity is responsible for most of the remediation. • **UOM= M^2** Phase 5 • Inspection and maintenance of site. • **UOM=M^2/YR**
				X	**X**		
	X	**X**	**X**	**X**		**.05.36**	**DEMOBILIZATION** Phases 2 to 5 • Transportation of equipment, personnel, back to the owners. This element provides for all work associated with plant takedown and removal of temporary facilities, utilities, equipment, material, and personnel • **UOM= LS**
X	**X**	**X**	**X**	**X**	**X**	**.05.9x**	**OTHER**

X	**X**	**X**				**.06**	**PRE-REMEDIAL SURVEILLANCE & MAINTENANCE**
X	**X**	**X**				**06.01**	**FACILITY TRANSITION** Phase 1-3 • Upfront planning for acceptance criteria and end point development and for end point criteria verification. • **UOM= FTE**
X	**X**	**X**				**06.02**	**OUTDOOR SURVEILLANCE & MAINTENANCE** Phase 1-3 • Activity required to manage the inactive waste sites so as to minimize any spread of surface soil contamination and maintain compliance with regulatory requirements. Work is coordinated to support the overall goals of site characterization and cleanup. • **UOM= FTE/YR**
X	**X**	**X**				**06.03**	**INDOOR SURVEILLANCE & MAINTENANCE** Phase 1-3 • Ensure the risk to the environment and human health and safety, posed by the radiological and hazardous materials inventory of the active/inactive facilities from past operations is minimized. • **UOM= FTE/YR**
X	**X**	**X**				**06.9x**	**OTHER**
X	**X**	**X**	**X**	**X**	**X**	**.07**	**INVESTIGATIONS & MONITORING/SAMPLE COLLECTION**
X	**X**	**X**				**07.01**	**SITE RECONNAISSANCE** Phases 1 to 3 • Includes general survey of the site to determine the current situation or condition of the area. Activities include historical investigation of site, land survey, topographic mapping, field screening, well inventory and sampling, and ecological resources reconnaissance. • **UOM=M^2**

X	**X**	**X**	**X**	**X**	**X**	**07.02**	**METEOROLICAL MONITORING** Phases 1 to 6 • Includes measurement of wind, precipitation, and barometric pressure as well as other parameters. Also includes the procurement, construction of monitoring station, installation, setup, testing, and operation and maintenance of meteorological station and instrument shelters. • **UOM=EA**
X	**X**	**X**	**X**	**X**	**X**	**07.03**	**SITE CONTAMINANT SURVEY/RADIATION MONITORING** Phases 1 to 6 • Site contaminant survey includes determining the level of radiation or contamination present at the site or at a certain location. Radiation monitoring includes the measuring of radiation of personal body count levels and at specified site areas. Body count monitoring includes personal dosimetry systems, hand and/or foot counters and whole body counters. Area monitoring includes remote monitoring, alarm systems, survey monitoring and special case area monitoring. Also, the construction of the monitoring station and purchase and installation of equipment and material are included as part of site contaminant survey/radiation monitoring. • **UOM= EA**
X	**X**	**X**	**X**			**.07.04**	**HYDROGEOLOGICAL INVESTIGATIONS- GROUNDWATER** Phase 1 to 4 • Includes the investigation of the site hydrogeological characteristics such as gradient, depth and size of water table, permeability or porosity, flow direction, well drawdown, and other related activities. Mechanisms for investigation includes hydro punch, tidal influence studies, pump tests, groundwater elevation measurements, and other tests. Also, the purchase and installation of equipment and material are included as part of hydrogeological investigation- ground water. • **UOM= M^2**
X	**X**	**X**	**X**			**.07.05**	**HYDROGEOLOGICAL INVESTIGATIONS- SURFCE WATER** Phase 1 to 4 • Includes the investigation of the site hydrogeological characteristics such as flow, velocity, depth and size of water body, flow direction, water source, and other related activities. Mechanisms for investigation include field surveys, tidal influence studies, elevation measurements, and other tests. Also, purchase and installation of equipment and material are included as part of hydrogeological investigation- surface water. • **UOM= M^2**
X	**X**	**X**				**.07.06**	**GEOPHYSICAL /GEOTECHNICAL INVESTIGATION** Phase 1 to 3 • Includes investigation of the surface and subsurface geological characteristics such as mineral, biological, and organic composition of soil, soil moisture content, permeability, porosity, geological formations, soil conductivity, soil pressure, shear strength, soil classification, retardation or contaminant sorption capacity, and other physical properties of the soil. Activities include drilling, remote sensor surveys, review of site history, soil testing, seismic studies, and other techniques. • **UOM= M^2** Phase 4 to 6 • Not applicable

X	**X**	**X**				**.07.07**	**ECOLOGICAL INVESTIGATION** Phase 1 to 3 • Ecological investigation activities include wetland and habitat delineation, wildlife observation, wildlife and habitat community characterization, identification of endangered species, and other related activities to establish baseline conditions and to determine actions needed to taken to reduce environment and ecological impact during construction and facility operations. **UOM= M^2**
X	**X**	**X**	**X**	**X**	**X**	**.07.08**	**AIR MONITORING AND SAMPLING** Phase 1 to 6 · Air monitoring and sampling is the monitoring for detection of HTRW to ensure compliance with clean air regulations. Includes monitoring of asbestos, HTRW, contaminated dust gases and vapors. See "Asbestos Abatement" (33.15.01.) for air monitoring during asbestos abatement. Also, construction of the monitoring station and hardware installment are included as part of air monitoring and sampling cost. · **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.07.09**	**GROUNDWATER SAMPLING AND MONITORING** Phase 1 to 6 • Include the sampling and monitoring of groundwater for the detection of HTRW to ensure compliance with local, state, and federal regulations. Cost for collection of routine samples and construction of the monitoring station are associated with this activity. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.07.10**	**SURFACE WATER SAMPLING** Phase 1 to 6 • Include the sampling and monitoring of surface water for the detection of HTRW to ensure compliance with local, state, and federal regulations. Cost for collection of routine samples and construction of the monitoring station are associated with this activity. **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.07.11**	**SOIL/SEDIMENT SAMPLING** Phase 1 to 6 • Include the sampling of soil and sediments for the detection of HTRW to ensure compliance with local, state, and federal regulations. Cost for collection of routine samples and construction of bore holes, drilling and other miscellaneous are considered associated with this activity if the cost have not been included in WBS 33.xx.xx, Geophysical/geotechnical investigation. • **UOM= EA**

X	**X**	**X**	**X**	**X**	**X**	**.07.12**	**ECOLOGICAL SAMPLING** Phase 1 to 6 • Include sampling of the habitat or biota to ensure that HTRW have not affected the species (such as changes to food supply, growth, reproduction, population, and other factors) surrounding the construction site or the facility. Also include is the cost of equipment and material required to obtain the samples. **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.07.13**	**WASTE SAMPLING** Phase 1 to 6 • Sampling liquid includes the work associated with the retrieval of liquid, solid, sludge, and gas waste samples for HTRW contaminants. This also includes sampling of leachate , residues, and treatment process effluents. Costs also include the construction of monitoring and sampling stations, and the cost of equipment and material required to obtain the samples. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.07.14**	**CONTAMINATED BUILIDING/STRUCTURE SAMPLE** Phase 1 to 6 • Include sampling of equipment, furniture, building walls, and other structures for presence of HTRW contaminants to ensure safety of the workers and occupants. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.07.9X**	**OTHER**
X	**X**	**X**	**X**	**X**	**X**	**.08**	**SAMPLE ANALYSIS** Is the process of analyzing the content of the samples to determine the contaminant and their concentrations. The samples include liquids, solids, sludge, sediments, air, or a combination of these. The sample analysis can be shipped off-site, on-site, in a mobile laboratory, or real time. **The preparation, handling, packaging, and transportation/delivering of samples to analytical laboratories will be captured under the 33.09.01, Prepare and Ship Environmental Samples**
X	**X**	**X**	**X**	**X**	**X**	**.08.01**	**AIR/GAS SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of air and gas samples for HTRW contaminants and concentrations. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA certified laboratory. For an on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management. • **UOM= EA**

X	**X**	**X**	**X**	**X**	**X**	**.08.02**	**GROUNDWATER SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of water samples for HTRW contaminants and concentrations. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA certified laboratory. For an on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.03**	**SURFACE WATER SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of surface water samples for HTRW contaminants and concentrations. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA certified laboratory. For an on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.04**	**SOIL/SEDIMENT SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of air and gas samples for HTRW contaminants and concentrations. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA certified laboratory. For an on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.05**	**GAS WASTE SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of gaseous waste samples for HTRW contaminants and concentrations. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA certified laboratory. For an on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.06**	**LIQUID WASTE SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of aqueous samples for HTRW contaminants and concentrations. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA certified laboratory. For an on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management. • **UOM= EA**

X	**X**	**X**	**X**	**X**	**X**	**.08.07**	**SOLID WASTE SAMPLE ANALYSIS** Phase 1 to 6 • Analysis solid waste samples for HTRW contaminants and concentrations. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA certified laboratory. For an on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.08**	**BIOTA SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of samples from the fauna and flora for HTRW contaminants and concentrations. For off-site sample analysis, it is assumed that the samples need to be packaged and delivered/transported to an EPA certified laboratory. For an on-site analysis, it is assumed that the laboratory is located at the site or facility, and may be operated and maintained by the same site management. **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.09**	**BIOASSAY SAMPLE ANALYSIS** Phase 1 to 6 • Analyzes retention of internal depositions of radionuclides contaminants in humans or animals. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.10**	**BIOACCUMULATION STUDIES** Phase 1 to 6 • Bioaccumulation is the accumulation of a substance, such as a toxic chemical, in various tissues of living organism. Bioaccumulation studies analyze the presence of contaminants and concentrations in organisms, and how these contaminants effect the organism. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.11**	**MOBILE-AIR/GAS SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of air and gas samples for HTRW contaminants and concentrations at a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on site, near the sampling location. A mobile unit allows sample analysis to be completed at a very short turnaround time. • **UOM= EA**

X	**X**	**X**	**X**	**X**	**X**	**.08.12**	**MOBILE- GROUNDWATER SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of groundwater samples for HTRW contaminants and concentrations at a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on site, near the sampling location. A mobile unit allows sample analysis to be completed at a very short turnaround time. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.13**	**MOBILE –SURFACE WATER SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of surface water samples for HTRW contaminants and concentrations at a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on site, near the sampling location. A mobile unit allows sample analysis to be completed at a very short turnaround time. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.14**	**MOBILE – SOIL/SEDIMENT SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of soil and sediment samples for HTRW contaminants and concentrations at a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on site, near the sampling location. A mobile unit allows sample analysis to be completed at a very short turnaround time. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.15**	**MOBILE-GAS WASTE SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of gas waste samples for HTRW contaminants and concentrations at the mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought to the site, near the sampling location. A mobile unit allows sample analysis to be completed at a very short turnaround time. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.16**	**MOBILE- LIQUID WASTE SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of liquid waste samples for HTRW contaminants and concentrations at a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on site, near the sampling location. A mobile unit allows sample analysis to be completed at a very short turnaround time.
X	**X**	**X**	**X**	**X**	**X**	**.08.17**	**MOBILE- SOLID WASTE SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of solid waste samples for HTRW contaminants and concentrations at a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on site, near the sampling location. A mobile unit allows sample analysis to be completed at a very short turnaround time. • **UOM= EA**

X	**X**	**X**	**X**	**X**	**X**	**.08.18**	**MOBILE- BIOTA SAMPLE ANALYSIS** Phase 1 to 6 • Analysis of flora and fauna samples for HTRW contaminants and concentrations at a mobile unit. A mobile unit is defined as a transportable unit such that an analysis unit can be brought on site, near the sampling location. A mobile unit allows sample analysis to be completed at a very short turnaround time. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.19**	**REAL TIME- AIR/GAS SAMPLE ANALYSIS** Phase 1 to 6 • Real time analysis of air and gas samples for HTRW contaminants and concentrations. A portable, hand held, or stationary analyzer such as Flame Ionization Detector Photon Ionization Detectors, portable gas chromatograph or other systems that can analyze for contaminants immediately or within a few minutes. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.20**	**REAL TIME - GROUNDWATER SAMPLE ANALYSIS** Phase 1 to 6 • Real time analysis of groundwater samples for HTRW contaminants and concentrations. A portable, hand held, or stationary analyzer such as pH meter, or conductivity sensors, thermometer, or contaminant test kits that can be used to determine the contaminants and concentrations immediately or within a few minutes. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.21**	**REAL TIME –SURFACE WATER SAMPLE ANALYSIS** Phase 1 to 6 • Real time analysis of surface water samples for HTRW contaminants and concentrations. A portable, hand held, or stationary analyzer such pH meter, thermometer, flow meter, Fluorescence analyzer, or other assay and test kits can be used to determine the contaminants and concentrations immediately or within a few minutes. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.22**	**REAL TIME – SOIL/SEDIMENT SAMPLE ANALYSIS** Phase 1 to 6 • Real time analysis of soil/sediment sample for HTRW contaminants and concentrations. A portable, hand held, or stationary analyzer such pH meter, thermometer, Fluorescence analyzer, or other assay and test kits can be used to determine the contaminants and concentrations immediately or within a few minutes. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.23**	**REAL TIME -GAS WASTE SAMPLE ANALYSIS** Phase 1 to 6 • Real time analysis of waste gas samples for HTRW contaminants and concentrations. A portable, hand held, or stationary analyzer such as Flame Ionization Detector Photon Ionization Detectors, portable gas chromatograph or other systems that can analyze for contaminants immediately or within a few minutes. • **UOM= EA**

X	**X**	**X**	**X**	**X**	**X**	**.08.24**	**REAL TIME - LIQUID WASTE SAMPLE ANALYSIS** Phase 1 to 6 Real time analysis of liquid waste samples for HTRW contaminants and concentrations. A portable, hand held, or stationary analyzer such pH meter, thermometer, conductivity probes, Fluorescence analyzer, or other assay and test kits can be used to determine the contaminants and concentrations immediately or within a few minutes. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.25**	**REAL TIME - SOLID WASTE SAMPLE ANALYSIS** Phase 1 to 6 • Real time analysis of solid waste sample for HTRW contaminants and concentrations. A portable, hand held, or stationary analyzer such Geiger counter, thermometer, Fluorescence analyzer, or other assay and test kits can be used to determine the contaminants and concentrations immediately or within a few minutes. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.08.9x**	**OTHER** Phase • Other site investigation, sampling or monitoring processes.
X	**X**	**X**	**X**	**X**	**X**	**.09**	**SAMPLE MANAGEMENT/DATA VALIDATION/DATA EVALUATION**
X	**X**	**X**	**X**	**X**	**X**	**.09.01**	**PREPARE AND SHIP ENVIRONMENTAL SAMPLES** Phase 1 to 6 • This includes preserving samples, handling and packaging samples, completing chain of custody form for transport, delivery or transport of samples to analytical laboratory, and other miscellaneous functions. • **UOM=EA**
X	**X**	**X**	**X**	**X**	**X**	**.09.02**	**COORDINATE WITH SAMPLE MGT PERSONNEL/REGULATORS** Phase 1 to 6 • Coordination of the sampling process with management, regulators, and other personnel to ensure that duplicative effort are not being performed or to that appropriate activities are being conducted. • **UOM= FTE/MO**
X	**X**	**X**	**X**	**X**	**X**	**.09.03**	**IMPLEMENT EPA-APPROVED LABORATORY QA PROGRAM** Phase 1 to 6 • Implementation of the total program designed to ensure the reliability of collected samples and their analytical result. • **UOM= FTE**
X	**X**	**X**	**X**	**X**	**X**	**.09.04**	**PROVIDE SAMPLE MANAGEMENT** Phase 1 to 6 • Provide for storing, tracking, and management of the samples. This include administrative management of the sampling personnel, ensuring that personnel adhere to the QA/QC procedure, ensuring the receiving and delivering of samples for analysis, receiving of sample analysis results, and other sample management functions. • **UOM= FTE/MO**
X	**X**	**X**	**X**	**X**	**X**	**.09.05**	**DERIVED WASTE DISPOSAL** Phase 1 to 6 Disposal of derived waste. See also disposal of waste under 33.xx.xx

							UOM= M^3
X	**X**	**X**	**X**	**X**	**X**	**.09.06**	**PERFORM DATA VALIDATION** Phase 1 to 6 • This activity is performed after samples have been analyzed. After analysis results have been received, the data, sampling, and the analysis process need to be review to ensure that it is valid. If not, the data will be thrown out. This might include performing statistical analysis and reviewing of outlier data. Written documentation of the validation also be provided. • **UOM= FTE/MO**
X	**X**	**X**	**X**	**X**	**X**	**09.07**	**DATA USABILITY EVALUATION/FIELD QA/QC** Phase 1 to 6 • Evaluation of the site investigation, sampling analysis, and monitoring data to determine if these data can be used. This is accomplished by ensuring that all QA/QC procedures were followed in all the processes. This also includes determining the relevancy of the data collected for use in determining technology selection, and other project and program plans. Also the calibration of the equipment and maintenance of the equipment are included as part of this task. • **UOM= FTE/MO**
X	**X**	**X**	**X**	**X**	**X**	**09.08**	**DATA REDUCTION, TABULATION AND EVALUATION** Phase 1 to 6 • Process of eliminating invalidated data, data that is irrelevant, or data that is statistically out of the acceptable range. After the data have be evaluated and reduced, the results will be tabulated and analyzed for specific trends or characteristics. • **UOM= FTE/MO**
X	**X**	**X**	**X**	**X**	**X**	**.09.09**	**MODELING** Phase 1 to 6 • Based on information available from literature search; site investigation, sampling data; and maybe based on benchscale studies, develop and run the computer model of surface and groundwater flow, transportation, retardation, and other relevant characteristic of the contaminant fate. • **UOM= FTE**
X	**X**	**X**	**X**	**X**	**X**	**.09.10**	**DOCUMENT DATA EVALUATION** Phase 1 to 6 • Documentation and development of the data evaluation process. • **UOM= FTE/MO**
X	**X**	**X**	**X**	**X**	**X**	**.09.9x**	**OTHER**
	X	**X**				**.10**	**TREATABILITY/RESEARCH &DEVELOPMENT**
	X	**X**				**.10.01**	**LITERATURE SEARCH** Phase 2 to 3 • Research and review of journal articles, books, reports, and other documents to determine relevant and applicable technologies for the site and for the contaminant to be treated. • **UOM= FTE**

	X	**X**				**.10.02**	**DATA COLLECTION** Phase 2 to 3 • Collection of essential site, chemical, thermal, technology, and other essential data for further screening of technology alternatives found from literature search. The data will also be used for planning and preparation of bench scale or pilot testing. • **UOM= FTE**
	X	**X**				**.10.03**	**DEVELOP TREATABILITY WORK PLAN** Phase 2 to 3 • Development and preparation of work plan for the treatability process. This include determining amount and size of materials and equipment that will be needed, additional information that needs to be collected from the bench scale testing, cost and schedule estimate, process for implementing the treatability study, and other related procedures. **UOM= FTE**
	X	**X**				**.10.04**	**DESIGN/PROCURE NEW EQUIPMEMT** Phase 2 to 3 • This activity includes the development of detailed design and operating procedure for the bench scale, pilot, and field demonstration testing and equipment. At the same time, these equipment and materials need to be purchased or procured if not readily available. **UOM= FTE**
	X	**X**				**.10.05**	**BENCH TEST** Phase 2 to 3 • This is a laboratory data development process. The purpose is to obtain enough data on chemistry, kinetics or reaction rates, material balance, heat transfer data, and other relevant data, which will be needed for equipment design and selection, and for initial cost and schedule estimates. **UOM= LS**
	X	**X**				**.10.06**	**PILOT SCALE TEST** Phase 2 to 3 • Usually at a smaller scale than the actual plant. This entails obtaining of permit, construction, testing, and operation of the pilot plant to evaluate performance data and to obtain more information on the construction and operation of the full scale or actual plant. See 33.10.04 for design of equipment and system design. **UOM= LS**

	X	**X**				**.10.07**	**FIELD TEST** Phase 2 to 3 • This usually entails a demonstration at an actual site, using actual waste. Field testing includes obtaining permits, constructing, and operating of the plant or technology. See 33.10.04 for designing of equipment and system. • **UOM= LS**
	X	**X**				**.10.08**	**TEST SPECIAL TOOLS AND EQUIPMENTS** Phase 2 to 3 • Testing of special tools and equipment, prior to final installation and use. Testing can be performed at testing facilities or laboratories. Testing include determining strength and durability data, use of equipment or tools, or efficiency or performance data. • **UOM= LS**
	X	**X**				**.10.09**	**DESIGN, PROCURE, TEST NEW PROCEDURES** • **???Need more information is this really necessary?**
	X	**X**				**.10.10**	**SIMULATION AND MODELING** Phase 2 to 3 • Include the use of simulator at a facility, or the development of a simulator to test materials and equipment or to simulate an operation of an equipment or facility. Computer programs can also be developed which models the construction and operation of equipment, technology, or a facility. The use of simulators or modeling reduces the risk of public, worker, or the environment being exposed to hazardous conditions. It is also less expensive because an actual construction does not take place. • **UOM= FTE**
	X	**X**				**.10.11**	**DOCUMENT TREATABILITY STUDY** Phase 2 to 4 • Documentation of the processes and results of the treatability studies. • **UOM= FTE**
	X	**X**				**.10.9x**	**OTHER**
			X	**X**		**.11**	**TREATMENT PLANT/FACILITY**
			X	**X**		**.11.01**	**MOBILIZATION** Phase 4 and 5 • This element provides for mobilization of personnel, facilities and equipment, construction of temporary facilities, temporary utilities, temporary relocation and setup of decontamination facilities and construction plant. • **UOM=LS**

			X	X		.11.02	**SHEDS & OTHER SUPPORTING FACILITIES** Phase 4 • This element provides for the construction of permanent facilities including sheds, covers, and other facilities not included in the waste management facility but are required to support waste management activities. • **UOM =M^2 (area of facility)** Phase 5 • This element provides for the operations (e.g., receiving, loading, unloading) and maintenance of these facilities during the waste management operations. • **UOM= M^2/YR**
			X	X		.11.03	**SIMPLE REMEDIAL TREATMENT FACILITIES** Phase 4 • This element provides for the construction of permanent facilities including equipment pads and utilities for a simple treatment, such as, an extraction well. This element is not intended to provide for larger treatment trains requiring rain covers (see WBS .11.04 for that type of facility). • **UOM =M^2** • Phase 5 • This element provides for the operations of the associated utilities (not, for example, extraction well operation) and maintenance of these facilities during the remedial action well. • **UOM = M^2/YR**
			X			.11.04	**TREATMENT TRAIN FACILITY — CONSTRUCTION** Phase 4 • This element provides for the construction of permanent facilities including rain covers, other structures and utilities for treatment trains (a series of treatment technologies employed in one location) in the field. • **UOM =M^2**
				X		.11.05	**TREATMENT TRAIN FACILITY — OPERATIONS** Phase 5 • This element provides for the operations of the overall operation of the facility where the operator or maintenance mechanic is not performing a task specific to a treatment technology. For example, the recharge of the Ion Exchange unit will be included in WBS .24.07. This element also includes operation and maintenance of associated utilities and facilities during the remedial action. • **UOM = M^2/YR**
			X			.11.06	**FULL SCALE WASTE MANAGEMENT PLANT/FACILITY — CONSTRUCTION** Phase 4 • This element provide for the construction of the entire waste management facility with the exception of the functional space areas included in the WBS elements .11.07 through .11.12. Operations and maintenance are not included in this element because it is considered an overhead type cost with respect to the waste management operation, and should be covered under WBS .01. • **UOM =M^2**

			X			.11.07	**WASTE MANAGEMENT LOW/MODERATE HAZARD TREATMENT FRONT END** Phase 4 • This element provides for the construction of permanent facilities (for low/moderate hazardous waste streams) dealing with the receiving and inspection, container handling, open/dump/sort and preparation of waste streams for waste management treatment. • **UOM =M^2** Phase 5 • This element provides for the operations (for low/moderate hazardous waste streams) including receiving and inspection, container handling, open/dump/sort and preparation of waste streams for waste management treatment. It also includes and maintenance of these facilities during the waste management operations. • **UOM =M^2/YR**
				X			
			X			.11.08	**WASTE MANAGEMENT HIGH HAZARD/REMOTE TREATMENT FRONT END** Phase 4 • This element provides for the construction of permanent facilities (for high hazardous waste and remote handled waste streams) dealing with the receiving and inspection, container handling, open/dump/sort and preparation of waste streams for waste management treatment. • **UOM =M^2** Phase 5 • This element provides for the operations (for high hazardous waste and remote handled waste streams) including receiving and inspection, container handling, open/dump/sort and preparation of waste streams for waste management treatment. It also includes and maintenance of these facilities during the waste management operations. • **UOM =M^2/YR**
				X			
			X			.11.10	**WASTE MANAGEMENT LOW HAZARD FUNCTIONAL AREA** Phase 4 • This element provides for the construction of functional space area of permanent dealing with the treatment of low hazardous waste streams (e.g., typical hazardous materials not requiring respirators). • **UOM =M^2** Phase 5 • This element provides for the operations of functional space area of permanent dealing with the treatment of low hazardous waste streams (e.g., typical hazardous materials not requiring respirators). This element provides for the operations of the overall operation of the facility where the operator or maintenance mechanic is not performing a task specific to a treatment technology. For example, the recharge of the Ion Exchange unit will be included in WBS .24.07. This element also includes operation and maintenance of associated utilities and facilities during the waste management. **UOM = M^2/YR**
				X			

			X			.11.11	**WASTE MANAGEMENT HIGH HAZARD FUNCTIONAL AREA** Phase 4 • This element provides for the construction of functional space area of permanent dealing with the treatment of low hazardous waste streams (e.g., high hazardous wastes including high level radioactive waste and mixed waste). • **UOM =M^2** Phase 5 • This element provides for the operations of functional space area of permanent dealing with the treatment of low hazardous waste streams (e.g., high hazardous wastes including high level radioactive waste and mixed waste). This element provides for the operations of the overall operation of the facility where the operator or maintenance mechanic is not performing a task specific to a treatment technology. For example, the recharge of the Ion Exchange unit will be included in WBS .24.07. This element also includes operation and maintenance of associated utilities and facilities during the waste management. • **UOM = M^2/YR**
				X			
			X			.11.12	**WASTE MANAGEMENT REMOTE FUNCTIONAL AREA** Phase 4 • This element provides for the construction of functional space area of permanent dealing with the treatment of low hazardous waste streams (e.g., high hazardous wastes including high level radioactive waste and alpha contaminated waste requiring remote handling). • **UOM =M^2** Phase 5 • This element provides for the operations of functional space area of permanent dealing with the treatment of low hazardous waste streams (e.g., high hazardous wastes including high level radioactive waste and alpha contaminated waste requiring remote handling). This element provides for the operations of the overall operation of the facility where the operator or maintenance mechanic is not performing a task specific to a treatment technology. For example, the recharge of the Ion Exchange unit will be included in WBS .24.07. This element also includes operation and maintenance of associated utilities and facilities during the waste management. • **UOM = M^2/YR**
				X			
			X	X		.11.13	**DEMOBILIZATION** Phases 4 and 5 • This element provides for all work associated with remedial action plant takedown and removal of temporary facilities, utilities, equipment, material, and personnel. • **UOM =LS**
			X	X	X	.12	**STORAGE FACILITY**
			X	X		.12.01	**MOBILIZATION** Phases 4 and 5 • This element provides for mobilization of personnel, facilities and equipment, construction of temporary facilities, temporary utilities, temporary relocation and setup of decontamination facilities and construction plant • **UOM =LS**

			X	X		12.02	**CONVENTIONAL STORAGE/WAREHOUSES** Phase 4 • This element provides for the construction of permanent facilities including sheds, warehouses and other facilities not included in the waste management facility but are required for storage of hazardous waste and materials. • **UOM =M^2** Phase 5 • This element provides for the operations (e.g., receiving, loading, unloading) and maintenance of these facilities for as long as the storage facility is active or required. • **UOM = M^2/YR**
			X	X		.12.03	**STORAGE FACILITY FRONT-END - LOW/MODERATE HAZARD** Phase 4 • This element provides for the construction of permanent facilities (for low/moderate hazardous waste streams) dealing with the receiving and inspection, container handling, open/dump/sort and preparation of waste streams for storage. • **UOM =M^2** Phase 5 • This element provides for the operations (for low/moderate hazardous waste streams) including receiving and inspection, container handling, open/dump/sort and preparation of waste streams for waste storage. It also includes and maintenance of these facilities during the waste storage period. • **UOM = M^2/YR**
			X	X		.12.04	**STORAGE FACILITY FRONT-END - HIGH/REMOTE HAZARD** Phase 4 • This element provides for the construction of permanent facilities (for high hazardous and remote handled waste streams) dealing with the receiving and inspection, container handling, open/dump/sort and preparation of waste streams for storage. • **UOM =M^2** Phase 5 • This element provides for the operations (for high hazardous and remote handled waste streams) including receiving and inspection, container handling, open/dump/sort and preparation of waste streams for waste storage. It also includes and maintenance of these facilities during the waste storage period • **UOM = M^2/YR**
			X	X		.12.05	**CONTACT HANDLED STORAGE** Phase 4 • This element provides for the construction of permanent storage facility dealing with the contact handled hazardous waste streams (e.g., high hazardous wastes including hazardous/toxic waste and radioactive waste). • **UOM =M^2** Phase 5 • This element provides for the operations of permanent storage facility dealing with the contact handled hazardous waste streams (e.g., high hazardous wastes including hazardous/toxic waste and radioactive waste). The operations include

							receiving, loading, unloading and maintenance of these facilities for as long as the storage facility is active or required. • **UOM = M^2/YR**
			X			**.12.06**	**REMOTE HANDLED STORAGE** Phase 4 • This element provides for the construction of permanent storage facility dealing with the contact handled hazardous waste streams (e.g., high hazardous wastes including high level radioactive waste and alpha contaminated waste requiring remote handling). • **UOM =M^2** Phase 5 • This element provides for the operations of permanent storage facility dealing with the contact handled hazardous waste streams (e.g., high hazardous wastes including high level radioactive waste and alpha contaminated waste requiring remote handling). The operations include receiving, loading, unloading and maintenance of these facilities for as long as the storage facility is active or required. • **UOM = M^2/YR**
				X			
			X			**.12.07**	**MIXED WASTE STORAGE FACILITY** Phase 4 • This element provides for the construction of permanent storage facility dealing with the contact handled hazardous waste streams (e.g., high hazardous wastes and low level radioactive waste). • **UOM =M^2** Phase 5 • This element provides for the operations of permanent storage facility dealing with the contact handled hazardous waste streams (e.g., high hazardous wastes and low level radioactive waste). The operations include receiving, loading, unloading and maintenance of these facilities for as long as the storage facility is active or required. • **UOM = M^2/YR**
				X			
			X	**X**		**.12.08**	**DEMOBILIZATION** Phase 4 and 5 • This element provides for all work associated with remedial action plant takedown and removal of temporary facilities, utilities, equipment, material, and personnel. • **UOM =LS**
			X	**X**	**X**	**.13**	**DISPOSAL FACILITY**
			X	**X**		**.13.01**	**MOBILIZATION** Phases 4 and 5 • This element provides for mobilization of personnel, facilities and equipment, construction of temporary facilities, temporary utilities, temporary relocation and setup of decontamination facilities and construction plant. • **UOM =LS**

			X			.13.02	**DISPOSAL FACILITY FRONT-END - LOW/MODERATE HAZARD** Phase 4 • This element provides for the construction of permanent facilities (for low/moderate hazardous waste streams) dealing with the receiving and inspection, container handling, open/dump/sort and preparation of waste streams for disposal. • **UOM =M^2** Phase 5 • This element provides for the operations (for low/moderate hazardous waste streams) including receiving and inspection, container handling, open/dump/sort and preparation of waste streams for waste disposal. It also includes and maintenance of these facilities during the waste disposal operational period. • **UOM = M^2/YR** Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM =FTE**
				X			
					X		
			X			.13.03	**DISPOSAL FACILITY FRONT-END - HIGH/REMOTE HAZARD** Phase 4 • This element provides for the construction of permanent facilities (for high hazardous and remote handled waste streams) dealing with the receiving and inspection, container handling, open/dump/sort and preparation of waste streams for disposal. • **UOM =M^2** Phase 5 • This element provides for the operations (for high hazardous and remote handled waste streams) including receiving and inspection, container handling, open/dump/sort and preparation of waste streams for waste disposal. It also includes and maintenance of these facilities during the waste disposal operational period • **UOM = M^2/YR** Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM = M^2/YR**
				X			
					X		

			X			.13.04	**LANDFILL/BURIAL GROUND/TRENCH/PITS** Phase 4 • This element provides for the construction of a landfill, burial ground, burial trench, or burial pits. • **UOM =M^3** Phase 5 • This element provides for the operation including receiving, inspection handling, and monitoring of a landfill, burial ground, burial trench, or burial pits. • **UOM = M^3/YR** Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time • **UOM = M^2/YR**
				X			
					X		
			X			.13.05	**ABOVE GROUND VAULT** Phase 4 • This element provides for the construction of an above ground disposal vault. • **UOM =M^3** Phase 5 • This element provides for the operation including receiving, inspection, handling, and monitoring of an above ground disposal vault. • **UOM = M^2/YR** Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM = M^2/YR**
				X			
					X		
			X			.13.06	**UNDERGROUND VAULT** Phase 4 • This element provides for the construction of an underground disposal vault. • **UOM =M^3** Phase 5 • This element provides for the operation including receiving, inspection, handling, and monitoring of an underground disposal vault • **UOM = M^3/YR** Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM = M^2/YR**
				X			
					X		
			X			.13.07	**UNDERGRUND MINE/SHAFT** Phase 4 • This element provides for the construction of an underground disposal mine/shaft. • **UOM =M^3**

				X			Phase 5 • This element provides for the operation including receiving, inspection, handling, and monitoring of an underground disposal mine/shaft. • **UOM = M^3/YR**
					X		Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM = M^2/YR**
			X			**.13.08**	**TANKS** Phase 4 • This element provides for the construction of disposal storage tanks. **UOM = M^3**
				X			Phase 5 • This element provides for the operation including receiving, inspection, handling, and monitoring of disposal storage tanks. • **UOM = M^3/YR**
					X		• Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM = M^3/YR**
			X			**.13.09**	**PADS (TUMULUS/RETRIEVABLE STORAGE/OTHER)** Phase 4 • This element provides for the construction of a disposal pads (tumulus, retrievable storage, or other). • **UOM =M^2**
				X			Phase 5 • This element provides for the operation including receiving, inspection, handling, and monitoring of a disposal pads (tumulus, retrievable storage, or other). • **UOM = M^2/YR**
					X		• Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM = M^2/YR**
			X			**.13.10**	**CONFINED DISPOSAL FACILITIES (CDFS)** Phase 4 • This element provides for the construction of confined disposal facilities. • **UOM =M^3**
				X			• Phase 5 • This element provides for the operation including receiving, inspection, handling, and monitoring of confined disposal facilities. • **UOM = M^3/YR**
					X		Phase 6

							• This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM = M^3/YR**
			X			**.13.11**	**ENGINEERED DISPOSAL** Phase 4 • This element provides for the construction of engineered disposal facilities. • **UOM =M^3** Phase 5 • This element provides for the operation including receiving, inspection, handling, and monitoring of engineered disposal facilities. • **UOM = M^3/YR** Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM = M^2/YR**
				X			
					X		
			X			**.13.12**	**INTERMEDIATE DEPTH DISPOSAL** Phase 4 • This element provides for the construction of intermediate depth disposal facilities. • **UOM =M^3** Phase 5 • This element provides for the operation including receiving, inspection, handling, and monitoring of intermediate depth disposal facilities. • **UOM =M^3/YR** Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM = M^3/YR**
				X			
					X		
			X			**.13.13**	**GEOLOGIC DISPOSAL** Phase 4 • This element provides for the construction of geologic disposal facilities. • **UOM =M^3** Phase 5 • This element provides for the operation including receiving, inspection, handling, and monitoring of geologic disposal facilities. • **UOM = M^3/YR** Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM = M^2/YR**
				X			
					X		

			X			.13.14	**SHALLOW LAND DISPOSAL** Phase 4 • This element provides for the construction of shallow land disposal facilities. • **UOM =M^3** Phase 5 • This element provides for the operation including receiving, inspection, handling, and monitoring of shallow land disposal facilities. • **UOM = M^3/YR** Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM = M^2/YR**
				X			
					X		
			X			.13.15	**DEEP WELL INJECTION** Phase 4 • This element provides for the construction of deep well disposal facilities. • **UOM =EA** Phase 5 • This element provides for the operation including receiving, inspection, handling, and monitoring of deep well disposal facilities. • **UOM =EA/YR** Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM =EA/YR**
				X			
					X		
			X			.13.16	**SILO DISPOSAL** Phase 4 • This element provides for the construction of silo disposal facilities. • **UOM =M^3** Phase 5 • This element provides for the operation including receiving, inspection, handling, and monitoring of silo disposal facilities. • **UOM =FTE** Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM =FTE**
				X			
					X		

			X	X	X	.13.17	**BORE - HOLE DISPOSAL** Phase 4 • This element provides for the construction of bore-hole disposal facilities. • **UOM =EA** Phase 5 • This element provides for the operation including receiving, inspection, handling, and monitoring of bore-hole disposal facilities. • **UOM =EA/YR** Phase 6 • This element provides for the long term surveillance and maintenance after facility closure for an indefinite period of time. • **UOM =EA/YR**
			X	X	X	.13.18	**DISPOSAL FEES AND TAXES** Phase 1 to 6 • For disposal taxes and fees charged between agencies or departments, see "Disposal Fees and Taxes." • **UOM =LS**
			X	X		.13.19	**INTERNAL COMBUSTION ENGINE (NOT INCLUDING HALOGENATED VOCS)** Phase 4 and 5. • This element provides for the disposal of petroleum products through use of internal combustion engines. • **UOM =M^3 (size/capacity of the engine)**
			X	X		.13.20	**DEMOBILIZATION** Phases 4 and 5 • This element provides for all work associated with remedial action plant takedown and removal of temporary facilities, utilities, equipment, material, and personnel. • **UOM =LS**
			X	X	X	.13.21	**OTHER**
			X	X		.14	**ORDNANCE AND EXPLOSIVE REMOVAL AND DESTRUCTION** (CWM is included in Waste Management WBS .10/.11 and Technologies WBS .020 -.28)
			X			.14.01	**DEMOLITION FOR OE REMOVAL** Phase 4 • This is the preparation of the area for explosive demolition activities. May require sandbags, use of heavy equipment, brush clearing, running electrical wire from a safe area to the point where explosives operations will be conducted. May require building a fence or posting warning signs. This is construction of a site that will be used for the destruction of unexploded ordnance (UXO) / munitions found during OE activities. • **UOM= M^2**
			X			.14.02	**BRUSH CLEARING WITH OE** Phase 4 • Forming work teams of labors that will remove brush for either surface or subsurface UXO activities. These personnel will be exposed to UXO. Teams will have at least one UXO qualified person to act as a safety observer. Use of saws, ax, and other brush clearing equipment is required

							• **UOM= M^2**
			X			**.14.03**	**BLAST MATS** Phase 4 • Commercial mats made of rubber and various other materials used to cover explosives. When the explosives detonate, these mats are supposed to catch the rocks and other fragments, and keep them from being propelled away from the explosion • **UOM= EA**
			X			**.14.04**	**BLAST SHIELDS** Phase 4 • These are engineering controls designed to protect personnel and the public from accidental detonations of UXO. They are not for the UXO personnel, but primarily to protect public property and personnel. They are usually locally built from plans drawn up by Huntsville's, Civil Structures Branch. They are of various materials (usually alum.). • **UOM= EA**
			X			**.14.05**	**SURFACE SWEEP (VISUAL)** Phase 4 • UXO Teams of up to seven people walk in a line formation and investigate all surface items that are potential UXO. Teams can be supplemented by non-UXO personnel, if they have UXO safety training • **UOM= M^2**

			X			.14.06	**SURFACE SWEEP (MAGNETOMETER)** Phase 4 • UXO Teams of up to seven people walk in a line formation and investigate all surface items that are potential UXO. Teams can be supplemented by non-UXO personnel, if they have UXO safety training. Magnetometers are used to aid in the search. This is usually in forests, where leaves and brush are a problem. Much slower progress than visual sweeps. Magnetometers only detect ferrous metals • **UOM= M^2**
			X			.14.07	**SURFACE SWEEP (MAG & FLAG)** Phase 4 • Anomaly Identification (Mag and Flag). The OE project is usually divided into grids. They are normally 200' x 200 '. A team of up to seven people mark off five foot lanes and they use magnetometers to locate all subsurface anomalies in a grid. Each anomaly is marked with a pin flag for future investigation • **UOM= M^2**
			X			.14.08	**EXCAVATE BY HAND 0' - 2' DEPTH** Phase 4 • Teams of up to seven people use hand tool (i.e.; shovels, trowels, picks) to investigate subsurface anomalies and determine if they are UXO. Surface Sweep (Mag and Flag) and Excavation by hand can be combined if all team members are UXO qualified. Very tedious and dangerous since current detection and location equipment do not give accurate depth if OE. • **UOM= M^3**
			X			.14.09	**EXCAVATE WITH HEAVY EQUIPMENT > 2' DEPTH** Phase 4 • Same as Excavate by hand except at areas with hard ground or deep anomalies, heavy equipment is allowed to dig to within 12 inches of the anomaly. Then hand tools are used. The object again, is to safely determine if the anomaly is a UXO. • **UOM= M^3**
			X			.14.10	**SIFTING** Phase 4 • At site where the area is saturated with small metal and the UXO items you are investigating area safe to disturb. UXO teams may use a hand or mechanical sifter to separate the soil and debris from the UXO. UXO personnel stand at the sifter or at a conveyor and separate the UXO from the scrap and debris. The sifter is sometimes used to separate chunks of explosives from soil. To separate smaller materials from larger materials by using a sieve. Smaller items will pass through the sieve and larger items will be retained on the sieve. • **UOM= M^3**
			X			.14.11	**REMOVAL OF CHEMICAL WARFARE MATERIAL (CWM)** Phase 4 • CWM is military munitions or containers that are filled with chemical agent (Mustard Agent, VX,GB, Lewisite ect.). Contractor UXO Teams are tasked to investigate anomalies at suspect CWM sites and determine if CWM items are present. If CWM items are found, we then turn the items over to Technical Escort EOD personnel and PMNSM for stabilization, transportation, storage and disposal.

							• **UOM= EA**

			X			.14.12	**OE ON-SITE DESTRUCTION** Phase 4 • When UXO items are found during OE investigations, the normal procedure is to destroy them in place. The second choice is to transport to another location on that project site and destroy them. These are our preferred means of disposal of found UXO. • **UOM= EA**
			X			.14.13	**OE OFF-SITE DESTRUCTION TRANSPORTATION TO DOD FACILITY** Phase 4 • When on-site disposal of UXO is not a viable option and the UXO are safe to transport, we can direct the UXO contractor to ship the UXO to another facility for destruction. This very seldom happens on OE projects. • **UOM= EA**
			X			.14.14	**BUNKERS (TEMPORARY)** Phase 4 • The correct term for our explosive storage facility is **magazine** rather than bunker. These are ATF approved containers for temporary storage of explosives and UXO that are awaiting destruction. • **UOM= EA**
			X	X		.14.9x	**OTHER (USE NUMBERS 90-99)**
X	X	X	X	X	X	.15	**DRUMS/TANKS/STRUCTURES/MISCELLANEOUS DEMOLITION AND REMOVAL**
X	X	X	X	X	X	.15.01	**DRUM REMOVAL** Phase 1 to 6 • Drum removal activities include locating buried or submerged drums, machine and hand excavation of buried drums, handling of drums, drum cleaning and decontamination, and all necessary drum crushing and shredding. Excludes removal of drum contents, **see .20.02 and .20.04.** • **UOM= EA**
			X			.15.02	**TANK REMOVAL** Phase 4 • Tank removal during remedial action includes locating buried or submerged tanks, machine and hand excavation of buried tanks, tank cleaning and decontamination, tank cutting/demolition and tank crushing. Excludes removal of drum contents, **see .20.02. and .20.04.** • **UOM= EA**
			X			.15.03	**STRUCTURE REMOVAL** Phase 4 • Structure removal is the decontamination, demolition, and removal of existing structures. Examples are buildings, pump stations, and out-fall structures. • **UOM= M^2**

			X			**.15.04**	**ASBESTOS ABATEMENT** Phase 4 • Asbestos abatement includes isolation of work area, asbestos removal or encapsulation, cleanup, disposal of wastes, and final inspections. Also included are HEPA filtration devices, vacuums, air monitoring equipment and amended water. • **UOM= M^2**
			X			**.15.05**	**PIPING AND PIPELINE REMOVAL** Phase 4 • Piping/pipeline removal during remedial action includes locating buried or above ground piping, machine and hand excavation of buried piping, cutting, demolition, and handling of pipe, and removal of concrete pipe pits. • **UOM= M**
			X			**.15.06**	**WELL ABANDONMENT** Phase 4 • Well abandonment includes properly sealing and abandoning wells to eliminate physical hazard of the well, to eliminate contaminant migration pathway, and to prevent hydraulic head changes and the mixing of water between aquifers. Boreholes must be clear of obstruction prior to abandonment, remove obstacles out of the well, and grout the well prior to pulling the casing. Sealants, used to provide a watertight barrier to contaminant migration consist of cement based grout, bentonite clay, or a combination of these substances. A grout pump and tremie pipe are preferred for delivering grout to bottom of well. • In some cases, re-drilling may be necessary to properly abandon the well.In some cases, redrilling may be necessary to properly abandon the well. • **UOM= EA**
X	**X**	**X**	**X**	**X**	**X**	**.15.9x**	**OTHER (Use Numbers 90-99)** Includes all remedial action demolition and removal of drums, tanks, and structures not described by the above listed subsystems.
			X	**X**		**.16**	**AIR POLLUTION/GAS COLLECTION AND CONTROL**
			X			**.16.01**	**GAS/VAPOR COLLECTION TRENCH SYSTEM** Phase 4 • Gas/Vapor collection trench systems constructed during remedial action consist of deep narrow trenches backfilled with gravel, to form a path of least resistance through which gases move upward to a collection apparatus. Assemblies include excavation, backfill, geotextile linings, well point dewatering and a ventilation system for the site. • **UOM= M** Phase 5 • Includes operations and maintenance activities such as replacement of consumable materials, replacement of parts, cleaning of components, making repairs, and other activities for proper and optimal operation of the gas/vapor collection trench system. • **UOM= M/YR**
				X			

			X			.16.02	**GAS/VAPOR COLLECTION WELL SYSTEM** Phase 4 • Gas/Vapor collection well permit the venting of underground gases to a collection well system in order to prevent migration or buildup. Collection and monitoring wells will include drilling rig setup, well drilling, handling of cuttings/water, casing, casing removal, gravel pack material, grout, wet well, well development/testing, well screen, capping, well house, well pump and instrumentation, well piping, valves and fittings and electrical. Also included are blowers and/or compressors, piping, metering, and control systems. This should not be confused with the soil vapor extraction process listed under "Soil Vapor Extraction" (26.34.). • **UOM= EA** Phase 5 • Include operations and maintenance activities such as replacement of consumable materials, replacement of parts, cleaning of components, making repairs, and other activities for proper and optimal operation of gas/vapor collection well system. • **UOM= EA/YR**
				X			
			X			.16.03	**GAS/VAPOR COLLECTION AT LAGOON COVER** Phase 4 • Provides for the labor, material and equipment used during remedial action to construct the subsystem for the venting of gases and vapors at lagoon covers to prevent migration or buildup. Assemblies include collection hose, tank, vacuum blower/compressor, valves, boxes, and manholes. • **UOM= M^2** Phase 5 • Include operations and maintenance activities such as replacement of consumable materials, replacement of parts, cleaning of components, making repairs, and other activities for proper and optimal operation of gas/vapor collection at lagoon system. • **UOM= M^2/YR**
				X			
			X			.16.04	**FUGITIVE DUST/VAPOR/GAS EMISSIONS CONTROL** Phase 4 • Fugitive dust/vapor/gas emissions control systems prevent the spread of airborne contaminants. Assemblies include sprayed chemical dust suppressants, wind fences/screens, synthetic covers over waste piles, and water spraying. • **UOM= M^2** Phase 5 • Include operations and maintenance activities such as replacement of consumable materials, replacement of parts, cleaning of components, making repairs, and other activities for proper and optimal operation of fugitive/vapor/gas emission control system. • **UOM= M^2/YR**
				X			
			X	X		.16.9x	**OTHER (Use Numbers 90-99)** Includes all remedial action air pollution and gas collection and control not described by the above listed subsystems.

			X	**X**		**.17**	**SURFACE WATER/SEDIMENTS CONTAINMENT, COLLECTION OR CONTROL**
			X			**.17.01**	**DREDGING/EXCAVATING** Phase 4 • Dredging during remedial action is the removal of sediment and sludge with overlying water. Dredging maybe used for the removal of sediments in contaminated settling basins, lagoons and retention ponds. Includes hydraulic, mechanical and pneumatic dredges using cutterheads, bucket dredges, wheel dredges and suction dredging. Excavation is the removal of soils, solids, or contaminated materials from ground. Dredging/excavation during remedial action is for purposes of first time construction or action. Maintenance and operation of the dredging or excavating equipment will be considered part of the dredging or excavating cost. This cost will be included in the price the contractor submitted. • **UOM= M^3** Phase 5 • Include dredging and excavating to maintain the system for ongoing operation. For example, this will include activities such as dredging or excavating sediments or deposits in a weir, plumes, or channel. • **UOM =M^3**
				X			
			X			**.17.02**	**BERMS** Phase 4 • Berm is an earthen structure used to control contaminated surface water by diverting its flow. Its primary purpose is the diversion of surface runoff that has entered a contaminated area and must be collected. Includes excavation and backfill, hauling, drainage facing materials, etc. • **UOM= M^3** Phase 5 • Includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities to ensure structural stability of the berm. • **UOM= M/YR**
				X			
			X			**.17.03**	**FLOODWALLS** Phase 4 • Floodwalls are structures used to protect land from flooding and inundation. Includes excavation and backfill, hauling, concrete or other structures, etc. • **UOM= M^2** Phase 5 • Includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities to ensure structural stability of the floodwall • **UOM= M^2/YR**
				X			

			X			.17.04	**LEVEES/DAMS/DIKE** Phase 4 Levees, dams and dikes are used to prevent a body of contaminated water from overflowing. Includes excavation and backfill, hauling, drainage facing materials, and other activities required to construct the structures. • **UOM= M^3** Phase 5 • Includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities to ensure structural stability of the levees/dams/dike. • **UOM= M^3/YR**
				X			
			X			.17.05	**TERRACES AND BENCHES** Phase 4 • Terraces and benches are used for the control of contaminated surface water runoff by intercepting the flow of water before it causes erosion. Includes site preparation, excavation and backfill, hauling, soil stabilization, geotechnical testing, drainage facing materials, and other activities required to construct the structures. • **UOM= M** Phase 5 • Includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities to ensure structural stability of the terraces and benches. • **UOM= M/YR**
				X			
			X			.17.06	**CHANNELS/WATERWAYS/DITCHES (SOIL/ROCK)** Phase 4 • Includes the construction of pathway for movement and directing water, liquids, or other contaminated fluids. Construction activities may include excavation, concrete, filling, formwork, ripraps. • **UOM= M^3** Phase 5 • Includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities to maintain the channels/waterways/ditches. • **UOM= M/YR**
				X			

			X			.17.07	**CHUTES OR FLUMES** Phase 4 • Chutes and flumes are natural or man-made channels that divert contaminated water away from a given area. Includes grading, earthwork, concrete, formwork, reinforcing steel, and rip-rap. • **UOM= M** Phase 5 • Includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities to maintain the chutes and flumes. • **UOM= M/YR**
				X			
			X			.17.08	**SEDIMENT BARRIERS** Phase 4 • Sediment barriers control the amount of sediments that are suspended and transported by the flow of contaminated surface water. Includes silt fencing, installation of straw bales, and excavation/grading of temporary sediment basins. • **UOM= M** Phase 5 • Includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities to maintain the sediments barriers. • **UOM= M/YR**
				X			
			X			.17.09	**STORM DRAINAGE** Phase 4 • Includes construction of piping, junction boxes, manholes, inlets, invert construction, grates, covers, headwalls, rip rap, excavation, and backfill. • **UOM= M** Phase 5 • Includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities to maintain the storm drains. • **UOM= M/YR**
				X			

			X			.17.10	**LAGOONS/BASINS/TANKS** Phase 4 • Construction of lagoons/basins/tanks/dikes for the storage of liquid wastes. Includes earth structures, liners, spillways, intake/outlet structures, underground tanks, aboveground tanks, concrete retention basins, and overtopping alarm systems. Also includes construction of pumping stations and controls, lift stations and controls, manholes, piping and fittings, hosing, and holding tanks. • **UOM= M^3** Phase 5 • Includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities to maintain the lagoons/basins/tanks. • **UOM= M^2/YR**
				X			
			X			.17.11	**PUMPING/DRAINING/COLLECTION** Phase 4 • Includes work associated with pumping or draining aboveground or underground tanks and basins. Also include inspection, replacement of materials, clearing of area, making repairs, and other activities to maintain the pumps, drains and collection system during the removal process. • **UOM= M^3** Phase 5 • Includes removal of liquid and sludge as part of operations and maintenance activities. Such activities will occur as there are leaks and infiltration into structures which will the removal of the waste. Also include inspection, replacement of materials, clearing of area, making repairs, and other activities to maintain the pumps, drains and collection system during the removal process. • **UOM= M^3**
				X			
			X			.17.12	**EROSION CONTROL** Phase 4 • Includes establishment of turf and installation of trees, shrubs, and ground covers. Also includes mowing of established turf. • **UOM= M^2** Phase 5 • Includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities ensure proper erosion control • **UOM= M^2/YR**
				X			
			X	X		.17.9x	**OTHER (Use Numbers 90-99)** Includes all remedial action surface water collection and control not described by the above listed subsystems.

			X	**X**		**.18**	**GROUNDWATER COLLECTION AND CONTROL**
			X			**.18.01**	**EXTRACTION WELLS** Phases 4 • Extraction wells are utilized for pump and treat operations. Extraction and injection wells include drilling rig setup, well drilling, well construction, handling of cuttings/water, casing, casing removal, gravel pack material, grout, wet well, well developing/testing, well screen, capping, well house, well pump and instrumentation, well piping, valves, fittings, electrical, and other components. • **UOM = EA** Phase 5 • Operation and maintenance during construction, and well abandonment. • **UOM =EA/YR**
				X			
			X			**.18.02**	**INJECTION WELLS** Phase 4 • Injection wells are for injecting liquid wastes deep underground between geologically impermeable layers, usually of clay or shale, to contain or remove the contaminant plume, to direct contaminants to the extraction wells, or to lower the water table to prevent it from intercepting buried HTRW. • **UOM= EA** Phase 5 • Includes maintenance activities such as inspection, replacement of components, clearing of area, making repairs, and other activities ensure proper functioning of injection wells. • **UOM= EA/YR**
				X			
			X			**.18.03**	**SUBSURFACE DRAINAGE/COLLECTION** Phase 4 • Drainage/collection includes items associated with the remedial action construction of a site subsurface gravity drainage and collection system. Assemblies include trench excavation and shoring, geotextile fabrics, liners, manholes, piping and fittings, hosing, and holding tanks. • **UOM= M** Phase 5 • Includes maintenance activities such as inspection, replacement of components, clearing of area, making repairs, and other activities ensure proper functioning of subsurface drainage and collection system. • **UOM= M/YR**
				X			

			X			.18.04	**SLURRY WALLS** Phase 4 • Slurry walls are narrow vertical trenches, typically 24-36 inches wide, excavated through pervious materials to a relatively impervious underlying strata and backfilled with a soil/bentonite or cement/bentonite slurry mixture. This provides a vertical barrier to reduce the horizontal permeability of soil. Slurry wall construction includes excavation, bentonite slurry makeup, and backfill/slurry displacement. The operation of batch plant equipment such as storage tanks, ponds, grout plants, circulation pumps and batch mixers are also included. • **UOM= M^2** Phase 5 • Includes maintenance activities such as inspection, replacement of materials, making repairs, and other activities to ensure stability of slurry wall. • **UOM= M^2/YR**
				X			
			X			18.05	**GROUT CURTAIN** Phase 4 • A grout curtain is an impenetrable barrier placed to prevent further contaminant migration by drilling into pervious rock formations at spaced intervals and injecting cement-based grouts under pressure. Grout curtain items include drilling rig, grout materials, on-site batch plants, grout pumps, and grout injection monitors. • **UOM= M^2** Phase 5 • Includes maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities ensure stability of grout curtain. • **UOM= M^2/YR**
				X			
			X			18.06	**SHEET PILING** Phase 4 • Sheet piling serves as an impervious barrier for contaminant migration once it is driven to an impervious underlaying strata. Includes all materials, labor and equipment to drive sheet piling and pull/salvage, if required. • **UOM= M^2** Phase 5 • Includes maintenance activities such as inspection, replacement of components, clearing of area, making repairs, and other activities ensure proper functioning of extraction wells. • **UOM=M^2/YR**
				X			
			X	X		.18.9x	**OTHER (Use Numbers 90-99)** Includes all remedial action groundwater collection and control not described by the above listed subsystems.

			X	**X**		**.19**	**SOLIDS COLLECTION AND CONTAINMENT**
			X			**19.01**	**CONTAMINATED SOIL COLLECTION** Phase 4 • Includes the removal of soil contaminated by HTRW waste. Collection equipment includes front end loader, backhoe, gradall, clamshell, dragline or other mechanical means. • **UOM= M^3** Phase 5 • Inspection of contaminated soil to ensure it meets the requirement of federal, state and local rules and regulation. • **UOM= M^3/YR**

			X			19.02	**WASTE CONTAINMENT, PORTABLE (FURNISH/FILL)** Phase 4 • Waste containment includes the procurement of and labor to fill containers during remedial action with solid HTRW wastes. Examples of containers are open top sludge containers, closed top sludge containers, roll-off containers, open head drums, spill containment vessels, spill containment pallets, storage tanks, drum liners, over packs and lab packs. • **UOM= M^3** Phase 5 • Includes maintenance activities such as inspection, clearing of area, and other activities ensure wastes are not exposed to environment and integrity of containers are maintained. • **UOM= M^3/YR**
				X			
			X			19.03	**SOIL/CLAY CAP** Phase 4 • A single or combination layer cap consisting of soil and/or clay. Provides a contact barrier between landfill or contaminated material and the above ground environment. Infiltration of moisture to landfill or contaminated material will depend on the depth and compaction of the cap. • **UOM= M^2** Phase 5 • Includes maintenance activities such as inspection, replacement of components, clearing of area, making repairs, and other activities to ensure integrity of cap is maintained. • **UOM= M^2/YR**
				X			
			X			19.04	**ASPHALT/CONCRETE CAP** Phase 4 • Cap constructed of asphalt or concrete. Provides a contact and infiltration barrier between landfill and the above ground environment. • **UOM =M^2** Phase 5 • Includes maintenance activities such as inspection, replacement of materials, repair of caps, clearing of area, and other activities to ensure integrity of cap. • **UOM= M^2/YR**
				X			

			X			**19.05**	**RCRA C CAP** Phase 4 • RCRA Subtitled C cap is for use in RCRA hazardous waste applications. These caps generally consist of an upper vegetative (topsoil) layer, a drainage layer, and a low permeability layer which consists of a synthetic liner over 2 feet of compacted clay. The compacted clay liners are effective if they retain a certain moisture content but are susceptible to cracking if the clay material is desiccated. As a result alternate cap designs are usually considered for arid environments. • **UOM= M^2** Phase 5 • Includes maintenance activities such as inspection, replacement of components, clearing of area, making repairs, and other activities to ensure the integrity of cap is maintained • **UOM= M^2/YR**
				X			
			X			**.19.07**	**ARID CLIMATE ENGINEERED CAP** Phase 4 • Engineered landfill cap design to provide a barrier between landfill or contaminated material and the aboveground environment in regions where there is low moisture. May be a single layer or multilayered cap. If it can be shown to the regulators that there is no groundwater contamination from the waste, design of the cap can be less stringent than required by RCRA regulations. • **UOM= M^2** Phase 5 • Includes maintenance activities such as inspection, replacement of components, clearing of area, making repairs, and other activities to ensure integrity of cap is maintained. • **UOM= M^2/YR**
				X			
			X			**.19.08**	**BOTTOM BARRIERS** Phase 4 • Single or a multilayer barrier to prevent infiltration of water into a contaminated area or a landfill. Barrier materials, placed beneath the contaminated material can consist of geomembranes, geotextiles, soil, clay, rocks. Critical components include barrier layers and drainage layers to collect the leachate in case of a barrier leakage. • **UOM= M^2** Phase 5 • Includes maintenance activities such as inspection, replacement of components, clearing of area, making repairs, and other activities to ensure integrity of barrier is maintained • **UOM= M^2/YR**
				X			
			X	X		**.19.9x**	**OTHER (Use Numbers 90-99)** Includes all remedial action solids collection and containment not described by the above listed subsystems.

			X	**X**		**.20**	**LIQUIDS WASTE/SLUDGES (e.g. UST/AST) COLLECTION AND CONTAINMENT**
			X			**.20.01**	**INDUSTRIAL VACUUMING** Phase 4 • Industrial vacuuming is the process of removing industrial wastes contained in tanks, containers, surface impoundment or process vessels by pumping or pneumatic conveyance. Includes the operations of the unit, repair, and replacement of components during the removal activity. • **UOM= M^3** Phase 5 • Includes removing industrial waste as part of operations and maintenance due to ongoing activities, leaks, or infiltration. Operations of the unit, repair, and replacement of components are also accounted for. • **UOM= LS/YR**
				X			
			X			**.20.02**	**RADIOACTIVE SPECIFIC WASTE CONTAINMENT (FURNISH/FILL)** Phase 4 • Radioactive specific waste includes the procurement of and labor to fill containers with low level and high level radioactive liquid waste. Examples of containers are Low Specific Activity (LSA) waste containers, LSA drum over packs, LSA laundry containers, strong-tight containers, Type A containers, Type B shipping containers, lead-shielded containers, reusable containers and special use containers. • **UOM= M^3** Phase 5 • Includes maintenance activities such as inspection, clearing of area, and other activities ensure wastes are not exposed to environment and integrity of containers are maintained • **UOM= LS/YR**
				X			
			X			**.20.03**	**PUMPING/DRAINING/COLLECTION** Phase 4 • Pumping/drainage/collection includes work associated with removing liquid wastes from drums, tanks, and basins. Inspection, replacement of materials, clearing of area, making repairs, and other activities to maintain the pumps, drains and collection system are also included here. • • **UOM= M^3** Phase 5 • Includes pumping/drainage/collection of liquid as part of operations and maintenance activities as needed when such activities occurs such as leaks and infiltration of liquid. Activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities to maintain the pumps, drains and collection system are also included. • **UOM= FTE**
				X			
			X	**X**		**.20.9x**	**OTHER (Use Numbers 90-99)** Includes all remedial action for liquids, sediments, and sludge collection and containment not described by the above listed subsystems.

			X	**X**		**.21**	**IN SITU BIOLOGICAL TREATMENT**
			X			**.21.01**	**BIOLOGICAL BARRIER** Phase 4 • Consist of sorbent material placed across the flowpath of the contaminated plume. The sorbent barrier consists of materials that retards the movement of organic and microbes that biodegrade the sorbed organic while prohibiting the movement of biologically degradable contaminants. The barrier volume provides localized control of in situ environment, such as nutrients, co-substrates, and/or electron donors or acceptors, to optimize biodegration. • **UOM= M^2** Phase 5 • Includes maintenance activities such as inspection, replacement of nutrients or chemical, clearing of area, and other activities to maintain the biological barrier system • **UOM= M^2/YR**
				X			
			X			**.21.02**	**BIOSLURPING** Phase 4 • A process for recovering free phase light non-aqueous phase liquids (LNAPL) and/or contaminated groundwater from near the vadose zone/water table interface via vacuum enhanced pumping; often accomplished with a variable length suction pipe (for extracting liquids) inside of a soil vapor extraction well. The screened interval of the soil vapor extraction well usually spans the vadose zone/water table interface. Soil vapor extraction and free product/groundwater extraction occur simultaneously; resulting in aeration of surrounding soil which enhances biodegredation compounds amenable to biodegredation under aerobic conditions. Equipment required for bioslurping includes wells, mainifold piping, suction piping (or drop tubes), vacuum pump(s) (often liquid-ring pumps), air/water separator(s), and oil/water separator(s). Extracted liquids and air may require treatment. Use "Injection Wells" (.18.01) and "Extraction Well" (.18.02.) for drilling and well development costs. • **UOM= M^3 (size of pumps, amount of free product recovery)**
				X			Phase 5 • Includes operations and maintenance activities such as inspection, replacement of materials or components, clearing of area, making repairs, and other activities to maintain the pumps, and collect the contaminants • **UOM= M^2/YR**

			X			.21.03	**BIOVENTING/BIOSPARGING** Phase 4 • A process for aerating subsurface soils, using injected air as the oxygen source, to stimulate in-situ biological activity and promote biodegredation of compounds amenable to biodegredation under aerobic conditions. In contrast to soil vapor extraction, bioventing is designed to maximize in-site biodegredation, rather then volatilization of amenable compounds. Thus, bioventing systems usually operate at much lower per well air flow rates than soil vapor extraction systems. Equipment required for bioventing includes wells, manifold piping, and blower(s). Use "Injection Wells" (.18.01) and "Extraction Well" (.18.02.) for drilling and well development costs. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, replacement of materials and parts, clearing of area, making repairs, and other activities to maintain the pumps and system. • **UOM= M^3/YR**
				X			
			X			.21.04	**COMETABOLIC BIOTREATMENT** Phase 4 • Co-metabolism is one form of secondary substrate transformation in which enzymes produced for primary substrate oxidation are capable of degrading the secondary substrate fortuitously, even though the secondary substrates do not afford sufficient energy to sustain the microbial population. An emerging application involves the injection of water containing dissolved primary substrate (e.g. methane, toluene) and oxygen into ground water to support the co-metabolic breakdown of targeted organic contaminants. • The addition of methane or methanol supports methanotrophic activity, which has been demonstrated effective to degrade chlorinated solvents, such as vinyl chloride and TCE, by co-metabolism. • Although toluene, propane and butane are used to stimulate a different class of microorganisms, not methanotrophs, they have been used successfully for supporting co-metabolism of TCE. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, replacement of components, clearing of area, making repairs, and other activities to maintain the system. • **UOM= M^3/YR**
					X		

			X			.21.05	**CONSTRUCTED WET LANDS** Phase 4 • Uses natural geochemical and biological processes inherent in an artificial wetland ecosystem to accumulate and remove metals, explosives, and other contaminants from influent waters. The process can be a filtration or degradation. • Although this technology incorporates principal components of wetland ecosystems, including organic soils, microbial fauna, algae, and vascular plants, microbial activity is responsible for most of the remediation. • **UOM= M^2** Phase 5 • Inspection and maintenance of site. • **UOM= M^2/YR**
				X			
			X			.21.06	**ENHANCED BIOREMEDIATION** Phase 4 • Bioremediation is a process in which indigenous or inoculated microorganisms (i.e., fungi, bacteria, and other microbes) degrade (metabolize) organic contaminants found in soil and/or ground water. Bioremediation attempts to accelerate the natural biodegradation process by providing nutrients, electron acceptors, and competent degrading microorganisms that may otherwise be limiting the rapid conversion of contamination organics to innocuous end products. • Enhanced bioremediation is accelerating the rate of bioremediation by increasing the concentrations of electron acceptors, nutrients, or limiting inorganic in groundwater, surface water, lechate, soil, and other media. Use "Injection Wells" (.18.01) and "Extraction Well" (.18.02.) for drilling and well development costs. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, replacement of chemicals, clearing of area, making repairs, and other activities to maintain the pumps to enhance bioremediaiton • **UOM= M^3/YR**
				X			
			X			.21.07	**LAND TREATMENT** Phase 4 • Land Treatment is a bioremediation technology in which contaminated soils, sediments, or sludge are turned over (i.e., tilled) to aerate, and allowed to interact with the soil and climate at the site. The waste, soil, climate, and biological activity interact dynamically as a system to degrade, transform, and immobilize waste constitutes. Tilling also allows for mixing of nutrients, waste, and microorganisms which enhances the biological activity. • **UOM= M^2** Phase 5 • Inspection and maintenance of the site. • **UOM= M^2/YR**
				X			

			X			.21.08	**NATURAL ATTENUATION** Phase 4 • Natural processes - such as dilution, dispersion, volatilization, biodegradation, adsorption, and chemical reactions with soil materials - are allowed to reduce contaminant concentrations to acceptable levels. • **UOM= M^2/YR**
			X			.21.09	**PHYTOREMEDIAITON** Phase 4 • Phytoremediation is a set of processes that uses plants to remove, transfer, stabilize and destroy organic/inorganic contamination in soil, sediments, ground water, surface water, and leachate. There are several ways plants can be used for the phytoremediation. These mechanisms include enhanced rhizosphere biodegradation, hydraulic control, phyto-degradation and phyto-volatilization. • **UOM= M^2** Phase 5 • Inspection and maintenance of site, provide moisture and food to plants • **UOM= M^2/YR**
				X			
			X	X		.21.9x	**OTHER (Use Numbers 90-99)** Includes all in situ biological treatments not described by the above listed subsystems
			X	X		.22	**EX-SITU BIOLOGICAL TREATMENT**
			X			.22.01	**ACTIVATED SLUDGE (SEQUENCING BATCH REACTORS)** Phase 4 • Activated sludge is a sludge that contains living organisms that are agitated and aerated to promote biological growth. Activated sludge treats wastewater containing biodegradable organic compounds. Note that not all activated sludge systems are sequencing batch reactors. Sequencing batch reactors are one of about a dozen variations of activated sludge treatment and do not necessarily have to be aerated. Activated sludge assemblies include reactors, aerators, aerobic bacteria (maintained in suspension), settling tanks, and a recycling line for the settled biomass. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, replacement of materials, clearing of area, making repairs, and other activities to maintain the reactor. • **UOM= M^3/YR**
				X			

			X			.2202	**BIOFILTER (Removal of Vapor Phase Organic)** Phase 4 • Biofilter removes vapor phase organic streams using a biomass or soil column where they are degraded by microorganisms in the soil. Specific strains of bacteria may be introduced into the filter and optimal conditions provided to preferentially degrade specific compounds. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, clearing of area, making repairs, and other activities to enhance microorganisms. • **UOM= M^3/YR**
				X			
			X			.22.03	**BIOPILES (BIOHEAPS, BIOMBOUND, COMPOSTING)** Phase 4 • It is a process for degrading and/or detoxifying contaminants by use of an ex-situ version of soil bioventing. Biopile treatment is a short term process where excavated soils are mixed with soil amendments and placed on a treatment area that includes leachate collection systems and some form of aeration. It is used to reduce concentrations of petroleum constituents in excavated soils through the use of biodegradation. Moisture, heat, nutrients, oxygen, and pH can be controlled to enhance biodegradation.It is a process for degrading and/or detoxifying contaminants by use of an ex-situ version of soil bioventing. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, replacement of materials or nutrients, clearing of area, and other activities to maintain the biopiles. • **UOM= M^3/YR**
				X			
			X			.22.04	**COMETABOLIC BIOTREATMENT** Phase 4 • Co-metabolism is one form of secondary substrate transformation in which enzymes produced for primary substrate oxidation are capable of degrading the secondary substrate fortuitously, even though the secondary substrates do not afford sufficient energy to sustain the microbial population. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, replacement of nutrients, clearing of area, and other activities to enhance microbiological activities. • **UOM= M^3/YR**
				X			

						22.05	**GENETICALLY ENGINEERID ORGANISM (WHITE ROT FUNGUS** Phase 4 • Refers to microorganisms that have undergone external processes by which its basic set of genes has been altered. The utilization of genetically engineered organisms involves the controlled use of these specially cultivated organisms to treat contaminants. • **UOM=M^3** Phase 5 • Includes operations and maintenance activities such as inspection, replacement of nutrients, clearing of area, and other activities to enhance microbiological activities • **UOM= M^3/YR**
			X			**.22.06**	**LAND FARMING/COMPOSTING** Phase 4 • Landfarming is where, contaminated soil, sediment, or sludge is excavated, placed into lined beds (or other methods to control leachates), and periodically turned over or tilled to aerate the waste. Tilling also enhance biodegradation by allowing the contaminated media to mix with nutrients. • Composting is a process that biologically degrades soil contaminants, sludge, or municipal solid organic wastes. The contaminated media is mixed with organic nutrients. A bulking agent, such as wood chip, and inorganic nutrients are also mixed in. The mixture is then placed in (compost) piles to promote heat generation and, thus, faster and more efficient biodegradation. Composting systems can be simple windrows mixed or turned periodically or have complete mechanical mixing and aerating systems. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, clearing of area, making repairs, and other activities to maintain the land farm. • **UOM= M^3/YR**
				X			
			X			**.22.07**	**ROTATING BIOLOGICAL CONTACTORS** Phase 4 • Rotating biological contactors consist of slowly rotating circular disks of polystyrene, polyvinyl chloride or other stable material which are partly exposed to the air and partly submerged in troughs containing wastewater. The disks are covered with microorganisms that degrade dissolved organic compounds as they rotate in and out of the wastewater. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, replacement of parts, clearing of area, making repairs, and other activities to maintain the RBC. • **UOM= M^3/YR**
				X			

			X			.22.08	**SLURRY BIODEGRADATION** Phase 4 • Slurry biodegradation is the use of microbial action to break down sludge or soils in a water suspension into simple, stable compounds. Slurry biodegradation activities include excavation, material segregation, scrubbing, aeration, bioreactor mixing, dewatering, and placement of additional nutrients. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, nutrient introduction, replacement of components, clearing of area, and other activities to maintain and enhance biodegradation. • **UOM= M^3/YR**
				X			
			X			.22.09	**TRICKLING FILTERS** Phase 4 • A trickling filtration system uses a rotary sprinkler to evenly distribute a waste liquid across a bed of filtration media into which microorganisms are attached. As the waste stream trickles through the filter media, the organic contaminants are biodegraded by the microorganisms. Trickling filters consist of a highly permeable bed of media, rotary sprinklers, porous underdrain systems, and settling tanks. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, cleaning or filters, clearing of area, making repairs, and other activities to maintain the filters. • **UOM= M^3/YR**
				X			
			X			.22.10	**BIOLOGICAL LAGOONS** Phase 4 • Biological lagoons use a lined earthen basin and sometimes aeration to promote the optimal growth of microorganisms for the effective remediation of contaminated liquids and sludge. This method of treatment relies on algae photosynthesis, adequate mixing, good inlet-outlet design and adequate air temperatures to operate efficiently. Facultative lagoons typically are used to treat low to medium strength organic wastes. Anaerobic lagoons and/or aerated lagoons are modified processes that treat wastes at higher rates. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, clearing of area, making repairs, and other activities to maintain the biological lagoons. • **UOM= M^3/YR**
				X			
			X	X		.22.9x	**OTHER (Use Numbers 90-99)** Includes all biological treatments during remedial action not described by the above listed subsystems.

			X	X		.23	**IN-SITU CHEMICAL TREATMENT**
			X			.23.01	**CHEMICAL BARRIER** • Barrier which will allow the passage of water while prohibiting the movement of contaminants by employing Such chemical agents as zero-valent metals, chelators (ligands selected for their specificity for a given metal), adsorbents, ion exchange resins, and others chemicals specific to the contaminants. Includes the cost of transport of equipment and components to site. • **UOM= M^2** Phase 5 • Includes operations and maintenance activities such as inspection, replacement of chemcials, clearing of area, making repairs, and other activities to maintain barrier • **UOM= M^2/YR**
				X			
			X			.23.02	**OXYGEN RELEASE COMPOUNDS** • Compounds such as hydrogen peroxide, or liquid or gaseous oxygen which may be passively introduced in wells, trenches, or pumped into the contaminated area to enhance biotreatment. Oxygen release compounds are primarily designed to treat VOCs, SVOCs, and fuels. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, regular placement of materials, and other activities. • **UOM= M^3/YR**
				X			
			X			.23.03	**NEUTRALIZATION** Phase 4 • Neutralization is the adjustment of a wastewater stream pH by the use of acids and caustics. Neutralization includes acids, caustics, chemical storage, mixing basins, pH probes and controls. • **UOM= M^3** Phase 5 • Inspect and maintain the site. • **UOM= M^3/YR**
				X			

			X X			.23.04	**OXIDATION/REDUCTION** Phase 4 • In-situ treatment of hydrocarbon, halocarbon, radionuclides, and/or metal ions that contaminate ground water and unsaturated zone. Application of oxidants such as ozone, hydrogen peroxide, or potassium permanganate directly to contaminant will render them to more benign chemicals such as carbon dioxide and water or will precipitate metal ions to a more unsoluble/immobile form. Oxidants can be combined with In-situ reduction such as use of zero valent iron. • **UOM= M^3** • Equipment can include air compressor, oxygen generator, ozone generator, mixing tank, injection wells, piping, Phase 5 • Includes operations and maintenance activities such as site inspection, prepare and feed chemicals, clearing of area, making repairs, and other activities to maintain the system. • **UOM= FTE**
			X X			.23.05	**SOIL FLUSHING** Phase 4 • In situ soil flushing is the extraction of contaminants from the soil with water or other suitable aqueous solutions. Soil flushing is accomplished by passing the extraction fluid through in-place soils using an injection or infiltration process. Extraction fluids must be recovered from the underlying aquifer and, when possible, they are recycled. Use "Injection Wells" (.18.01) and "Extraction Well" (.18.02.) for drilling and well costs. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, preparation of chemicals, clearing of area, making repairs to components, and other activities. • **UOM= M^3/YR**
			X	X		.23.9x	**OTHER (Use Numbers 90-99)** Includes all in-situ chemical treatments not described by the above listed subsystems.

			X	X		.24	**EX-SITU CHEMICAL TREATMENT**
			X			.24.01	**ALKALI METAL/POLYETHYLENE GLYCOL (A/PEG)** Phase 4 • APEG and potassium polyethylene glycol (KPEG) are batch processes which detoxify halogenated aromatic and other organic compounds such as PCBs or pentachlorophenols (PCPs) by heating them with polyethylene glycol (PEG) and sodium hydroxide (NaPEG) or potassium hydroxide (KPEG) for several hours at 300 degrees F. The APEG process decomposes PCBs and representative halogens in an exothermic and self-sustaining manner. A dechlorination reagent is formed by reacting alkali metals (such as sodium) with the polyethylene glycol in the presence of heat and oxygen. The reaction mechanism involves nucleophilic substitution/elimination and the oxidative degradation of chlorine through the generation of numerous free radicals. The process reactivity can be "tuned" or directed at various aliphatic or aromatic systems by varying the molecular weight of the polyethylene glycol. Typical by-products of the reaction are salts such as sodium chloride, hydrogen and hydroxylated organic derivatives. The primary advantage of the system is that the reagent is not based on a dispersed metallic sodium reaction, can tolerate low levels of water content and is stable in air. Therefore, the process maybe applicable to soils, dredgings, sediments and low moisture sludge. • **UOM =M^3**
				X			Phase 5 • Includes operations and maintenance activities such as inspection, preparation of chemicals, clearing of area, making repairs to components, and other activities **UOM= M^3/YR**
			X			.24.02	**BASED CATALYZED DECOMPOSITION PROCESS** Phase 4 • Base-catalyzed decomposition (BCD) process remediate soils and sediments contaminated with chlorinated organic compounds, especially PCBs, dioxins, and furans. Contaminated soil is screened, processed with a crusher and pug mill, and the soil is mixed with sodium bicarbonate and heated at about 350°C for one hour. 25%-75% of the halogenated aromatics are dehalogenated in this step. The rest are volatilized and passed on to the second reactor, a slurry or liquid phase reactor which utilizes a high boiling-point hydrocarbon oil, catalyst, sodium hydroxide and heat (350°C) to dehalogenate or decompose the contaminants. Contaminated oily liquids (such as pesticides and PCB transformer oil) are treated with the slurry/liquid phase reactor only. • **UOM= M^3**
				X			Phase 5 • Includes operations and maintenance activities such as facility inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**

			X			.24.03	**CHEMICAL HYDROLYSIS** Phase 4 • Hydrolysis is the chemical reaction of water with another substance in which hydrogen (H) and hydroxyl (OH) are added to the other substance usually forming two or more new compounds. Assemblies include feed systems, storage tanks, piping, and diaphragm metering pumps. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as facility inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= FTE**
				X			
			X			.24.04	**CHLORINATION** Phase 4 • Chlorination is the application of chlorine to drinking water, sewage or industrial wastes to disinfect or to oxidize undesirable compounds. Assemblies include feed systems, storage tanks, chemicals, piping, and diaphragm metering pumps. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as facility inspection, preparation of chemical feed, making repairs to components, and other routine functions. • **UOM= M^3/YR**
				X			
			X			.24.05	**DEHALOGENATION** Phase 4 • Dehalogenation is the chemical process in which halogenated (usually chlorinated) organic compounds in an aqueous or soil media are mixed and heated with basic reagent to remove the halogens (usually chlorine). Included in this subsystem are all dehalogenation processes that are not based on alkali metals or based catalyzed decomposition process. See "Alkali Metal Dehalogenation" (24.01) and Based Catalyzed Decomposition .24.02.) • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as facility inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			

			X			.24.06	**HYDROGEN REDUCTION** Phase 4 • Reduction of chemicals by using hydrogen as reducing agent. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as facility inspection, purchase and preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			.24.07	**ION EXCHANGE** Phase 4 • Ion exchange is the process by which inorganic compounds are removed by the capture of ions on a resinous material known as ion exchange resins. The resin is contained in a column and the wastewater is continuously passed through the column until the resin becomes exhausted, and is then regenerated. Ion exchange is not a destructive technology and the contaminated regenerant will eventually need disposal. Exchangers include cation exchangers, anion exchangers, and mixed-bed exchangers. Assemblies include ion exchange columns, chemical feed pumps, and storage tanks. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as facility inspection, preparation of chemicals, cleaning of resins, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			.24.08	**OXIDATION/REDUCTION (CATALYTIC OXIDATION, UV OZONE, PEROXIDE, SOLAR DETOXIFICATION, ETC.)** Phase 4 • Oxidation/reduction (redox) reactions are those in which an atom or group of atoms lose or gain electrons, hence oxidation/reduction is the transfer of electrons. In oxidation/reduction reactions the contaminants become more stable or more mobile. The addition of oxygen breaks down organic waste or chemicals such as cyanides, phenols and organic sulfur compounds. Peroxide and ozone are the oxidizing agents usually used in conjunction with UV. Reduction of heavy metals usually to less mobile forms of chemical. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as facility inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			

			X			.24.09	**OXYGEN RELEASE COMPOUNDS** Phase 4 • Compounds such as hydrogen peroxide, or liquid or gaseous oxygen which may be passively introduced in wells, trenches, or pumped into the contaminated area to enhance biotreatment. Oxygen release compounds are primarily designed to treat VOCs, SVOCs, and fuels. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as facility inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			.24.10	**OZONATION** Phase 4 • Ozone induced oxidation is a water or wastewater treatment process involving the use of ozone as an oxidizing agent. Ozone is produced with corona discharge technology, and must be produced on site due to the hazards of transporting and storing ozone. Ozone induced oxidation can be conducted in a batch or continuous process. Batch production uses a single reaction tank, while continuous operation uses two separate tanks, one being an overflow tank for excess ozone. Note that electricity (high amounts are used) should be included. Assemblies include post treatment to remove any residual ozone, and monitoring units. Oxidation rates can be increased by supplying ultraviolet (UV) radiation during treatment. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as facility inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			

			X		.24.11	**SOLVENT EXTRACTION** Phase 4 • Separation processes in which two immisible or partially soluble liquid phases are brought into contact for the transfer of one or more compounds are referred to as liquid-liquid extraction or, more loosely, as solvent extraction. The processes taking place are primarily physical, since the solutes being transferred are ordinarily recovered without chemical change. On the other hand, the physical equilibrium relationships on which such operations are based depend mainly on the chemical characteristics of the solutes and solvents. Thus, use of a solvent that chemically resembles one component of a mixture more than the other components will lead to concentration of that component in the solvent phase, with the exclusion from the phase of the dissimilar components. The contaminant is not altered by extraction but is transferred to a different phase. The most common systems include 1) mixer-settler, consisting of a mixing chamber and a settling chamber for phase dispersion and separation, 2) extraction columns, consisting of either packed extractors or sieve-tray extractors for mixing of the solute and solvent, and 3) centrifugal contactors, which rely on centrifugal force to mix the solute and solvent. Refer to "Soil Washing" (26.35) for ex-situ extraction of contaminants from soils or "Soil Flushing" (..25.12) for in-situ extraction of contaminants from soils. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as facility inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X		
			X		.24.12	**NEUTRALIZATION** Phase 4 • Neutralization is the adjustment of a wastewater stream pH by the use of acids and caustics. Neutralization includes acids, caustics, chemical storage, mixing basins, pH probes and controls. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as facility inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X		

			X			.24.13	**ULTRAVIOLET PHOTOLYSIS** Phase 4 • Ultraviolet photolysis is the process by which chemical bonds are broken under the influence of ultraviolet light. Products of photo-degradation vary according to the matrix in which the process occurs, but the complete conversion of an organic contaminant to CO_2, H_2O, etc., is not probable. Equipment includes UV lamps, process pumps and monitors. Note that this account does not include UV oxidation. See "Oxidation/Reduction (Catalytic Oxidation...)" (.24.09). • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as facility inspection, preparation of chemicals, replace parts, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X	X		.24.9x	**OTHER (Use Numbers 90-99)** Includes all chemical treatments not described by the above listed subsystems.
			X	X		.25	**IN-SITU PHYSICAL TREATMENT**
			X			.25.01	**CIRCULATING WELL/WELL AIR STRIPPING** Phase 4 • Circulating well (CW) provide a technique for subsurface groundwater by creating a three dimensional circulating pattern of groundwater. Groundwater is drawn into a well through one screened section and is pumped through the well to a second screened section where it is reintroduced to the aquifer. The upward and downward flow can be redirected depending on site specific conditions. Because groundwater is not pumped above the ground, cost of operations is reduced. In addition, simultaneous remediation of the vadose zone provided in the form of bioventing and vapor extraction from the circulating well. • CW system can provide treatment inside the well, in the aquifer, or a combination of both. For in well treatment, the contaminant must be adequately soluble, and mobile so it can be recirculated. In well treatment include air stripping, activated carbon adsorption, and biodegradation. In situ treatment is achieved by enhancing aerobic biodegradation. Use “Injection Wells” (.18.01) and “Extraction Well” (.18.02.) for drilling and well development costs. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, clearing of area, making repairs to components, and other activities • **UOM= M^3/YR**
				X			

			X			.25.02	**AIR SPARGING** Phase 4 • Air sparging is a ground water remediation technology which removes organic contaminants by injecting air into the aquifer and allowing the air to pass upward into the unsaturated soil. Contaminants are removed either through partitioning into the moving air or through biodegradation enhanced by the introduction of dissolved oxygen from the injected air. The injected air is almost always meant to be captured by an SVE system. Air sparging equipment consists of an air compressor (usually an oil-less compressor), piping, and injection wells. Associated equipment includes instrumentation and controls, and occasionally involves air filters and a heat exchanger. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			**25.03**	**CONDENSATION** Phase 4 • Used for removal of VOCs from a non-condensable gas stream. By varying the gas stream temperature and pressure, organic vapors condenses and separate from the non-condensable gas stream. The condensed organic are collected, and sometimes reused. Surface condensers are shell and tube heat exchangers where coolant flows inside the tube and the condensed VOC stream is collected outside the tube. Contact condensers operate by spraying a cool liquid directly into a gas stream to cool and condense the organic vapors. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, operation of equipment, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			**.25.04**	**CRYOGENICS (FROZEN SOIL BARRIER)** Phase 4 • The frozen soil barrier is a temporary in situ containment technology. A 4-6 foot-thick barrier is formed by circulating refrigerant through dual tube boreholes spaced around the area to be contained, which freezes the soil moisture and reduces permeability. This technology isolate or prohibit migration of the contaminants by freezing of the ground thus limiting contaminant movement in or out of the frozen area. • **UOM= M^2** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. **UOM= M^3/YR**
				X			

			X			.25.05	**FRACTURING (HYDRAULIC FRACTURING** Phase 4 • This technology uses high-pressure injection of a water/sand mixture to create open fractures in low-permeability soils. Injected sand keeps fractures open, enabling contaminant removal and reagent addition. This will increase contaminant removal rates by creating a more permeable pathway for fluid and vapor. • Applicable for removal of chlorinated organic and petroleum contamination from fine-textured soils, and hydraulic fracturing can be coupled with thermally enhanced soil vapor extraction. • **UOM= M** Phase 5 Includes operations and maintenance activities such as equipment inspection, preparation of materials, cleaning of area, making repairs to components, and other activities. • **UOM= FTE** •
				X			
			X			25.06	**LASAGNA PROCESS** Phase 4 • Lasagna is a combination of process which includes: electrokenetics to move the water and soluble contaminants in soil pores; chemical or biological treatment zones, where the contaminant can be decomposed or adsorbed;and drilling or fracturing process which allows for the development of the remediation zones. Lasagna remediates contaminated soils with very low permeability, where conventional pumping or excavation will not be cost effective. • **UOM= M^2** Phase 5 • Includes operations and maintenance activities such as preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			.25.07	**LASER (CUTTING)** Phase 4 • Use of laser to cut equipment, structures, and other items for removal and demolition purposes. Operation of the laser is included in this activity. • **UOM= M** Phase 5 • Use for cutting items during operations and maintenance. • **UOM= M**
				X			

			X	X		.25.10	**LASER (SURFACE DECONTAMINATION)** Phase 4 • Use of laser to move contaminated layer of paint or coating without having to decontaminate the whole item. Also include the operation of the laser during use. • **UOM= M^2** Phase 5 • Use of laser to move contaminated layer of paint or coating without having to decontaminate the whole item during facility operation and maintenance stage. Also include the operation of the laser during use. • **UOM= M^2**
			X	X		.25.11	**PASSIVE TREATMENT WALL/REACTIVE BARRIER** Phase 4 • Consists of a trench filled with reactive materials or electrochemical barrier, constructed, down gradient, in the path of a contaminated plume. As the trench intercept the plume, the contaminated water passively travels through the reactive media and degrade the contaminants. There are a variety of reactive media that can be used to treat the contaminants. • A common reactive barrier configuration is the funnel and gate that directs large volume of contaminated water through the reactive wall without the need for pumping. • **UOM= M^2** Phase 5 • Includes operations and maintenance activities such as treatment site inspection, preparation of chemicals or materials, cleaning of area, making repairs to barrier, and other activities. • **UOM= M^2/YR**
			X	X		.25.12	**SKIMMING** Phase 4 • Skimming is the removal of floating material at the top. Skimming can be use to separate oil from water, liquids of different densities, solids from liquids, etc. Skimming devices include rotating arms, vacuuming devices, scrapers, special absorptive cloths, and other processes. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, preparation of equipment, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**

			X			**.25.13**	**SOIL FLUSHING (SURFACTANT/SOLVENT)** Phase 4 • Soil flushing is an in-situ treatment of soils, sludge and sediments with water (with or without additives) to remove hazardous, toxic or radioactive contaminants. The wastewater is then recovered and treated. Assemblies include infiltration basins, water storage tanks with associated pumps, valves, and piping, groundwater recovery wells, and treatment for the recovered water. See "Soil Washing (Surfactant/solvent)" (33.xx) for ex-situ treatment. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			**.25.14**	**SOLIDS DEWATERING/DRYING** Phase 4 • Solids dewatering is the process of removal of water, moisture, liquids or fluids by open air drying, enhanced evaporation through venting or heating in place, placement of heavy loads on contaminated waste and collecting the leachate, installation of materials which enhances water movement in a direction, or other methods. Dewatering or drying also reduces volume and ease handling of the waste. May include drilling, piping, fans or air pumps, liquid pumps, electrodes for heating, vents for collecting off-gas, etc. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			

			X			**25.15**	**STEAM EXTRACTION** Phase 4 • In-situ steam extraction is the removal of hydrocarbons from contaminated soils by the continuous pumping of steam and heated compressed air and recovery of the subsequent contaminated water and off-gases which are cooled to condense water and organic. The resultant air-stream is then treated (by carbon adsorption, catalytic oxidation, etc.), compressed and returned to the soil being treated. The condensed water is removed from the liquid stream with a gravity separator followed by treatment to remove dissolved organic. The condensed organic are collected and held for recycling or disposal. Assemblies include drilling injection and extraction wells and vacuum pumps. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, preparation of materials, cleaning of equipment and area, making repairs to components, and other activities. • **UOM= FTE**
				X			
			X	X		**.25.9x**	**OTHER (USE NUMBERS 90-99)** Include other in-situ physical treatments not described by the above listed subsystems
			X	X		**.26**	**EX-SITU PHYSICAL TREATMENT**
			X			**26.01**	**ADVANCED ELECTRICAL REACTOR** Phase 4 • The advanced electrical reactor employs a thermal destruction process in which wastes are incinerated within a reactor core that is heated by electrically heated carbon electrodes (which are insulated by nitrogen gas). Included are reactor ownership/rental, feeders for solids and nozzles for liquids, and post reactor treatment. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replace equipments, cleaning of area, making repairs to components, and other activities. • **UOM= FTE**
				X			

			X			.26.01	**AERATION** Phase 4 • Aeration is the process of bringing about contact between air and water, soil, sludge, or other contaminated media for the purpose of promoting biological degradation or oxidation. Aeration can be accomplished by a variety of methods including tilling the land, air compressors, blowers, sprinkler systems, etc. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, preparation of feed materials, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			.26.02	**AGGLOMERATION** Phase 4 • Agglomeration is the transformation of sludge into dry, dense pellets. Agglomeration is accomplished by batchmixing sludge with an agglomeration agent. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			.26.03	**AIR STRIPPING** Phase 4 • Air stripping is the physical transfer of dissolved molecules from a liquid waste stream to a flowing gas. It is normally carried out as a continuous operation that employs a packed tower. For air stripping, liquid waste is pumped near the top of stripping column and flows downward through the tower, concurrent to an upward air flow. As the air flow contacts the liquid wastes, the volatile organic are stripped from the liquid waste. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			

			X			.26.04	**CHELATION** Phase 4 • Chelation is the process in which toxic metals are removed from the soil. Metals contained in the soil are contacted with an aqueous solution containing a chelating agent. The resulting slurry is dewatered and the chelating agent combined with the toxic metal is sent to a storage or treatment plant. Assemblies include conveyors, water storage tanks, dewatering devices, and associated piping and valves. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit or reactor inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			.26.05	**COAGULATION/FLOCCULATION/PRECIPITATION** Phase 4 • Coagulation is the increased clumping of particles in wastewater by biological or chemical means allowing for the separation of the particles from the water by sedimentation or filtration. It is often induced by chemicals such as lime, alum and iron salts. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			.26.06	**COMPACTION/VOLUME REDUCTION** Phase 4 • The use of physical force to reduce the volume of solids. Ease handling, transportation, storage, and disposal of the waste. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as compactor unit inspection, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			

			X			.26.07	**CONDENSATION** Phase 4 • Used for removal of VOCs from a noncondensable gas stream. By varying the gas stream temperature and pressure, organic vapors condenses and separate from the noncondensable gas stream. The condensed organic are collected, and sometimes reused. Surface condensers are shell and tube heat exchangers where coolant flows inside the tube and the condensed VOC stream is collected outside the tube. Contact condensers operate by spraying a cool liquid directly into a gas stream to cool and condense the organic vapors. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, operation of equipment, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			.26.08	**DECANT/PHASE SEPARATION** Phase 4 • Separation of liquid from the sediment that has settled at the bottom. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as compaction unit inspection, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			.26.09	**DISSOLVED AIR FLOATATION** Phase 4 • Dissolved air floatation (DAF) is commonly used as a pretreatment process for the separation of suspended solids, oil, and grease from wastewater without the use of chemicals. Gas bubbles are brought out of solution and into contact with contaminants in the waste stream. These gas bubbles attach to the contaminants and lift them to the surface. Assemblies include pressurization units, discharge heads, and tanks. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			

			X			.26.10	**DISTILLATION** Phase 4 • Distillation is the process of purifying liquids through boiling, so that the steam condenses to a pure liquid and the pollutants remain in a concentrated residue. It involves two basic phases, the liquid phase and the vapor phase. The components which are to be separated by distillation are present in both phases but in different concentrations. If there are only two components in the liquid, one concentrates in the condensed vapor (condensate) and the other in the residual liquid. If there are more than two components, the less volatile components concentrate in the residual liquid and the more volatile in the vapor condensate. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			.26.11	**E-BEAM** Phase 4 • Electron beam treatment technology is where organic contaminated waste water, soil, sediments, or sludge suspended in aqueous matrix is destructed. The high energy electron beam generate strongly reducing reactive species and strongly oxidizing reactive species at the same time and in almost same concentration in the solution. The reactive transient initiate the chemical reactions that is capable of destroying hazardous compounds in aqueous solution. In most cases, transforming into carbon dioxide, water, and salt. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, cleaning of area, making repairs to components, and other activities • **UOM= M^3/YR**
				X			
			X			.26.12	**ELECTROCHEMICAL OXIDATION** Phase 4 • The process is comprised of electrochemical cell in which the anode and cathodes are present and where electric current flows through the cell, causing chemical reaction in the electrolyte. Electrochemical reaction creates ions which is used for electrochemically oxidizing aqueous organic liquid, organic liquid, and some organic solids into carbon dioxide and water. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, preparation of chemicals, cleaning of area, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			

			X			.26.13	**ELECTROKINETICS** Phase 4 • The process removes metals and organic contaminants from low permeability soil, mud, sludge, and marine dredging. When direct current is passed through low permeable soil, it mobilizes charged species, causing ions and water to move toward the electrodes. Positively charged ions and compounds move toward the cathode. Negatively charged ions and compounds move toward the anode. The current creates an acid front at the anode and a base front at the cathode. This generation of acidic condition in situ may help to mobilize sorbed metal contaminants for transport to the collection system at the cathode • Two primary mechanisms transport contaminants through the soil towards one or the other electrodes: electromigration and electroosmosis. In electromigration, charged particles are transported through the substrate. In contrast, electroosmosis is the movement of a liquid containing ions relative to a stationary charged surface. Of the two, electromigration is the main mechanism for the electrokinetic remediation process. The direction and rate of movement of an ionic species will depend on its charge, both in magnitude and polarity, as well as the magnitude of the electroosmosis-induced flow velocity. Non-ionic species, both inorganic and organic, will also be transported along with the electroosmosis induced water flow. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, cleaning of electrodes, making repairs to components, and other activities **UOM= M^3/YR**
				X			
			X			.26.14	**ELECTROLYSIS** Phase 4 • Electrolysis is the process in which reduction and oxidation reactions take place at the surface of conductive electrodes immersed in an electrolyte, under the influence of an applied potential. Electrolysis oxidizes the substances at the anode and reduces the substances at the cathode. Assemblies include trough-shaped elongated cells, monitoring equipment, anode and cathode material. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, cleaning of electrolytes, making repairs to components, and other activities • **UOM= M^3/YR**
				X			

			X			**26.15**	**EQUALIZATION** Phase 4 • Equalization is the process in which collected wastewater is mixed to produce a homogenous solution and is discharged to a treatment plant. Blending is used to even out variations in contaminated soils and sludge, similar to equalization. Equalization is used to maintain stability and to reduce disruptions in a treatment system. Assemblies include mixers, aerators, discharging pumps and equalization tank. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, cleaning, making repairs to components, and other activities • **UOM= M^3/YR**
				X			
			X			**.26.16**	**EVAPORATION** Phase 4 • Evaporation treats organic material that can be removed by heat or to reduce the volume of liquid or high moisture content waste. Evaporation will also increase the concentration of contaminants in the waste media. This is usually conducted under vacuum conditions to reduce atmospheric pressure and thus promote evaporation or increasing surface area to further promote separation. Assemblies include simple stills, flash and circulation evaporators, rotors, and heating. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as inspection, cleaning, making repairs to components, and other activities • **UOM= M^3/YR**
				X			
			X			**.26.17**	**EX-SITU VAPOR EXTRACTION** Phase 4 • Vapor extraction, also known as soil vapor extraction (SVE), is a technology which removes volatile organic compounds from soil by pulling air through the soil. The air is moved by means of a blower or vacuum pump connected via piping to reactors or cells. Associated equipment includes condensate handling devices, instrumentation and controls, and, in most cases, off-gas treatment. The SVE process is distinct from vapor/gas venting and collection listed under Gas/Vapor Collection Trench System (.16.01). Activities associated with SVE may include surface covering (placement of geomembrances) and air sparging (.25.02). • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, cleaning of components, making repairs to components, and other activities • **UOM= M^3/YR**
				X			

			X			.26.18	**FILTER PRESSES** Phase 4 • Filter presses are used for sludge dewatering. Filter presses consist of a number of chamber filter plates which sludge is pumped between. Under high pressure, the plates are forced together which effectively dewater the sludge. The resulting sludge cake is then discharged from the press. Assemblies include filter press ownership/rental costs, operating costs, sludge transfer and feed pumps, chemical feed and storage equipment, sludge storage and conditioning tanks, mixers, belt filter, vacuum filter, drying beds, and necessary pipe work. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as filter press unit inspection, cleaning, making repairs to components, and other activities • **UOM= M^3/YR**
				X			
			X			.26.19	**FILTRATION** Phase 4 • Filtration is the physical process whereby micro particles suspended in a liquid or gaseous fluid are separated by forcing the fluid through a porous medium. As the fluid passes through the medium, the suspended particles are trapped on the surface of the medium and/or within the body of the medium. The pressure differential to move the fluid through the medium can be induced by gravity, positive pressure, or vacuum. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as filtration unit inspection, cleaning, making repairs to components, and other activities • **UOM= M^3/YR**
				X			
			X			.26.20	**FREEZE CRYSTALIZATION** Phase 4 • Freeze crystallization process removes purified solvent from solution as frozen crystals. When a solution containing dissolved contaminants is slowly frozen, water ice crystals form on the surface, and the contaminants are concentrated in the remaining solution (called "mother liquor"). The ice crystals can be separated from the mother liquor, washed and melted to yield a nearly pure water stream. The contaminated waste stream, mother liquor, and any precipitated solids, are generally more amenable to subsequent treatment by conventional destruction and stabilization technologies due to the higher concentrations. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as unit inspection, cleaning, making repairs to components, and other activities • **UOM= M^3/YR**
				X			

			X			**.26.21**	**GRANULAR ACTIVATED CARBON ADSORPTION - GASES/VAPOR** Phase 4 • Vessels containing activated carbon are used to remove organic contaminants from gaseous waste streams. Organic molecules are adsorbed into the carbon, which is either replaced or regenerated. Items associated with carbon adsorption are granular activated carbon columns, prefilters, and items associated with regenerating the spent carbon. Organic carbon analyzers are used for on-line control. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as carbon unit inspection, cleaning or regeneration of carbon, making repairs to components, and other activities • **UOM= M^3/YR**
				X			
			X			**.26.22**	**GRANULAR ACTIVATED CARBON ADSORPTION - LIQUIDS** Phase 4 • Carbon adsorption use activated carbon to remove organic contaminants from liquid waste streams. Granular activated carbon is applied in a stationary column or filter bed, where organic contaminants are adsorbed. Items associated with carbon adsorption are isotherm tests, granular activated carbon columns, prefilters, and items associated with regenerating the spent carbon. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as carbon unit inspection, cleaning or regeneration of carbon, making repairs to components, and other activities • **UOM= M^3/YR**
				X			
			X			**.26.23**	**HEAVY MEDIA SEPARATION** Phase 4 • Heavy media separation is the physical process used to separate materials of differing density by float/sink in a colloidal suspension of a finely ground dense mineral. This suspension, or media, usually consists of a water-suspension of magnetite, galena or ferrosilicon. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as separation unit inspection, cleaning, making repairs to components, and other activities • **UOM= M^3/YR**
				X			

			X			.26.24	**HIGH PRESSURE AQUEOUS DESTRUCTION** Phase 4 • Surface cleaning technology which use high pressure water to remove contaminants from soils, solids and structures. It may be used in conjunction with surfactants and solvents for cleaning and decontamination purposes. Ultrahigh pressure waterjet equipment can also be use as a cutting tool. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, cleaning of unit, making repairs to components, and other activities • **UOM= M^3/YR**
				X			
			X			.26.25	**LIGNIN ADSORPTION/SORPTIVE CLAYS** Phase 4 • Lignin adsorption/sorptive clays are used to treat aqueous waste streams with organic, inorganic and heavy metals contamination. The waste stream is treated due to the molecular adhesion of the contaminants to an adsorptive surface. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, preparation of chemicals, making repairs to components, and other activities • **UOM= M^3/YR**
				X			
			X			.26.26	**MAGNETIC SEPARATION** Phase 4 • Magnetic separation is used to extract slightly magnetic radioactive particles from host materials such as water, soil, or air. All uranium and plutonium compounds are slightly magnetic while most host materials are nonmagnetic. The process operates by passing contaminated fluid or slurry through a magnetized volume. The magnetized volume contains a magnetic matrix material such as steel wool or spherical steel balls that extracts the slightly magnetic contamination particles from the slurry. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, cleaning of components, making repairs to components, and other activities • **UOM= M^3/YR**
				X			

			X			.26.27	**MEMBRANE SEPARATION - REVERSE OSMOSIS** Phase 4 • Membrane separation removes dissolved salts, soluble silica, colloids and organic molecules from waste streams. Wastewater is collected and sent through a reverse osmosis system under pressure. The reverse osmosis systems filters, then concentrates waste materials while water easily passes through. Equipment includes reverse osmosis membranes, containment modules, chemical feed (usually acid), high pressure pumps, and treatment and disposal of the concentrate. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, preparation of chemicals, replacement of components, making repairs to equipment, and other activities • **UOM= M^3/YR**
				X			
			X			.26.28	**MEMBRANE SEPARATION - ELECTRODIALYSIS** Phase 4 • Electrodialysis is the process in which an electrically charged membrane is introduced into a waste stream where the voltage drives the charged ions towards the membrane. Electrodialysis removes dissolved salts, soluble silica and organic materials from waste streams and concentrates the dissolved heavy metals. Assemblies include water storage tanks, associated pumps, piping, and valves, and backwashing of contaminated membranes. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities • **UOM= M^3/YR**
				X			
			X			.26.29	**OIL/WATER SEPARATION** Phase 4 • Oil/water separation is the process of separating oil and water due to density differences and gravitational pull. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities • **UOM= M^3/YR**
				X			
			X			.26.30	**SEDIMENTATION** Phase 4 • Sedimentation is the physical process by which particles suspended in a liquid are made to settle by means of gravitational and inertial forces acting on both the particles suspended in the liquid and the liquid itself. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities • **UOM= FTE**
				X			

			X			.26.31	**SHREDDING** Phase 4 • Shredding is used to break up large solid wastes and process drums and their contents. Necessary equipment includes conveyors and rotary shear shredders. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities • **UOM= M^3/YR**
				X			
			X			.26.32	**SIEVING** Phase 4 • To separate smaller materials from larger materials by using a sieve. Smaller items will pass through the sieve and larger items will be retained on the sieve. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities • **UOM= M^3/YR**
				X			
			X			.26.33	**SKIMMING** Phase 4 • Skimming is the removal of floating material at the top of contaminated media. Skimming can be used to separate oil from water, liquid of different densities, solids for liquids, etc. Skimming devices include rotating arms, vacuuming devices, scrappers, belt skimmers or rope wicks which made of oleophilic or hydrophobic material, floating filter mesh with high affinity for non-polar hydrocarbons, and other devices. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities • **UOM= M^3/YR**
				X			

			X			.26.34	**SOIL WASHING (SURFACTANT/SOLVENT)** Phase 4 • Soil washing is an ex-situ separation technology which uses a fluid (usually water or water with wash improving additives) to remove hazardous, toxic, or radioactive contaminants from excavated soils, sludge and sediments. The soil is rinsed to remove any excess surfactants, while the liquids are treated as contaminated liquids. Assemblies include conveyors, screens, tanks, dewatering devices, associated piping and valves, and liquid waste treatment units. Refer to "Dehalogenation (Catalytic Dechlorination)" (.24.05.), "Alkali Metal Dechlorination" (.24.01.), "Solvent Extraction" (.24.11.) (which uses an organic chemical to dissolve, separate and concentrate organic contaminants) and "Soil Flushing (Surfactant/Solvent)" (.23.05.) for in-situ treatment. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, chemical preparation, replacement of components, making repairs to equipment, and other activities • **UOM= M^3/YR**
				X			
			X			.26.35	**SOLIDS DEWATERING/DRYING** Phase 4 • Solids dewatering is the process of the removal of water, moisture, liquids or fluid by filtration, centrifugation, open air drying, or other mechanical or evaporative methods. Dewatering or drying also reduces volume and ease handling of the waste. Dewatering sludge disposal by burning or landfilling and Does not include dewatering through the use of a filter press, see "Filter Presses" (.26.18.). • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities • **UOM= FTE**
				X			
			X			.26.36	**SPRINKLER IRRIGATION** Phase 4 • Sprinkler irrigation is a relatively simple treatment technology used to volatilize VOCs from contaminated wastewater. The process involves the pressurized distribution of VOC-laden water through a standard sprinkler irrigation system. Sprinkler irrigation transfers VOCs from the dissolved aqueous phase to the vapor phase, whereby the VOCs are released directly to the atmosphere. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities • **UOM= M^3/YR**
				X			

			X			.26.37	**SUPERCRITICAL EXTRACTION** Phase 4 • Supercritical extraction is the process in which the organic constituents of a waste stream are dissolved after mixing with a gas (such as carbon dioxide, propane, or butane) pressurized to the supercritical state. The enhanced solubilities of the fluid, due to the high pressures and temperatures, aid in the removal of the wastes. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities • **UOM= M^3/YR**
				X			
			X			.26.38	**SURFACTANT ENHANCED RECOVERY** Phase 4 • The application of surfactant micelles or steam to the ground water can facilitate the ground water pumping process by increasing the mobility and solubility of the contaminants sorbed to the soil matrix. This material can also facilitate the entrainment of hydrophobic contaminants to allow removal and assures that multi-phase contaminants can be effectively removed. Thus it can increase the contaminant mass removal per pore volume of ground water flushing through the contaminated zone. • The implementation of surfactant-enhanced recovery requires the injection of surfactants into a contaminated aquifer. Typical systems utilize a pump to extract ground water at some distance away from the injection point. The extracted ground water is treated ex situ to separate the injected surfactants from the contaminants and ground water. In order to be cost-effective, the design of the surfactant-enhanced recovery system is critical. Once the surfactants have separated from the ground water they can be re-injected into the subsurface. Contaminants must be separated from the ground water and treated prior to discharge of the extracted ground water. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, chemical preparation, replacement of components, making repairs to equipment, and other activities • **UOM= M^3/YR**
				X			
			X			.26.39	**SYNTHETIC RESIN ADSORPTION** Phase 4 • A process by which contaminants are adsorbed and captured onto a resin in a liquid or gaseous stream. Synthetic resins are more durable than natural adsorbents, and also provide large surface area and higher adsorption capacity for organic molecules. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, resin regeneration, replacement of components, making repairs to equipment, and other activities
				X			

							• **UOM= M^3/YR**
			X	**X**		**.26.9x**	**OTHER (Use Numbers 90-99)** Includes all physical treatments during remedial action not described by the above listed subsystems.
			X	**X**		**.27**	**IN-SITU THERMAL TREATMENT**
			X	**X**		**.27.01**	**THERMAL BLANKET** Phase 4 • Thermal blanket vaporizes contaminants by heating soils to the boiling point of the contaminant. Contaminated vapors are then drawn out of the soil by a vacuum unit and treated in an off-gas unit. • Thermal blanket consists of a steel box with a layer of steel webbing located at the bottom of the box. Heating elements are woven through the webbing where heat is transferred to the soil below the blanket. After the placement of the blanket above the contaminated soil, a layer of vermiculite insulation is placed 12" to 18" above the blanket. This also ensure complete sealing between the blanket and the contaminated soil. Thermal blankets are effective on contaminants located to a depth of approximately three feet • **UOM=M^2** Phase 5 • Includes the operations and maintenance of the treatment unit. Activities include monitoring of equipment and processes, replacement of consumable materials, replacement of parts, and other tasks. • **UOM= M^2/YR**
			X	**X**		**.27.02**	**SIX PHASE EXTRACTION** Phase 4 • This technology combines six phase soil heating with soil vapor extraction. Six phase electrical heating splits conventional three phase electricity into six separate electrical phases, producing an improved subsurface heat distribution. Heating raises the vapor pressure of volatile and semi-volatile contaminants, increasing the removal capabilities form the soil vapor extraction system. Heating also dries the soil and creates steam which increases the permeability and strips contaminants that may not be removed by conventional soil vapor extraction system. • **UOM= M^3** Phase 5 • Includes the operations and maintenance of the treatment unit. Activities include monitoring of equipment and processes, replacement of consumable materials, replacement of parts, and other tasks. • **UOM= M^3/YR**
			X			**.27.03**	**IN SITU HEATING- VACUUM EXTRACTION** Phase 4 • Heating of contaminated area, usually in saturated areas, using electrodes, microwave, or other mechanisms. As the contaminated area is heated, VOCs are volatilized and vacuum is applied to collect and treat the VOC. • **UOM= M^3**
				X			Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities • **UOM= M^3/YR**

			X			.27.04	**STEAM/HOT WATER INJECTION VACUUM EXTRACTION** Phase 4 • In-situ steam extraction is the removal of hydrocarbons from contaminated soils by the continuous pumping of steam and heated compressed air and recovery of the subsequent contaminated water and off-gas which are cooled to condense water and organic. The resultant air-stream is then treated (by carbon adsorption, catalytic oxidation, etc.), compressed and returned to the soil being treated. The condensed water is removed from the liquid stream with a gravity separator followed by treatment to remove dissolved organic. The condensed organic are collected and held for recycling or disposal. Assemblies include drilling injection and extraction wells and vacuum pumps. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			
			X			.27.05	**HIGH TEMPERATURE THERMAL DESORPTION** Phase 4 • High temperature thermal desorption heats (directly or indirectly) contaminated media such as soil, sediments, sludge and filter cakes between 600 – 1000°F, driving off water and volatile contaminants. The volatile contaminants may be burned in an afterburner, condensed to reduce the volume to be disposed of, oxidized through catalytic oxidation or captured by carbon adsorption beds. Auxiliary equipment includes shredders, conveyors, blowers, fuel system, instrumentation and controls, bag houses, scrubbers, and treated material handling systems. At high temperatures, decontaminated soil may not retains its physical properties and components in the soil not damaged, which usually does not enables treated soil to retain the ability to support future biological activity. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			
			X			.27.06	**IN SITU VITRIFICATION** Phase 4 • In-situ vitrification is the in-place encapsulation of contaminated soils and sludge into a solid glassy matrix by melting the soil using large amounts of electrical current. Assemblies include electrical generators, electrical power distribution, electrodes, graphite placed over the soil to establish a conductive path and exhaust hood system to capture gaseous wastes. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy • **UOM= M^3/YR**
				X			

			X			.27.07	**LOW TEMPERATURE THERMAL DESORPTION** Phase 4 • Low temperature thermal desorption (also called Low Temperature Volatilization) heats (directly or indirectly) contaminated media such as soil, sediments, sludge and filter cakes between 200 – 600°C, driving off water and volatile contaminants. The volatile contaminants may be burned in an afterburner, condensed to reduce the volume to be disposed of, oxidized through catalytic oxidation or captured by carbon adsorption beds. Auxiliary equipment includes shredders, conveyors, blowers, fuel system, instrumentation and controls, bag houses, scrubbers, and treated material handling systems. At low temperatures, Decontaminated soil retains its physical properties and components in the soil are not damaged, which enables treated soil to retain the ability to support future biological activity. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			
			X	X		.27.9x	**OTHER**
			X	X		.28	**EX-SITU THERMAL TREATMENT**
			X			.28.01	**HIGH TEMPERATURE THERMAL DESORPTION** Phase 4 • High temperature thermal desorption unit at temperatures greater than 340°C (650°F) is suitable for treatment of material contaminated by organic compounds that are classified as semi-volatile. Oxygen levels may be limited or reduced to prevent combustion in the primary chamber. • **UOM=M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			
			X			.28.02	**INCINERATION** Phase 4 • Includes fluidized bed, rotary kiln, multiple hearth, infrared, circulating bed, liquid injection, pyrolysis, plasma torch, wet air oxidation, batch, etc. Incineration is the thermal destruction of wastes through burning in combustion chambers and energy recovery devices. Incineration is accomplished by oxidative or pyrolytic methods. Auxiliary equipment includes shredders, conveyors, blowers, fuel system, instrumentation and controls, bag houses, scrubbers, and treated material handling systems. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			
						.28.03	**LOW TEMPERATURE THERMAL DESORPTION**

			X				Phase 4 • Includes fluidized bed, rotary kiln, multiple hearth, infrared, circulating bed, liquid injection, pyrolysis, plasma torch, wet air oxidation, batch, etc. Low temperature thermal desorption (also called Low Temperature Volatilization) heats (directly or indirectly) contaminated media such as soil, sediments, sludge and filter cakes between 200 – 1000°F, driving off water and volatile contaminants. The volatile contaminants may be burned in an afterburner, condensed to reduce the volume to be disposed of, oxidized through catalytic oxidation or captured by carbon adsorption beds. Auxiliary equipment includes shredders, conveyors, blowers, fuel system, instrumentation and controls, bag houses, scrubbers, and treated material handling systems. • **UOM= M^3** Phase 5
				X			• Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
			X			**.28.04**	**MOLTEN SALT DESTRUCTION** Phase 4 • Molten salt destruction is the combustion of waste materials in a bed of molten salt. Wastes are fed into a vessel containing the molten salt and air in which the high rate of heat transfer to the wastes causes destruction. Melt removal can be continuous or in batch mode. A variety of salts are used, with the most common being sodium carbonate and potassium carbonate. Assemblies for molten salt destruction include salts, incinerators, storage systems, filtration systems, dewatering pretreatment systems, plus a secondary reactor and cleanup system for off-gases. • **UOM= M^3** Phase 5
				X			• Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
			X			**.28.05**	**OPEN BURN AND OPEN DETONATION** Phase 4 • Open burn (OB) and open detonation (OD) operations are conducted to destroy excess, obsolete, or unserviceable (EOU) munitions and energetic materials. In OB operations, energetics or munitions are destroyed by self-sustained combustion, which is ignited by an external source, such as flame, heat, or a detonation wave. In this case, an auxiliary fuel may be added to initiate and sustain the combustion of materials. In OD operations, detonatable explosives and munitions are destroyed by a detonation, which is generally initiated by the detonation of an energetic charge. • **UOM= M^3** Phase 5
				X			• Includes operations and maintenance activities such as site inspection and cost of energy. • **UOM= M^3/YR**

			X			.28.06	**PLASMA** Phase 4 • Incineration or vitrification process which use plasma or an electrically neutral, highly ionized gas composed of ions, electrons, and neutral particles to generate the heat. Plasma torch, that uses electricity creates and maintains enough heat (in excess of 5000°C) to vaporize and destroy organic materials and inorganic materials are retained in a molten bath. Plasma processes usually cannot treat solids. Off-gas system removes particulates, organic vapors, and volatilize metals. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			
			X			.28.07	**PYROLISYS** Phase 4 • Pyrolysis transforms hazardous organic materials into gaseous components, small quantities of liquid, and a solid residue (coke) containing fixed carbon and ash. Pyrolysis is formally defined as chemical decomposition induced in organic materials by heat in the absence of oxygen. In practice, it is not possible to achieve a completely oxygen-free atmosphere; actual pyrolytic systems are operated with less than stochiometric quantities of oxygen. Because some oxygen will be present in any pyrolytic system, nominal oxidation will occur. If volatile or semi-volatile materials are present in the waste, thermal desorption will also occur. • Pyrolysis typically occurs under pressure and at operating temperatures above 430 °C (800 °F). Pyrolysis of organic materials produces combustible gases, including carbon monoxide, hydrogen and methane, and other hydrocarbons. The pyrolysis gases require further treatment. The off-gases may be treated in a secondary combustion chamber, flared, and partially condensed. Particulate removal equipment such as fabric filters or wet scrubbers are also required. Pyrolysis minimizes the production of flue gases as compared to oxidation. • Conventional thermal treatment methods, such as rotary kiln, rotary hearth furnace, or fluidized bed furnace, are used for waste pyrolysis. Kilns or furnaces used for pyrolysis would be physically similar to incinerator equipment but would operate at lower temperature and with less air supply than would be required for combustion. Molten salt process may also be used for waste pyrolysis. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			

			X			.28.08	**RADIO FREQUENCY HEATING** Phase 4 • Radio frequency heating includes heating soil with radio frequency waves to thermally decompose, vaporize, and distill hazardous constituents. Vapors emitted from the soil are collected in a vapor barrier above the soil surface for treatment or incineration. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			
			X			.28.09	**RETORT/AMALGAMATION** Phase 4 • Generally used for the removal and recovery of mercury. The contaminated media is heated to volatilize the contaminants. Then the contaminant is captured or recovered by reacting with another metal such as on gold plated surface or chemicals which can stabilize or convert to highly insoluble form. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			
			X			.28.10	**SOLAR DETOXIFICATION** Phase 4 • Solar detoxification photolytically degrades vaporized soil contaminants in a solar reactor into which sunlight is focused from a parabolic mirror array. The vaporized contaminants flow into the reactor after being desorbed from the soil when the latter is heated to about 750°F. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. • **UOM= M^3/YR**
				X			

			X			.28.11	**STEAM STRIPPING** Phase 4 • Steam stripping is the physical transfer of dissolved molecules from a liquid waste stream to a vapor stream. It is normally carried out as a continuous operation that employs a conventional fractional distillation column. For steam stripping, preheated wastewater is pumped near the top of the distillation column and flows downward, concurrent to an upward flow of steam rising from the column bottom. As the steam contacts the liquid wastes, the volatile organic are stripped from the liquid waste and carried to a condenser in a water-cooled heat exchanger and collected in an accumulator tank. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			
			X			.28.12	**SUPERCRITICAL WATER OXIDATION** Phase 4 • It is the oxidation of organic at various concentrations, with air, oxygen or other oxidants, in the presence of high concentration of water under temperatures and pressures above the critical point value for water. The critical point is where vapor-liquid occurs. Oxidation is usually conducted at 400 to 650 under $253x10^5$ Pa. Above the critical temperature and pressure, the properties of water are quite different from those of normal liquid or atmospheric steam. Under these conditions chemicals such as organic substances are completely soluble in water under some supercritical conditions and salts are almost insoluble under other supercritical conditions. • Reactor (which can withstand the temperature and pressure and corrosive nature of the system), heat exchanger, and air compressor are key components. • This process is also referred to as Supercritical Wet Oxidation and Supercritical Wet-Air Oxidation • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			
			X			.28.13	**THERMALLY ENHANCED VAPOR EXTRACTION** Phase 4 • Steam/hot air injection or electrical resistance/electromagnetic/fiber optic/radio frequency heating is used to increase the volatilization rate of semi-volatile and facilitate extraction. The process is similar to Soil Vapor Extraction, but requires heat resistant extraction wells. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			
			X	X		.28.9x	**OTHER (Use Numbers 90-99)**

							Includes all thermal treatment during remedial action not described by the above listed subsystems.
			X	**X**		**.29**	**IN-SITU STABILIZATION/FIXATION/ENCAPSULATION**
			X			**.29.01**	**ASPHALT-BASED ENCAPSULATION** Phase 4 • Asphalt-based encapsulation uses asphalt to form a matrix encapsulating contaminated liquid or solid wastes. The process entails mixing waste and asphalt together and heating until they fused together in a stable matrix. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as process inspection, preparation of chemicals, making repairs to components, and other activities. • **UOM= M^2/YR**
				X			
			X			**.29.02**	**GROUT INJECTION** Phase 4 • Injection of grout in the contaminated soil directly to prevent migration of the contaminants. Grouting will fill pores or seal voids that will allow for infiltration of fluid and reduce pathway for contaminant transport. Grouting will also encapsulate the contaminated soil. In most applications, cement is used for grouting applications. Assemblies include pumps for liquids or slurries, storage silos, weigh feeders, piping, mixers and disposal or storage. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as process inspection, preparation of chemicals, making repairs to components, and other activities. • **UOM= M^2/YR**
				X			
			X			**.29.03**	**IN-SITU POZZOLAN PROCESS (LIME/PORTLAND CEMENT)** Phase 4 • In-situ Pozzolan Process is the in-place encapsulation of waste material by combining pozzolanic (siliceous) material, lime, or portland cement with water to form a concrete-like solid and left in place, encapsulating the waste. Pozzolanic material includes fly ash, blast-furnace slag and cement kiln dust. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as process inspection, preparation of chemicals, making repairs to components, and other activities. • **UOM= M^2/YR**
				X			

			X			**.29.04**	**IN-SITU VITRIFICATION** Phase 4 • In-situ vitrification is the in-place encapsulation of contaminated soils and sludge into a solid glassy matrix by melting the soil using large amounts of electrical current. Most organics will be destroyed by the heat and the inorganics will be captured in the glass. Assemblies include electrical generators, electrical power distribution, electrodes, graphite placed over the soil to establish a conductive path and exhaust hood system to capture gaseous wastes. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as process inspection, preparation of additives, making repairs to components, and other activities. • **UOM= M^2/YR**
				X			
			X	**X**		**.29.9x**	**OTHERS**

			X	**X**		**.30**	**EX-SITU STABILIZATION/FIXATION/ENCAPSULATION**
			X			**.30.01**	**ASPHALT-BASED ENCAPSULATION** Phase 4 • Asphalt-based encapsulation uses asphalt to form a matrix encapsulating contaminated liquid or solid wastes. The process entails mixing waste and asphalt together, placement in a mold, and heating until they fused together in a stable matrix. Asphalt-based encapsulation includes dewatering, organic polymers, lime, kiln dust, or portland cement. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as process inspection, preparation of chemicals, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			**.30.02**	**CALCINATION** Phase 4 • Solidification technology which liquid waste is placed in a calcinator cell heated to 500°C by combustion of oxygen and kerosene. During calcination, the water in the waste is vaporized and the chemicals in the waste are transformed to calcine particles. The off-gas from the calcinator is passed through a combination of dry and wet cleanup system prior to atmospheric release. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as process inspection, preparation of additives, making repairs to components, and other activities. Cost of energy • **UOM= M^3/YR**
				X			
			X			**.30.03**	**ORGANIC BASED ENCAPSULATION** Phase 4 • Organic systems include incorporation of waste residues into hot, liquid bitumen or gross encapsulation in polyethylene jackets (thermalplastics). Organic systems also consist of monomers or prepolymers that are polymerized or crosslinked by the use of catalysts or accelerators after being mixed with liquid wastes (polymerization systems). • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as process inspection, preparation of additives, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			

			X			.30.04	**POZZOLAN PROCESS (LIME/PORTLAND CEMENT)** Phase 4 • Pozzolanic (siliceous) material, lime, or portland cement, and water are mixed to form a concrete-like solid matrix in which the waste is encapsulated. Batchmixers or pugmills are routinely used for the mixing of waste material, pozzolanic material and water. Pozzolanic material includes fly ash, ground blast-furnace slag, and cement kiln dust. Does not include the excavation and transport of contaminated material, see "Solids Collection and Containment" (.19.XX) and "Liquids/Sediments/Sludges Collection and Containment" (.20.XX.). • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as process inspection, preparation of additives, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			
			X			.30.05	**RETORT/AMALGAMATION** Phase 4 • Generally used for the removal and recovery of mercury. The contaminated media is heated to volatilize the contaminants. Then the contaminant is captured or recovered by reacting with another metal such as on gold plated surface or chemicals which can stabilize or convert to highly insoluble form. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as treatment unit inspection, replacement of components, making repairs to equipment, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			
			X			.30.06	**SLUDGE STABILIZATION (AGGREGATE/ROCK/SLAG)** Phase 4 • Sludge stabilization is the solidification of contaminated wastes using aggregate, rock and slag additives to form a uniform and stable matrix to encapsulate waste materials. Sludge stabilization includes pumps for liquids or slurries, conveyors for sludge or solids, storage silos, weigh feeders, piping, mixers and disposal or storage. • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as process inspection, preparation of additives, making repairs to components, and other activities. • **UOM= M^3/YR**
				X			

			X			**.30.07**	**VITRIFICATION** Phase 4 • Vitrification is used in destroying combustible hazardous organic and inorganic wastes and/or melting the contaminants and capturing them in the molten glass. During the process a pool of molten glass is developed and maintained by a high amount of electrical current passing between submerged electrodes. Combustible gases are mixed with air, ignite and react above the pool of molten glass. Solids and noncombustible materials are incorporated into the glass bed, while gases are pulled out of the chamber through a series of filters. Assemblies include pretreatment systems (evaporation and sedimentation), conveyors, sumps used to collect settling particles, heat recovery and air pollution control systems. Does not include the excavation and transport of contaminated material, see "Solids Collection and Containment" (.19.XX.) and "Liquids/Sediments/Sludges Collection and Containment" (.20.XX.). • **UOM= M^3** Phase 5 • Includes operations and maintenance activities such as process inspection, preparation of additives, making repairs to components, and other activities. Cost of energy. • **UOM= M^3/YR**
				X			
			X	**X**		**.30.9x**	**OTHER (Use Numbers 90-99)** Includes all stabilization/fixation/encapsulation treatments during remedial action not described by the above listed subsystems.
			X	**X**		**.31**	**FACILITY DECOMMISSIONING & DISMANTLEMENT**
			X			**.31.01**	**NUCLEAR FACILITY SHUTDOWN AND INSPECTION** Phase 4 • Includes activities such as plant shutdown and inspection, shutdown of unnecessary equipment, compilation and verification of as-built drawings, and other general housekeeping activities • **UOM=M^3** Phase 5 • Includes costs for operating and maintaining the equipment for facility shutdown and inspection. • **UOM= M^3/YR**
				X			
			X			**.31.02**	**DECOMMISSIONING - DEACTIVATION** Phase 4 • Preparation for the process of placing a facility in a safe and stable condition to minimize the long-term cost of a surveillance and maintenance program that is protective of workers, the public, and the environment until decommissioning is completed. Includes removal of fuel, draining and/or de-energizing of nonessential systems, removal of stored radioactive and hazardous materials and related actions. • **UOM=M^2** Phase 5 • Includes costs for operating and maintaining the equipment for the activities described in Phase 4. • **UOM= M^2/YR**
				X			

			X	X		.31.03	**PREPARATION FOR DORMANCY** Needs definition
			X			.31.04	**HOT CELL EQUIPMENT MODIFICATION** Phase 4 • Sealing and isolating equipment in the hot cell such as gloveports, bagout ports, bulkhead electrical fittings, inlet filters, and other penetrations into the glovebox to prevent contamination spread. **UOM=M^2** • Phase 5 • Involves maintaining sealed equipment. • **UOM= M^2/YR**
				X			
			X	X		.31.05	**SITE RECONFIGURATION, ISOLATING AND SECURING STRUCTURE** Phase 4 and 5 • Removal of obstacles to dismantlement such as other projects or facilities/structures, creating barriers to intrusion, and ensuring structural integrity of foundations, walls, framing, ceilings, decking, roofs, cover blocks, platforms, and other items. • **UOM=M^2**
			X			.31.06	**REMOVAL OF FUEL HANDLING EQUIPMENT** Phase 4 • Dismantlement and removal of fuel handling equipment including fuel positioning systems, cranes, and rigs. • **UOM=LS** Phase 5 • Involves operations and maintenance of removal equipment. • **UOM= LS/YR**
				X			
			X	X		31.07	**RADIOLOGICAL INVENTORY CATEGORIZATION FOR D&D** Phases 4 and 5 • Development of an estimate of the quantity of radionuclides present in the facility and the nature of their principal physical and chemical forms. Apart from spent fuel, the radiological inventory can be divided into two categories: (1) activation of the structural materials; and (2) surface contamination. This contamination may consist of activated corrosion products, fuel fragments, and/or fission products. • **UOM=LS**

			X			.31.08	**DECONTAMINATION OF AREA AND EQUIPMENT** Phase 4 • Includes locating all surface contamination on walls, floors, and equipment, constructing equipment, and treating, stabilizing, or removing all contamination using techniques such as chemical extraction, coatings, lasers, physical methods, thermal methods, vacuuming/blasting, and washing. • **UOM=M^2** Phase 5 • Includes costs for operating and maintaining the equipment for treating, stabilizing, or removing all contamination on walls, floors, and equipment. • **UOM= M^2/YR**
				X			
			X	X		.31.09	**REMOVAL OF CONTAMINATED EQUIPMENT/MATERIAL** Phase 4 and 5 • Activities include cutting, sizing, and removal of equipment, instrument tubing, piping, tanks, structures, stacks, and other components. • **UOM= M^2**
			X			.31.10	**DISMANTLING OPERATIONS ON REACTOR VESSEL & INTERNALS** Phase 4 • Removal of the reactor pressure vessel, internal and attached piping, control rods, assemblies, instrumentation, and other internals. • **UOM=EA** Phase 5 • Involves operations and maintenance of removal equipment. • **UOM=EA/YR**
				X			
			X			.31.11	**REMOVAL OF PRIMARY AND AUXILIARY SYSTEMS** Phase 4 Removal of the primary and auxiliary systems which include components such as piping, pumps, instrumentation, moisture separators, condensers, shielding, and others. **UOM= M^2** Phase 5 Involves operations and maintenance of removal equipment. • **UOM= M^2/YR**
				X			
			X			.31.12	**REMOVAL OF BIOLOGICAL SHIELD** Phase 4 • Removal of the absorbing material placed around a reactor or radioactive source which is intended to reduce radiation levels. • **UOM= M^2** Phase 5 • Involves operations and maintenance of removal equipment. • **UOM= M^2/YR**
				X			

			X			.31.13	**REMOVAL OF POOL LININGS** Phase 4 • Removal of linings from spent fuel pools which will include remote dismantlement of the steel lining. • **UOM=M^2** Phase 5 • Involves operations and maintenance of removal equipment. • **UOM= M^2/YR**
				X			
			X			.31.14	**DISMANTLING OF IN-CELL EQUIPMENT** Phase 4 • Dismantlement of hot cells including removal of lead glass windows, internal remote operated cranes and hoists, manipulators, tongs, glove ports, liquid and gas piping, electrical outlets, pass-through, fire suppression equipment, lighting, ventilation, and other equipment. • **UOM=EA** Phase 5 • Involves operations and maintenance of removal equipment. • **UOM=EA/YR**
				X			
			X			.31.15	**REMOVAL OF OTHER MATERIAL AND EQUIPMENT FROM CONTAINMENT STRUCTURE** Phase 4 • Removal of all other material and equipment not specified previously. • **UOM= M^2** Phase 5 • Involves operations and maintenance of removal equipment • **UOM= M^2/YR**
				X			
			X			.31.16	**FACILITY (CONTROLLED AREA) HARDENING, ISOLATION, OR ENTOMBMENT** Phase 4 • Encasing radioactive materials in concrete or other structural material sufficiently strong and structurally long-lived to ensure retention of the radioactivity until it has decayed to levels that permit restricted release of the site. • **UOM=M^3** Phase 5 • Operations and maintenance of equipment to perform hardening, isolation, or entombment • **UOM= M^2/YR**
				X			
			X			.31.17	**REMOVAL OF ALL OTHER FACILITIES, OR ENTIRE CONTAMINATED FACILITY** Phase 4 • Involves final takedown of the facility using shears, wrecking balls, rams, bulldozers, implosion, and/or other technique/equipment. • **UOM= M^2** Phase 5 • Involves operations and maintenance of removal equipment. • **UOM= M^2/YR**
				X			

			X			.31.18	**DISMANTLING OF TEMPORARY FUEL STORAGE FACILITY** Phase 4 • Involves final takedown of the facility using shears, wrecking balls, rams, bulldozers, and/or other technique/equipment. • **UOM=M^2** Phase 5 • Involves operations and maintenance of removal equipment. • **UOM= M^2/YR**
				X			
			X			.31.19	**DISMANTLING OF INTERMEDIATE FUEL STORAGE FACILITY** Phase 4 • Involves final takedown of the facility using shears, wrecking balls, rams, bulldozers, and/or other technique/equipment. • **UOM=M^2** Phase 5 • Involves operations and maintenance of removal equipment. • **UOM= M^2/YR**
				X			
			X			31.20	**REPROCESSING COSTS** Phase 4 • Includes the reprocessing the equipment, components, and other materials for reuse. • **UOM=M^3**
			X	X		.31.24	**DISMANTLEMENT - REPROCESSING COSTS** Phases 4 and 5 • Costs associated with making equipment available for reuse • **UOM=EA**
			X	X			**OTHER** Phases 1 – 4 • Includes all other activities involved in decommissioning and dismantlement not described by the above listed categories.
			X	X		.32	**MATERIAL HANDLING/TRANSPORTATION**
X	X	X	X			.32.01	**WASTE STREAM HANDLING/PACKAGING** Phases 1 to 4 • Involves lifting, packaging, and removing materials generated or removed from the environment during a remedial action. Systems which can aid in handling operations include automatic guided vehicles, palletizing robots, cranes, hoists, elevators, and conveyors. Waste is packaged in storage containers, receptacles, transportation packages, a major part of the transportation vehicle, or some other waste package. • **UOM=M^3** Phase 5 • Involves operation and maintenance of handling equipment. • **UOM= M^3/YR**
				X			

X	X	X	X	X		.32.02	**TRANSPORTATION DEVICE/EQUIPMENT** Phases 1 – 4 • Includes procurement of transportation devices/equipment such as railroads, trucks, and barges • **UOM=EA** Phase 5 • Involves operation and maintenance of transportation devices/equipment. • **UOM= EA/YR**
X	X	X	X	X		.32.03	**OE OFF-SITE DESTRUCTION/TRANSPORTATION TO DOD FACILITY** Phases 1 – 4 • Involves destruction of OE in an off-site location or DOD facility. • **UOM=M^3** Phase 5 • Involves operation and maintenance of transportation devices/equipment and OE destruction. • **UOM= LS/YR**
X	X	X	X	X		.32.04	**REMOVED DRUMS/TANKS AND MISC. TRANSPORTATION** Phases 1 – 4 • Includes costs of transporting drums and tanks removed from pits/trenches or facilities to a treatment, storage, or disposal facility. • **UOM=EA** Phase 5 • Involves operation and maintenance of transportation devices/equipment. • **UOM= EA/YR**
X	X	X	X	X		.32.05	**SURFACE WATER (FREE PRODUCT) & SEDIMENTS TRANSPORTATION** Phases 1 – 4 • Includes costs of transporting surface water and sediments to a treatment, storage, or disposal facility. • **UOM=M^3** Phase 5 • Involves operation and maintenance of transportation devices/equipment • **UOM= LS/YR**
X	X	X	X	X		.32.06	**GROUNDWATER (FREE PRODUCT) TRANSPORTATION** Phases 1 – 4 • Includes costs of transporting groundwater to a treatment, storage, or disposal facility. • **UOM=M^3** Phase 5 • Involves operation and maintenance of transportation devices/equipment. • **UOM= M^3/YR**

X	**X**	**X**	**X**	**X**		**.32.07**	**LIQUID WASTE/SLUDGE (E.G., UST/AST) TRANSPORTATION** Phases 1 – 4 • Includes costs of transporting liquid waste/sludge to a treatment, storage, or disposal facility. • **UOM=M^3** Phase 5 • Involves operation and maintenance of transportation devices/equipment. • **UOM= M^3/YR**
X	**X**	**X**	**X**	**X**		**.32.08**	**SOIL/SOLID WASTE TRANSPORTATION** Phases 1 – 4 • Includes costs of transporting soil/solid waste to a treatment, storage, or disposal facility. • **UOM=M^3** Phase 5 • Involves operation and maintenance of transportation devices/equipment. • **UOM= LS/YR**
X	**X**	**X**	**X**	**X**		**.32.09**	**D&D FACILITY CONTAMINATED EQUIPMENT/MATERIAL TRANSPORTATION** Phases 1 – 4 • Includes costs of transporting D&D contaminated equipment/material to a treatment, storage, or disposal facility. • **UOM=M^3** Phase 5 • Involves operation and maintenance of transportation devices/equipment. • **UOM= LS/YR**
			X	**X**		**.32.10**	**CERTIFICATION/SHIPPING** Phase 4 and 5 • Preparing equipment/material for storage/disposal by means of cutting and sizing, and transporting the equipment/material to a storage/disposal location • **UOM=EA**
X	**X**	**X**	**X**	**X**		**.32.9x**	**OTHER** Phases 1 – 5 • Includes all material handling/transportation activities not covered previously.
X	**X**	**X**	**X**	**X**		**.33**	**DISPOSAL - COMMERCIAL**
X	**X**	**X**	**X**	**X**		**.33.01**	**CONTAINER HANDLING** Phases 1 – 4 • Provides for all work associated with the handling of waste containers for periodic inventory or inspection. Does not include placement of waste into disposal units. • **UOM=M^3** Phase 5 • Involves operation and maintenance of handling equipment. • **UOM= LS/YR**

X	X	X	X	X		.33.02	**TRANSPORT WASTE TO COMMERCIAL DISPOSAL FACILITY** Phases 1 – 4 • Includes equipment, materials, and labor for hauling, loading, and unloading of solid and liquid wastes. • **UOM=M^3** Phase 5 • Involves operation and maintenance of transportation equipment. • **UOM= LS/YR**
X	X	X	X	X		.33.03	**TIPPING CHARGES AND TAXES** Phases 1 – 5 • Includes all tipping charges and taxes charged for the disposal of wastes. These include charges and taxes charged at third party/commercial facilities. • **UOM=LS**
						.33.9x	**OTHER**

Appendices

Second Level WBS
Third Level WBS & hird Level WBS with Metrics
Abridged Fourth & Fifth Level WBS