Project Baseline Summary Report

Data Source: **EM CDB** Report Number: **GEN-01b**

Operations/Field Office: **Oakland** Print Date: **3/9/2000**

Site Summary Level: **Lawrence Livermore National Laboratory** HQ ID: **0200**

Project **OK-001 / LLNL Main Site Remediation**

General Project Information

Project Description Narratives

Purpose, Scope, and Technical Approach:

Purpose of Project:
The Livermore Site was converted from agricultural use by the U.S. Navy in 1942 as a flight training base and for aircraft assembly, repair and overhaul. Solvents, paints, and degreasers were routinely used during this period. In 1952 the site was transferred to the Atomic Energy Commission (AEC). Under AEC the site became a weapons design and basic physics laboratory and continues with this mission under DOE today. Initial releases of hazardous materials occurred at the Livermore Site in the 1940s when the site was a Naval Air Station. There is also evidence that localized spills, leaking tanks and impoundments and landfills contributed volatile organic compounds (VOCs), fuel hydrocarbons (FHCs), metals and tritium to ground water and undersaturated sediments after the Navy era.

Identified in 1987, LLNL Main Site was added to EPAs NPL list. The purpose of this project is to identify existing contamination and to effectively remediate soil and ground water where contamination exceed regulatory limits. Remediation includes meeting regulatory guidelines for document preparation, community relations, compliance monitoring, hydrogeologic analysis, data management, chemicalanalysis, borehole geophysics, radiological analysis, treatment system design, construction and operation, extraction and reinjection wells, source area investigations, well placement decision analysis, and overall project management. Additionally, LLNLhas a line item funded tank removal program, where it is estimated that an average of 2 tanks per year will be removed.

DOE/LLNL established a Community Work Group for the Livermore Site in 1989 to providean ongoing forum to advance the understanding of technical issues and project decisions, community interests, and the Superfund process. Additionally, a public interest group called Tri-Valley Cares (TVC) was awarded an EPA Technical Assistance Grant (TAG) to monitor the progress of the cleanup for both sites. DOE/LLNL, shares on a yearly basis, the next years draft work plan task list with TVC. We consider TVC concerns prior to finalizing this list. For example, DOE/LLNL wanted to place higher priority in controlling on-site plumes but because off-site plumes were higher priority for the community the highest priority became control of off-site plumes.

Definition of Scope:
The Treatment Facility "A" (TFA) area is located in the southwest corner of the LLNL Livermore Site. It includes a contaminant source area in the vicinity of Building 111 and a ground water plume of contamination whose distal portion extends approximately 2500 feet offsite to the west. The contamination is predominantly tetrachloroethylene (PCE) and to a lesser degree trichloroethylene (TCE). The purpose of the TFA area ground water remediation is to remove contaminant mass and reduce contaminant concentrations and maintain hydraulic control of the offsite plume.
The TFB area is located along the western perimeter of the LLNL Livermore Site. It includes a contaminant source area of Building 141 and a ground water plume of contamination whose distal portion extends approximately 1000 feet offsite, west of Vasco Road. The purpose of the TFB area ground water remediation is to remove contaminant mass and reduce contaminant concentrations and maintain hydraulic control of the offsite plume.
The TFC area is located in the northwest quadrant of the LLNL Livermore Site. At least four separate TCE plumes have been identified in the TFC area. The purpose of the TFC ground water remediation is to remove contaminant mass, reduce contaminant concentrations and contain VOC migration along the western perimeter of LLNL nort of the TFA and TFB wellfields.
The TFD area is located in the northeast quadrant of the LLNL Livermore Site. It includes three major contaminant source areas in the vicinity of 1)

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the East Traffic Circle Landfill, 2) the Helipad, and 3) Building 490. The distal portion of the ground water plume of contamination extends approximately 1200 feet to the west. The purpose of the TFD area groundwater remediation is to remove contaminant mass and contaminant concentrations.

TFE-East (Treatment Facility E) is located in the southeast quadrant of the Livermore Site. The purpose of TFE-East area groundwater remediation is to remove contaminant mass and contaminant concentrations.

TFF//TF 406 (TFF/TF 406) area is located in the south-central portion of the LLNL Livermore Site. Two contaminants, fuel hydrocarbons (FHCs) and chlorinated VOCs are present in the TFF/TF406 subsurface. FHCs and VOCs are present in the vadose zone and shallow ground water, and VOCs are present in deeper groundwater. The purpose of the TF406 area ground water remediation is to hydraulically contain the southern boundary VOC plume, remove contaminant mass, and reduce contaminant concentrations as quickly and as cost-effectively as possible.

The TFG area is also located in the south-central portion of the LLNL Livermore Site approximately 2,000 feet west of TFF/TF406. It includes contaminant source areas in the vicinity of Buildings 212 and 321, and a ground water plume of contaminants whose distal portion extends at least 600 feet to the south. The purpose of the TFG area ground water remediation is to hydraulically contain the southern plume boundary, remove contaminant mass, and reduce contaminant concentrations.

TF518 area is located directly southeast of Building 518 in the southeast part of LLNL near East Avenue. The ground water contamination from the B518 area extends west to the TF 406 area and south beneath Sandia National Laboratory. TF518 is a vapor extraction system that began operation in September 1995.

The Trailer 5475/East Taxi Strip (T5475) area is located in the southeast quadrant of the LLNL Livermore Site immediately east of the TFE area. This area includes a contaminant source in the vicinity of T5475 and a ground water plume of contamination. The contaminants are VOCs and tritium. The purpose of the T5475 area is to remediate the VOCs while leaving the tritium in place to decay naturally (Oakland Site Technology Need No. 5).

Building 331(B-331), located in the south-central part of the Livermore Site, is designated as the Tritium Facility. Recent source investigation drilling conducted within the facility boundary found evidence of elevated tritium concentrations in the soil. To date, no tritium has been detected in the ground water in the area. Monitoring of tritium concentrations in ground water is conducted on a routine basis.

The Building 419 (B-419) task is primarily an ongoing source investigation, located in the southeast portion of LLNL. Monitoring of ground water contaminant concentrations is conducted on a routine basis.

The Building 292 (B-292) area is located in the northwest quadrant of the LLNL Livermore Site near the West Traffic Circle. B-292 housed a rotating target neutron source which was used for energy research between 1977 and 1987. The waste water from the experiments was collected in an underground storage tank. The primary contaminant in this waste water was tritium. In July of 1989, a leak was discovered in the underground tank system during a routine leak test. The tank system had successfully passed a leak test in June of 1986. Therefore, the release from the tank occurred between June of 1986 and July of 1989. As of October 1992, 19 boreholes had been drilled and sampled in the B-292 area. The data from these boreholes indicated that the tritium was concentrated beneath the suspected leak point of the tank. At present, the concentration of tritium in the ground water is below the MCL. The CERCLA ROD for clean up of the LLNL Livermore Site indicates that the tritium is effectively self-remediating via natural decay and the potential dose from the measured tritium in soil would not exceed 0.01% of the 10-millirem/year Federal dose standard. No pathway to humans exists for the observed tritium in ground water. The ground water in the surrounding area will continue to be monitored for tritium to track its distribution and concentration.

Treatment Systems:

TFA: Extraction of contaminated ground water which began in 1989 is treated by a high capacity air stripping system. Extracted VOC vapors are

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vented to the atmosphere through granular activated carbon (GAC). Effluent water is then discharged to a recharge basin located about one quarter mile south of East Avenue on Sandia National Laboratory property. Presently, TFA treats more than 15 million gallons of contaminated ground water per month.
TFB: Extraction of contaminated ground water which began in 1990 is treated in a permanent facility using an air stripper which vents to the atmosphere through GAC. Treated ground water is then discharged to a drainage ditch, which empties into Arroyo Las Positas at the northern site boundary. Presently, TFB is processing more than 2.5 million gallons of contaminated ground water per month.
TFC: Extraction of the contaminated ground water began in October 1993 and is discharged into Arroyo Las Positas.. Contaminated ground water is treated in a permanent facility using an air stripping system to remove VOCs that vents to the atmosphere through GAC, followed by an ion exchange unit to remove hexavalent chromium when necessary.
TFD: Extraction of the contaminated ground water began in 1994. Contaminated ground water is treated in a permanent facility, using air stripping to remove VOCs that vents to the atmosphere through GAC, followed by an ion exchange unit to remove hexavalent chromium when necessary. The treated ground water is discharged to Arroyo Las Positas along the northern boundary of the site. The specific Engineered Plume Collapse (EPC) innovative technologies that would have application in the TFD source area include electro-osmosis and in situ hydrous pyrolysis, Electrical Resistance Tomography (ERT). Funds have been allocated through the technical deployment initiative and we will begin a field demonstration in FY99. No above ground treatment would be required with the successful deployment of these technologies.
TFE: The extraction of contaminated ground water began in 1996 and is treated by a PTU using air stripping for the removal of VOCs that vent to the atmosphere through GAC. The EPC technologies, (HPD, EO and biofilter) will be applied to considerably shorten the time for source elimination.
TFF/TF406" Area: The VOC plume that underlies the gasoline - impacted area is being addressed by extracting ground water and remediating it above ground with a PTU prior to discharge into Arroyo Las Positas. TFG: Contaminated ground water will be treated by a PTU, using air stripping to remove VOCs that vent to the atmosphere through GAC, followed by an ion exchange unit, if needed, to remove hexavalent chromium.
TF518/Southeast Quad Area: The contaminated soil vapor is extracted from the vadose zone via extraction wells. The VTF518 processes soil vapor using a vapor extraction system with GAC canisters to remove the VOCs prior to venting to the atmosphere. The ground water contamination in the B518 area is extracted and treated by a PTU. The remediation of the B518 area vadose zone is expected to take five years to complete. Trailer 5475/East Taxi Strip Area: A closed loop in situ system that will reinject the tritiated ground water within the same hydrostratigraphic unit (HSU).

Technical Approach:
Conceptual Model for Site Cleanup The conceptual model of the subsurface at LLNL divides the site into two regimes: the distal portions of the plumes and the source areas. In the distal portions of the plumes, the contaminants in the ground water are almost entirely restricted to the permeable sediments, with only small amounts of VOC advecting and diffusing into the fine-grained sediments or lenses. In contrast, the source areas have contaminants throughout the vadose zone and below the water table in both course-grained and fine-grained materials. The model assumes that the source areas were created by the discharge of contaminants in high concentrations at the ground surface. Cleanup Strategy for the Distal Portions of the Plumes: The past six years pump and treat at the LLNL indicate that under existing chemical and hydrogeologic conditions, the distal portions of VOC plumes may be cleaned up to low 10s of ppb in 10 to 15 years. Assuming that the regulatory agencies will allow some flexibility in remediation at these concentrations for the on-site parts of the plumes, extraction wells near the leading edge of the plumes can be shut down. This will allow the contraction of the active remediation well field toward the source area. Pumping near the source areas prevents further migration of the higher concentrations of contaminants while contaminant concentrations in the distal plume margins would slowly decline as a result of dispersion and other hydrogeologic processes. Ultimately, the active wellfield will contract to a small number of wells at, and immediately downgradient of the source areas. This strategy, which we call Engineered Plume Collapse (EPC), would increase the efficiency of cleanup efforts, while greatly reducing costs by

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directing remediation efforts at the source areas until asymptotic concentrations are achieved. The timing of the distal versus source area cleanup activities is not critical, but aggressive and rapid deployment of cleanup activities in both areas would reduce the ultimate time and cost to achieve ground water restoration.

Source Areas:
Source area remediation is more complex and requires more aggressive cleanup techniques than the distal portions of the plumes. As described above, contaminants at the source exist in both the fine-grained and the coarse-grained sediments. Because of low hydraulic conductivity of the fine-grained sediments, estimated cleanup time for these sediments will increase (by a factor of two) as compared to that required to remediate the distal more permeable zones. In addition, retardation mechanisms of fine-grained materials have a greater impact than those of the higher permeability sediments. Aggressive, advanced pump and treat techniques and vadose zone vapor extraction will be used in the source areas, as well as innovative technologies as they are developed, such as those of EPC. Assuming this model is correct, relatively rapid reduction of contaminant concentrations to asymptotic levels should be achieved in the distal portions of the plumes. This model is supported by TFA data collected during the first six years of remediation. The source areas present a more complex problem. Because the contaminants are present in both high- and low-permeability zones, remediation by pumping will take longer in the source areas. While extraction wells located in the source areas will rapidly remove contaminant mass, the much lower hydraulic conductivities of the low-permeability sediments will delay restoration of ground water quality. Source area cleanup will be accomplished by aggressive pumping from the saturated zone and soil vapor extraction or other techniques in the vadose zone. Other innovative techniques for source area remediation will be tested, evaluated, and implemented if applicable and if sufficient funding is provided. Innovative in situ saturated zone techniques may include electro-osmosis, hot or cold water flushing, steam flushing, electrical heating, surfactant injection, zero-valent dehalogenation, bioremediation or hydrous pyrolysis. under the Engineered Plume Collapse Remediation Plan. Currently there are fifteen ground water extraction/treatment facilities and two vapor extraction system operating at the site. TFA and TFB have been operating nearly continuously since 1989 and 1990, respectively, and have attained hydraulic control and significant mass removal from the southwestern offsite plumes. With the addition of an expanded extraction system at TFC in FY1996, hydraulic control of the entire western perimeter has been achieved. With the startup of Treatment Facility G-1 (TFG-1) extraction from a deeper plume at TF406, and startup of TF518 the southern perimeter is hydraulically controlled. Now that full hydraulic control of the western distal plumes margin has been achieved, a more aggressive and integrated program to remediate the source areas will begin to expand the work on the sources to date. Continued vapor extraction at Vapor Treatment Facility 518 should result in cleanup of the southern perimeter vadose zone sources in less than five years. By extrapolating the distal area 3-D modeling results to the source areas, we anticipate that ground water cleanup of the source areas to 5 ppb might be accomplished in approximately 42 years after complete buildout of the extraction/treatment systems. Livermore Site cleanup will be accelerated by continuing to utilize advanced pump and treat techniques and granular activated carbon within the distal portions of the contaminant plumes. As the ground water is remediated to a negotiated cleanup level, the active wellfields will contract toward the source areas and only a small number of wells will remain pumping immediately downgradient of the source areas to prevent further downgradient contaminant transport. Simultaneously with the cleanup of the distal portions of the plumes, the source areas will be aggressively remediated by ground water pumping, vapor extraction and a series of new in-situ destruction technologies including electro-osmosis and possibly hydrous pyrolysis. In-situ technologies are currently being pursued under the Engineered Plume Collapse Strategy and could significantly reduce the estimated time to cleanup. With successful demonstration of source remediation technologies, we will negotiate with the agencies to replace some of the RAIP milestones associated with new technology application. Budgeted amounts for the replaced work will be used for new technology application.

Engineered Plume Collapse (EPC): LLNL has formed a unique partnership between the Environmental Restoration Division, the Earth and

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Environmental Science Directorate, and private industry to conduct EPC. This partnership proposes to demonstrate innovative technologies for rapid in situ contaminant destruction. If fully funded, LLNL Livermore Site would serve as the test bed for optimal deployment of the new technologies, while existing ground water pump and treat systems would provide perimeter control. The project`s phased approach identifies site characterization and aggressive pump and treat in FY97 and FY98. Deployment of the in situ technologies will begin in FY99. Transfer of the technologies to private industry and to other DOE sites would follow successful demostrations.

EPC will demonstrate a system of technologies that rapidly remove contaminants from source regions of ground water plumes while concurrently preventing further plume dispersal. Innovative technologies to be demostrated will be tested as part of a concept called Phased Source Remediation (PSR).

It is the application of innovative electrical and possibly thermal treatment technologies to accelerate site closure.

PSR is the logical extension of LLNL's successful EPC strategy which was initiated in 1997 that integrates the right technology at the right time and place.

The focus of this effort in FY99 is to apply electro-osmosis (EO) as an initial remediation technique to remove VOC's from a source area during the first year (FY99) of deployment, followed by more energetic thermal applications in the second year (FY00), if needed. By using a phased approach, a decision point will occur following the application of EO. Based on analytical results from the wellfield, the size and configuration of potential thermal methods will be determined to further remediate the source area(s).

If warranted, a combination of dynamic underground stripping (DUS) which remediated gasoline contamination at an old gasoline station on the site, and hydrious pyrolysis / oxidation (HPO) technology, which destroys DNAPLS and dissolved contaminants in place by utilizing hydrothermal oxidation will be deployed. Accelerated pump and treat technology will complement the deployments. As individual source area concentrations are dimished by OE/pumping the EO configuration may be moved to additional source areas. Thermal treatment will be applied to source areas if needed. As cleanup proceeds, the technologies will eliminate eight identified individual source areas.

Project Status in FY 2006:

In FY06 cleanup will be complete in that all treatment facilites will be constructed and in operation.

Post-2006 Project Scope:

After FY06, Livermore Site remediation activities will consist of treatment facility operation and maintenance, and ground water monitoring/reporting. Completion of each treatment facility area will be accomplished by:

Treatment Facility "A" (TFA): 1997;
Building 518/Southeast Quad (TF518): 1997; Treatment Facility "B" (TFB): 1998
TF-5475 SWAT: 1999
TF-5475 CRD (Phase 2): 2000
TF-518 North SWAT: 2000

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TFE-Southwest Mini PTU: 2000
TFE-Southeast Mini PTU: 2000
TF-5475 CRD (Phase 3): 2001
TFE-West Mini PTU: 2001
TF406-South SWAT: 2001
TF5475 CRD (Phase 4): 2002

Project End State

By FY06, cleanup will be complete if sufficient funding is provided. All ground water treatment facilities will be constructed and in operation. Maintenance and operation of those treatment facilities will continue beyond FY06 until ground water contaminant concentrations reach regulatory approved levels. The overall length of operation and maintenance of the treatment facilities will be largely dependent on the success of source removal activities discussed in the general narrative. It has been assumed that by FY2015 remediation will be sufficient to allow the EM sponsered LTS&M to stop. Mormal landlord sponsered S&M will be sufficient to monitor the site.There will be no adverse impact on potential land use in that Lawrence Livermore National Laboratory is expected to continue to occupy and use the site indefinitely and the site contamination does not affect operations of the Laboratory. The project regulatory drivers are CERCLA, SARA and the NCP.

Cost Baseline Comments:

Where appropriate, Activity-Based Cost estimating is applied. We are in the process of developing a system of ABC estimating that can be applied to more of the Environmental Restoration program. The purpose of ABC estimating for this TYP effort is to identify the detailed activities and associated costs which comprises a project/program. ABC estimating will ensure that LLNL has a documented basis for cost estimates for each component of the Environmental Restoration program. During this process, management will review the entire scope/program and each component will be ranked according to its priority in the overall ER program.

Safety & Health Hazards:

The Hazard Evaluation for the Lawrence Livermore National Laboratory Main Site Restoration Project is documented in the Site Safety Plan (Rev. 1.0 1994, Draft Rev. 2 1997). The hazard evaluation considered all current and future Restoration activities, from characterization to full implementation of remediation. Potential chemical hazards are present in the form of contaminants found in environmental media, as well as chemicals used in sampling and treatment facility operation activities. Specific chemicals include volatile organic compounds (VOCs), tritium and chormium. Physical hazards associated with investigation and remediation activities include heavy equipment and the mechanical motions associated with such equipment (primarily associated with drill rigs), noise (associated with heavy equipment, steam cleaning and the use of air compressors), excavations, overhead power lines, underground utilities, confined space entry, fire and explosions, electrical hazards and heat stress.

Safety & Health Work Performance:

Prior to the start of an activity, workers are required to read and understand applicable OSPs, FSPs, SOPs and O&M manuals. All required training must be current. During the course of the activity, frequent safety meetings are required in which the adequacy of safety controls are reviewed and any unforeseen S&H hazards are identified and mechanisms to manage such hazards are developed. The Restoration Project has on staff a Site Safety Officer, and Training Coordinator, and a Quality Assurance Implementation Coordinator. These specialists monitor safety and health activities. Other

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S&H resources are available through the institution which is maintained via overhead funds (i.e. industrial hygienists, health physicists, safety team members, fire protection, etc). Details of funding and FTE`s is not required to be submitted by contractor

PBS Comments:

DOE/OAK and LLNL Environmental Restoration Stretch Goal: In order to meet the Stretch Goal of cleanup of the LLNL Livermore Site by the year 2016, the application of the Engineered Plume Collapse (EPC) technologies is not only necessary but essential (Oakland Site Technology Need No. 2). EPC developed technologies must be successfully demonstrated at selected Livermore Site source areas in FY98 and FY99. The primary EPC technology to be demonstrated is hydrous pyrolysis, an extension of Dynamic Stripping, an already successfully demonstrated in situ steam injection technology developed by LLNL. Based on the knowledge gained from Dynamic Stripping and further bench scale tests, we believe the demonstration of hydrous pyrolysis has a very high likelihood of success. The companion EPC technology methodology to be used is the application of biofilters to destroy VOCs that are beyond the influence of hydrous pyrolysis. We also believe there will be a likelihood of success in demonstrating this technology as well as electro-osmosis which will drive contaminats of the fine-grained materials.

The DOE/OAK "Stretch Goal" will be to work with LLNL to perform EPC demonstration and cleanup the Livermore Site (including completion of all O&M and monitoring activities) by FY16. This poses a dual challenge. First, both the demonstration and application of the source cleanup technologies will have to be accomplished with a budget substantially less than estimated to be realistic. Second, since distal plume cleanup, given source removal, controls this cleanup time a significantly relaxation of cleanup standards compared to the ROD is required. To accomplish the cleanup under this scenario, DOE/OAK will focus the entire EPC technology demonstration on application at the Livermore Site.

By not fully funding EPC, DOE will miss an opportunity to achieve recognition for sponsoring what could be a advance in environmental cleanup. Under less than full funding there will be a substantial risk that the new technology will not be adequately developed for successful development on LLNL source areas. The will be no commercialization efforts to facilitate the transfer of the EPC technologies to other DOE facilities and the private sector nor could we support the formation of a potential EPC technologies users group to ensure that issues brought up by other potential users could be resolved. Furthermore, a planned handbook or user`s guide for the technologies will not be prepared.

Regulatory Strategy: In order to more effectively utilize environmental restoration funds, DOE/OAK will propose to the public and the regulatory agencies a risk management based strategy for remediation of the two LLNL sites. This strategy will pursue cleanup levels for the offsite portion of the plume at their currently established levels of the state and federal MCLs. The mission of LLNL will not change and thus the laboratory will continue to have a research/industrial land use with complete control of access to ground water. Because on-site exposure to ground water is prevented and thus there is no on-site risk, DOE will propose that cleanup levels for ground water on-site be based on preventing contaminant plumes from leaving the site boundary at concentration above MCLs.DOE/OAK understands that this position will require renegotiation of the Livermore Site Record ofDecision cleanup levels and that the regulatory agencies and some members of the public have expressed concern about such a revision. DOE will maintain compliance with all applicable laws and agreements. Therefore, we will include in our cost information cost of cleanup to MCLs both on-site and off-site as well as the cost of cleanup based on the risk management strategy identified above. Based on some of our initial analysis, the difference between the two strategies will be seen primarily in the years after 2006 when remediation will be in an operations and maintenance mode. The required cleanup level on-site strongly drives this time to completion. The table below reports time vs. cleanup level based on a simulation normalized to LLNL experience at TFA.

Years After Construction of Full Wellfield	Contaminant Concentration
10	60
15	25
20	15

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30	7
42	5

Relatively small increases in cleanup levels result in major savings in Operation & Maintenance expenses.

Baseline Validation Narrative:

Validation reviews have been performed on the LLNL Main Site ERD Program, the most recent being in April 1996. This review was performed by DOE/OAK on representative portions of the LLNL Main Site baseline for FY1998. The validation review team interviewed members of the project and relevant project documentation. From this information the review team prepared an independent bottoms-up activity based cost estimate. DOE/OAK used this independent estimate to compare with the estimate prepared by LLNL for the Main Site Project. A report was prepared that discussed the major differences, point by point and meetings were held with the site to reconcile the cost differences. The review team based their cost estimates on costs developed from similar type projects at other government sites and private industry.

General PBS Information

Project Validated? Yes **Date Validated:** 4/4/1996

Has Headquarters reviewed and approved project? No

Date Project was Added: 12/1/1997

Baseline Submission Date: 7/13/1999

FEDPLAN Project? Yes

Drivers:

CERCLA	RCRA	DNFSB	AEA	UMTRCA	State	DOE Orders	Other
Y	N	N	N	N	Y	Y	N

Project Identification Information

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Is this a High Visibility Project (Y/N):

Planning Section

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Baseline Costs (in thousands of dollars)

	1997-2006 Total	2007-2070 Total	1997-2070 Total	1997	Actual 1997	1998	Actual 1998	1999	2000	2001	2002	2003	2004	2005	2006
PBS Baseline (current year dollars)	108,343	45,000	153,343	12,429	13,632	12,299	11,765	11,475	10,500	11,500	10,260	9,120	9,960	10,400	10,400
PBS Baseline (constant 1999 dollars)	102,312	34,913	137,225	12,429	13,632	12,299	11,765	11,475	10,224	10,967	9,584	8,343	8,925	9,127	8,939
PBS EM Baseline (current year dollars)	108,343	45,000	153,343	12,429	13,632	12,299	11,765	11,475	10,500	11,500	10,260	9,120	9,960	10,400	10,400
PBS EM Baseline (constant 1999 dollars)	102,312	34,913	137,225	12,429	13,632	12,299	11,765	11,475	10,224	10,967	9,584	8,343	8,925	9,127	8,939

	2007	2008	2009	2010	2011-2015	2016-2020	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2050	2051-2055	2056-2060	2061-2065	2066-2070
PBS Baseline (current year dollars)	5,000	5,000	5,000	5,000	25,000	0	0	0	0	0	0	0	0	0	0	0
PBS Baseline (constant 1999 dollars)	4,209	4,123	4,038	3,955	18,588	0	0	0	0	0	0	0	0	0	0	0
PBS EM Baseline (current year dollars)	5,000	5,000	5,000	5,000	25,000	0	0	0	0	0	0	0	0	0	0	0
PBS EM Baseline (constant 1999 dollars)	4,209	4,123	4,038	3,955	18,588	0	0	0	0	0	0	0	0	0	0	0

Baseline Escalation Rates

1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0.00%	0.00%	0.00%	2.70%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%

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2010	2011-2015	2016-2020	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2050	2051-2055	2056-2060	2061-2065	2066-2070
2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%

Project Reconciliation

Project Completion Date Changes:

Previously Projected End Date of Project: 9/30/2006

Current Projected End Date of Project: 9/30/2015

Explanation of Project Completion Date Difference (if applicable):

Project Cost Estimates (in thousands of dollars)

Previously Estimated Lifecycle Cost (1997 - 2070, 1998 Dollars):	176,146	**Actual 1997 Cost:**	13,632	**Actual 1998 Cost:**	11,765
Previously Estimated Lifecycle Cost of Project (1999 - 2070, 1998 Dollars):	150,749	**Inflation Adjustment (2.7% to convert 1998 to 1999 dollars):**			4,070
Previously Estimated Lifecycle Cost (1999 - 2070, 1999 Dollars):	154,819				

Project Cost Changes

	Cost Adjustments	Reconciliation Narratives
Cost Change Due to Scope Deletions (-):	35,062	Construction of portable treatment units instead of fixed facilities
Cost Reductions Due to Efficiencies (-):	7,259	Reduction in facility sampling; renegotiation of reporting requirements
Cost Associated with New Scope (+):		
Cost Growth Associated with Scope Previously Reported (+):		
Cost Reductions Due to Science & Technology Efficiencies (-):		
Subtotal:	112,498	
Additional Amount to Reconcile (+):	-1	
Current Estimated Lifecycle Cost (1999 - 2070, 1999 Dollars):	**112,497**	

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Operations/Field Office: **Oakland** Print Date: **3/9/2000**

Site Summary Level: **Lawrence Livermore National Laboratory** HQ ID: **0200**

Project **OK-001 / LLNL Main Site Remediation**

Milestones

Milestone/Activity	Field Milestone Code	Original Date	Baseline Date	Legal Date	Forecast Date	Actual Date	EA	DNFSB	Mgmt. Commit.	Key Decision	Intersite
Begin Operation of TF5475 CRD (Phase 1)	OK001-02		9/30/1998	9/30/1998			Y				
Begin Operation of VTF-5475 Vapor Extraction System	OK001-03		6/29/1999	6/29/1999			Y				
Begin Operation of TFD-South PTU	OK001-05		6/29/1999	6/29/1999			Y				
Project Mission Complete	OK001-41		9/30/2006	9/30/2006			Y				
Begin Operation of Bldg 518 Ground Water PTU	OK001-11		1/30/1998	1/30/1998			Y				
Submit Draft Final RD4 to Regulatory Agencies	OK001-17		1/16/1998	1/16/1998			Y				
Begin Operation of TFD-Southeast PTU	OK001-22		3/27/1998	3/27/1998			Y				
Begin Operation of TFE-Northwest PTU	OK001-09		6/26/1998	6/26/1998			Y				
Begin Operation of TF5475 SWAT	OK001-30		3/31/1999	3/31/1999			Y				
Begin Operation of TF5475 CRD (Phase 2)	OK001-31		9/30/1999	9/30/1999			Y				
Begin Operation of TF518-North SWAT	OK001-25		1/28/2000	1/28/2000			Y				
Begin Operation of TFE-Southwest Mini PTU	OK001-26		3/31/2000	3/31/2000			Y				
Begin Operation of TFE-Southeast Mini PTU	OK001-32		6/30/2000	6/30/2000			Y				
Begin Operation of TF5475 CRD (Phase 3)	OK001-33		9/29/2000	9/29/2000			Y				
Begin Operation of TFE-West Mini PTU	OK001-24		1/31/2001	1/31/2001			Y				
Begin Operation of TF406-South SWAT	OK001-34		4/30/2001	4/30/2001			Y				
Begin Operation of TFD-Northwest Pipeline	OK001-35		7/31/2001	7/31/2001			Y				
Begin Operation of TF5475 CRD (Phase 4)	OK001-36		9/28/2002	9/28/2002			Y				
Begin Operation of TFA-East SWAT	OK001-37		8/6/1999	8/6/1999			Y				
Begin Operation of TF406-Northwest GAC	OK001-38		1/31/2002	1/31/2002			Y				
Begin Operation of TFC-East Mini PTU	OK001-39		7/31/2002	7/31/2002			Y				
Issue Five Year Review	OK001-40		9/30/2002	9/30/2002			Y				

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Begin Operation of TFG-North	OK001-43		1/31/2003	1/31/2003			Y				
Begin Operation of TFC-Northeast	OK001-44		5/30/2003	5/30/2003			Y				
Begin East Taxi Strip Source Area Remediation	OK001-45		9/26/2003	9/26/2003			Y				
Begin Operation of TFD-South Drainage Retention Basin	OK001-46		1/30/2004	1/30/2004			Y				
Begin Southern East Traffic Circle Source Area Remediation	OK001-47		5/28/2004	5/28/2004			Y				
Begin TFD Hotspot Remediation	OK001-48		9/30/2004	9/30/2004			Y				
Begin Helipad Source Area Remediation	OK001-49		1/28/2005	1/28/2005			Y				
Begin TFE Hotspot Remediation	OK001-50		3/31/2005	3/31/2005			Y				
Begin Northern East Traffic Circle Source Area Remediation	OK001-51		6/30/2005	6/30/2005			Y				
Begin TF-406 Hotspot Remediation	OK001-52		9/30/2005	9/30/2005			Y				
Begin Bldg 419 Source Area Remediation	OK001-53		1/27/2006	1/27/2006			Y				
Begin TFB/TFC Hotspot Remediation	OK001-54		5/31/2006	5/31/2006			Y				
Begin Bldgs 511/514 Source Area Remediation	OK001-55		9/29/2006	9/29/2006			Y				
Begin Operation of VTF-5475 Vapor Extraction System			1/1/1999						Y		
Begin Operation of TFD-South PTU			6/1/1999						Y		
Project Start Date			9/30/1988	9/30/1988							
Project End			9/30/2015								

Milestones - Part II

Milestone/Activity	Field Milestone Code	Critical Decision	Critial Closure Path	Project Start	Project End	Mission Complete	Tech Risk	Work Scope Risk	Intersite Risk	Cancelled	Milestone Description

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Milestones - Part II

Milestone/Activity	Field Milestone Code	Critical Decision	Critial Closure Path	Project Start	Project End	Mission Complete	Tech Risk	Work Scope Risk	Intersite Risk	Cancelled	Milestone Description
Begin Operation of TF5475 CRD (Phase 1)	OK001-02										
Begin Operation of VTF-5475 Vapor Extraction System	OK001-03										
Begin Operation of TFD-South PTU	OK001-05										
Project Mission Complete	OK001-41					Y					
Begin Operation of Bldg 518 Ground Water PTU	OK001-11										
Submit Draft Final RD4 to Regulatory Agencies	OK001-17										
Begin Operation of TFD-Southeast PTU	OK001-22										
Begin Operation of TFE-Northwest PTU	OK001-09										
Begin Operation of TF5475 SWAT	OK001-30										
Begin Operation of TF5475 CRD (Phase 2)	OK001-31										
Begin Operation of TF518-North SWAT	OK001-25										
Begin Operation of TFE-Southwest Mini PTU	OK001-26										
Begin Operation of TFE-Southeast Mini PTU	OK001-32										
Begin Operation of TF5475 CRD (Phase 3)	OK001-33										
Begin Operation of TFE-West Mini PTU	OK001-24										

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Milestones - Part II

Milestone/Activity	Field Milestone Code	Critical Decision	Critial Closure Path	Project Start	Project End	Mission Complete	Tech Risk	Work Scope Risk	Intersite Risk	Cancelled	Milestone Description
Begin Operation of TF406-South SWAT	OK001-34										
Begin Operation of TFD-Northwest Pipeline	OK001-35										
Begin Operation of TF5475 CRD (Phase 4)	OK001-36										
Begin Operation of TFA-East SWAT	OK001-37										
Begin Operation of TF406-Northwest GAC	OK001-38										
Begin Operation of TFC-East Mini PTU	OK001-39										
Issue Five Year Review	OK001-40										
Begin Operation of TFG-North	OK001-43										
Begin Operation of TFC-Northeast	OK001-44										
Begin East Taxi Strip Source Area Remediation	OK001-45										
Begin Operation of TFD-South Drainage Retention Basin	OK001-46										
Begin Southern East Traffic Circle Source Area Remediation	OK001-47										
Begin TFD Hotspot Remediation	OK001-48										
Begin Helipad Source Area Remediation	OK001-49										
Begin TFE Hotspot Remediation	OK001-50										
Begin Northern East Traffic Circle Source Area Remediation	OK001-51										

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Milestones - Part II

Milestone/Activity	Field Milestone Code	Critical Decision	Critial Closure Path	Project Start	Project End	Mission Complete	Tech Risk	Work Scope Risk	Intersite Risk	Cancelled	Milestone Description
Begin TF-406 Hotspot Remediation	OK001-52										
Begin Bldg 419 Source Area Remediation	OK001-53										
Begin TFB/TFC Hotspot Remediation	OK001-54										
Begin Bldgs 511/514 Source Area Remediation	OK001-55										
Begin Operation of VTF-5475 Vapor Extraction System											Same milestone as #2670.
Begin Operation of TFD-South PTU											Same as milestone #2671
Project Start Date				Y							
Project End					Y						Project end date.

Performance Measure Metrics

Category/Subcategory	Units	1997-2006 Total	2007-2070 Total	1997-2070 Total	Actual Pre-1997	Planned 1997	Actual 1997	Planned 1998	Planned 1999	Planned 2000	Planned 2001	Planned 2002	Planned 2003	Planne 200
RS														
Assess.	NR	4.00	0.00	4.00	2.00	1.00	1.00		1.00	2.00				
RS														
Cleanup	NR	9.00	0.00	9.00	2.00	1.00	1.00	5.00	1.00	2.00				
Rem. Waste														
Disposed	M3	36.00	68.00	104.00	0.00		0.00	7.20	3.60	3.60	3.60	3.60	3.60	3.6
Tech.														
Deployed	Ntd	3.00	0.00	3.00						1.00	2.00			

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Category/Subcategory	Units	Planned 2004	Planned 2005	Planned 2006	Planned 2007	Planned 2008	Planned 2009	Planned 2010	Planned 2011 - 2015	Planned 2016 - 2020	Planned 2021 - 2025	Planned 2026 - 2030	Planned 2031 - 2035
RS Assess.	NR												
RS Cleanup	NR												
Rem. Waste Disposed	M3	3.60	3.60	3.60	3.60	3.60	3.60	3.60	18.00	18.00	17.60		
Tech. Deployed	Ntd												

Category/Subcategory	Units	Planned 2036 - 2040	Planned 2041 - 2045	Planned 2046 - 2050	Planned 2051 - 2055	Planned 2056 - 2060	Planned 2061 - 2035	Planned 2066 - 2070	Exceptions	Lifecycle Total
RS Assess.	NR								6.00	12.00
RS Cleanup	NR									12.00
Rem. Waste Disposed	M3									407.20
Tech. Deployed	Ntd									3.00

Release Sites

Site Code	RSF ID	Change Flag	Description	Class/Subclass Name	Planned Assess. Year	Forecast Assess. Year	Actual Assess. Date	Planned Comp. Year	Forecast Comp. Year	Actual Comp. Date	Acc. Year	No Action	Comp. Status	RAD
LLMS	0030		Bldg 292	Tanks/Underground Storage Tanks	1998			1998	1998	3/31/1998		N		Y
LLMS	0046		Bldg 331	Spills and	1998			1998	1998	3/31/1998		N		Y

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Release Sites

Site Code	RSF ID	Change Flag	Description	Class/Subclass Name	Planned Assess. Year	Forecast Assess. Year	Actual Assess. Date	Planned Comp. Year	Forecast Comp. Year	Actual Comp. Date	Acc. Year	No Action	Comp. Status	RAD
				Leaks/Surface Spills										
LLMS	0057		Bldg 518 Area Drum Rack	Spills and Leaks/Surface Spills	1998			1998	1998	3/31/1998		N		N
LLMS	0058		Bldg 518 Area Drum Rack Spills	Spills and Leaks/Surface Spills	1998			1998	1998	3/31/1998		N		N
LLMS	0059		Bldg 518 Area Solvent Spill	Spills and Leaks/Surface Spills	1998			2000	1998	3/31/1998		N		N
LLMS	0060		BLDG 543	Spills and Leaks/Surface Spills	2000	2000		2000	2000			N		N
LLMS	0066		Bldg 191 Area	Spills and Leaks/Surface Spills	1998			1998	1998	3/31/1998		N		N
LLMS	0071		East Taxi Strip Area Disposal Pits	Waste/Pits	1995		9/30/1995	1995		9/30/1995		Y	Pending	N
LLMS	0072		East Taxi Strip Area Disposal Pits	Waste/Pits	1993		9/30/1993	1993		9/30/1993		Y	Pending	N
LLMS	0082		Eastern Landing Mat. Storage Area Oil & Chem. Spills	Spills and Leaks/Surface Spills	1999		6/23/1999	1999	1999	6/23/1999		N		N
LLMS	0088		MW-501 Area	Surface and Groundwater/Groundwater Plumes	2000	2000		2000	2000			N		N
LLMS	0121		PCB Capacitor Area	/	1997	1997	9/30/1997	1997	1997	9/30/1997		N		

Technology Needs

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Technology Needs

Site Need Code: OK99-02

Site Need Name: In-Situ Aggressive Destruction Technologies to accelerate Remediation of Source Areas

Focus Area Work Package ID: SS-07 **Focus Area Work Package:** Vadose Zone Treatment Systems

Focus Area: SCFA **Agree with Technology Link:** Y

Benefits (Cost, Risk Reduction, Both): Risk Reduction

Technologies	Cost Savings (in thousands of dollars)	Range of Estimate
Electrical Resistance Tomography for Subsurface Imaging	0	Medium
Hydrous Pyrolysis/Oxidation	30,000	Medium

Related CCP Milestones	Related Waste Streams	Agree?	Change?
	01810: AB - HAZ-VOC Contaminated GW	Y	N

Site Need Code: OK99-05

Site Need Name: Separation of Tritium from VOC in Groundwater

Focus Area Work Package ID: SS-08 **Focus Area Work Package:** Saturated Zone Treatment Systems

Focus Area: SCFA **Agree with Technology Link:** Y

Benefits (Cost, Risk Reduction, Both): Risk Reduction

Technologies	Cost Savings (in thousands of dollars)	Range of Estimate

Related CCP Milestones	Related Waste Streams	Agree?	Change?
	01810: AB - HAZ-VOC Contaminated GW	Y	N

Technology Deployments

	Deployment Year		
Deployment Status	Planned	Forecast	Actual Date

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Technology Deployments

	Deployment Year		
Deployment Status	**Planned**	**Forecast**	**Actual Date**
Technology Name: Electrical Resistance Tomography for Subsurface Imaging			
Potential Deployment	2001		
Technology Name: Hydrous Pyrolysis/Oxidation			
Potential Deployment	2001		
Technology Name: Electro Osmosis			
Deployment Commitment	2000		