

Completion Review Report

Date: March 10, 2014

Licensee: South Texas Mining Venture, L.L.P.

License Number: R03626

Facility Name: Mt. Lucas Project

Location: Dinero, Texas

Licensed Area Being Terminated: Approximately 6,023 acres

Manager: Gary L. Smith, Ph.D., Section Manager, Uranium Section

Technical Reviewer: Philip Shaver, Uranium License Reviewer

I. SUMMARY

South Texas Mining Venture, L.L.P.'s (STMV) Mt. Lucas Project was an *in situ* leach (ISL) uranium mining and ion exchange (IX) uranium recovery site which has been decommissioned and reclaimed under Texas' Agreement State authority, derived from Title II of the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA). The Texas Commission on Environmental Quality (TCEQ) is the agency of the State of Texas currently granted jurisdictional authority for regulation of source material recovery licensees, under the provisions of Chapter 401 of the Texas Health and Safety Code. UMTRCA requires that prior to termination of the license, the U.S. Nuclear Regulatory Commission (NRC) shall make a determination that the licensee has complied with the applicable standards and requirements. Further, the NRC has reserved the right to provide concurrence on release to unrestricted use of licensed sites prior to license termination, under the provisions of Title 10 of the Code of Federal Regulations, Section 150.15a. Under the Agreement State program, the State of Texas via its agency, the TCEQ, is responsible for approval of the remediation plans for STMV and for site inspections to ensure that the actual remedial actions have been completed pursuant to the approved plans and complies with the applicable criteria.

This report documents the TCEQ's basis for its conclusion that decommissioning and reclamation have been acceptably completed at the Mt. Lucas site. The NRC FSME Procedure SA-900 titled "Termination of Uranium Milling Licenses in Agreement States," was used to prepare this report.

The primary applicable standards for uranium mill reclamation are Subchapter L of Chapter 336 of Title 30 of the Texas Administrative Code, titled "Licensing of Source Material Recovery and By-Product Material Disposal Facilities. This state regulation has been determined by review by the NRC to be consistent with and compatible with NRC regulations, as required by the state's Agreement State status with the NRC.

All applicable standards and requirements, with appropriate references to the related sections of this CRR, are identified in the Table 1 of this report. The TCEQ has performed a complete review of the Mt. Lucas site for compliance with all applicable standards and requirements. As a part of that review, the TCEQ has prepared a Uranium License Review Sheet (ULRS) to document the TCEQ's review. The ULRS includes references to correspondence to and from the licensee, regulatory agency inspection reports, and regulatory agency documents (e.g., memoranda documenting the activities and findings relating to confirmatory surveys, inspection reports) pertinent to decommissioning activities at the site. TCEQ's reviews of Licensee submittals and its own confirmatory activities were conducted using a variety of guidance documents (e.g., NUREG-1569 "Standard Review Plan for In Situ Leach Uranium Extraction License Applications," NUREG-1575 "Multi-Agency Radiation Survey and Site Investigation Manual" Rev. 1, TCEQ Draft Internal Procedure "Procedure for Conducting Confirmatory Close Out Surveys of Open Lands at In Situ Leach Uranium Recovery Facilities").

Table 1 Applicable Standards and Requirements Related to Topics Discussed in the CRR

Applicable Standards/Requirements				CRR Sections
State Rule: Title 30 of the Texas Administrative Code Section 331.107 UIC Permit: UR02493 Aquifer Restoration				Sections II.2 and II.3
State Rule: Title 30 of the Texas Administrative Code Section 331.46 UIC Permit: UR02493 Plugging and Abandonment of Wells				Section 2 and 3
Release of equipment and materials. State Rule: Title 25 of the Texas Administrative Code Section (§) 289.202(eee)(1) and §289.202(ggg)(6); and State Rule: Title 30 of the Texas Administrative Code Section 336.364 Appendix G License Condition: Condition 27.F Criteria for release of equipment, facilities and materials (i.e., discrete solid objects) for unrestricted use are as follows:				Section 4
Nuclide	Average	Maximum	Removable	
U-nat	5,000 dpm alpha/100 cm ²	15,000 dpm alpha/cm ²	1,000 dpm alpha/cm ²	
Ra-226, Ra-228, Th-nat,	1,000 dpm/100 cm ²	3,000 dpm/100 cm ²	200 dpm/100 cm ²	
Beta-gamma emitters	5,000 dpm beta, gamma/100 cm ²	15,000 dpm beta, gamma/100 cm ²	1,000 dpm beta, gamma/100 cm ²	
Release of sites (open areas with soil) to unrestricted use. State Rule: 30 TAC §336.1115(e); and State Rule: 25 TAC §289.202(eee)(4) and (6); and §289.260(h)(6)(A) and (C) Release of open areas with soil Criteria for release to unrestricted use of soils (i.e., land) are the following:				Section 4
<ul style="list-style-type: none">• Radium-226 or -228 averaged over 100 square meters:<ul style="list-style-type: none">○ 5 pCi/g, averaged over the first 15 cm of soil below the surface; and○ 15 pCi/g, averaged over 15 cm thick layers of soil more than 15 cm below the surface.• Natural uranium averaged over 100 square meters:<ul style="list-style-type: none">○ 30 pCi/g, averaged over the first 15 cm of soil below the surface; and○ 150, averaged over 15 cm thick layers of soil more than 15 cm below the surface.(Replaced November 13, 2013, with the “Radionuclides other than radium” standard)• Radionuclides other than radium – By-product material containing concentrations of radionuclides other than radium in soil (e.g., natural uranium, natural thorium, lead-210), and surface activity on remaining structures, must not result in a total effective dose equivalent (TEDE) exceeding the dose from cleanup of radium contaminated soil to the standard in paragraph (1) (i.e., the radium concentration limits specified in the preceding bullet) of this subsection (radium benchmark dose), and must be at levels which are as low				

as reasonably achievable. If more than one residual radionuclide is present in the same 100 m ² area, the sum of the ratios for each radionuclide of concentration present to the calculated radium benchmark dose equivalent concentration limits will not exceed "1" (unity). The calculation is made using the United States Nuclear Regulatory Commission (NRC) staff guidance on the Radium Benchmark Dose Approach.	
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The Texas Commission on Environmental Quality thinks that South Texas Mining Venture L.L.P.'s Mt. Lucas Project site generally meets the applicable standards and requirements. With a determination by the NRC, as required by Section 274c.(4) of the Act, that the applicable standards and requirements have been met, the Mt. Lucas Project site on Radioactive Material License No. R03626 can be released to unrestricted use.

II. DOCUMENTATION OF BASES FOR CONCLUSION

The following are the TCEQ's review results for items specified in FSME Procedure SA-900 "Termination of Uranium Milling Licenses in Agreement States."

1. Description of licensee's activities associated with decommissioning

The Mt. Lucas Project is an ISL uranium mine and satellite IX recovery facility located near Dinero, Texas. The Mt. Lucas licensed area covers approximately 6,023 contiguous acres of land. (Everest – 1986B; TDH – 1986A).

The Mt. Lucas site is bisected by a farm to market road which effectively divides the site into East and West operations. On the east side of the road resided the Mt. Lucas-East Plant site, four (4) irrigation areas and 10 wellfields. The Mt. Lucas-East plant site included a curbed and sumped concrete pad for the ion exchange facility equipment and tankage [consisting of four (4) ion exchange tanks IX-A through IX-D, two (2) tanks (T-1 and T-2)]; a tank located off the process slab labeled "Caustic;" an office building; a shop/office building; a structure consisting of a laboratory/control room and a lunch room; a metal maintenance building; a shed for storing valves; two (2) fenced by-product material storage areas; septic tank; trash pit (non-contaminated); and two (2) treatment ponds (East Pond and West Pond, with four (4) monitor wells (PRM-1 through PRM-4) around the ponds). Both ponds were clay-lined, however, the East Pond also had a synthetic liner. (Everest – 1986C, TDH – 1986A, TDH – 1986B)

The irrigation areas at the Mt. Lucas-East operation consisted of Phases I (22.78 acres), II (25.64 acres), III (28.52) and IV (27.39). The Phase I Irrigation Area was used from late 1983 to March 1986. Phase II was used from April 1986 to September 1995. Phase III was used from June 1986 to September 1995. Phase IV was used from July 1990 until January 1996. (Everest – 1996E)

The wellfields located on the Mt. Lucas-East operation included the Lillian (7.3 acres), EA (4.56 acres), EA-North (2.85 acres), EA-South (1.15 acres), E (9.6 acres), HM-East (6.7 acres), HM-West (13.73 acres), H (10.83 acres), H-Extension, and H-Expansion (1.83 acres combined). (Everest – 1996E)

The Mt. Lucas-West operation included a remote ion exchange plant site consisting of four (4) IX vessels, a resin tank and a surge tank situated on a caliche pad, and a control room/lab building adjacent to the caliche pad. (Everest – 1987, Everest - 1989)

Wellfields located on the Mt. Lucas-West operation included the M-Sand (14.39 acres), J (10 acres), North J (5 acres), South J (7.2 acres), J-6 and J-7 (4 acres combined). (Everest – 1996E)

Figure 1, an image depicting the overall layout of the Mt. Lucas Project site and the major features may be found in Appendix 2 of this report.

Decommissioning activities typically began with groundwater restoration. The completion dates for groundwater restoration for the various wellfields are given in Appendix 1 “Summary of Sequence of Activities” and information and documentation relating to successful completion of groundwater restoration and plugging and abandonment of wells in accordance with applicable standards are addressed in Sections 2 and 3 of Part II of this report. However, an exception to the typical sequence of events involved decommissioning of the ion exchange satellite plant on the Mt. Lucas-West operation. Instead of restoring the groundwater in the mining aquifer before dismantling the remote ion exchange (IX) facility, that is, the Mt. Lucas - West plant, the remote IX facility was dismantled. Equipment (i.e., tankage) from the remote IX facility was transferred to another of the Licensee’s facilities (Tex-1 Project) in 1987. The fluid from groundwater restoration operations in the wellfields previously served by the Mt. Lucas – West plant was diverted by pipeline to the Mt. Lucas – East plant site. (Everest – 1996B)

As groundwater restoration was achieved in the various wellfields, the pipelines used to transmit fluids to the processing plants, between processing plants and the irrigation areas were removed. In the instances where the pipeline had been buried, the Licensee conducted gamma surveys of the trenches. After the Licensee was satisfied that the trenches did not exceed release criteria, the regulatory agency was invited to perform a confirmatory survey. Upon receipt of notification from the regulatory agency that the trench was determined not to exceed release criteria, the Licensee backfilled the trench. (Everest – 1997A, Everest – 1997B, Everest - 1997C, Everest – 1997D, TDH – 1997A, TDH – 1997B)

At the conclusion of groundwater restoration, the irrigation areas were surveyed and reclamation work begun, if needed. Before beginning reclamation work in the wellfields, the remaining irrigation areas and the Mt. Lucas East plant site, decommissioning work came to a halt in the late 1990’s and early 2000’s due to limited financial resources available to the Licensee. Work did not resume until the Licensee was placed under an Agreed Order issued by the TDH specifying a timeline for completion of various aspects of the decommissioning process. (TDH – 2002A)

To complete reclamation of the wellfields and Phases I, II and III Irrigation Areas, the Licensee pleaded financial hardship and applied for and received an amendment to the radioactive material license to allow areas in the wellfields and the irrigation areas which exceeded the Ra-226 in soil concentration release criteria to be homogenized in place. Thus, *in situ* soil homogenization was used in the wellfields and irrigation areas to complete reclamation work. Following homogenization, an intermediate gamma survey was performed. If areas still indicated a potential to exceed the release criteria, homogenization efforts were again applied to those areas. A final verification gamma survey, and collection and analysis of soil samples was then made. When the

Licensee was satisfied that an area did not exceed release criteria for soils, the regulatory agency was notified and requested to conduct a confirmatory survey.

The final stages of decommissioning at the site involved conducting verification surveys and spot reclamation work in the wellfields and decommissioning (surveying and removal of the slab for the process plant; demolition of structures; transfer of equipment for reuse; disposal of contaminated materials, including soil removed from the plant and pond areas, and equipment; and conducting final surveys and collecting and analyzing soil samples) of the Mt. Lucas-East plant site. At the conclusion of the verification surveys and analysis of soil samples obtained from the aforementioned areas, the Licensee submitted reports to the regulatory agency and requested a confirmatory survey and release of the areas and site to unrestricted use.

Any material and/or equipment which was contaminated was disposed of by 1) transfer to a facility licensed to receive by-product material for disposal; 2) transfer to another person licensed to possess equipment contaminated with by-product material (i.e., a licensed uranium recovery facility); or decontaminated to not exceed the surface contamination limits specified in the section pertaining to release of equipment and materials in Table 1 "Applicable Standards and Requirements Related to Topics Discussed in the CRR" in Section I of this report and released for unrestricted use.

The Licensee performed surveys to confirm the effectiveness of decommissioning activities. All wellfields, irrigation, and plant site areas were surveyed and soil samples collected to demonstrate that the limits specified in the section of this report pertaining to release of sites (open areas with soil) to unrestricted use (re: Table 1 "Applicable Standards and Requirements Related to Topics Discussed in the CRR" in Section I of this report) were not exceeded. More details regarding the surveys and soil sample collection and analysis are provided in Section 5 of Part II of this report. Decommissioning activities were completed in December 2012.

From May of 2009 through November 2012 the TCEQ performed confirmatory surveys and collected soil samples at various sites (i.e., wellfields, irrigation areas, and plant sites) at the Mt. Lucas site. Analysis of soil samples indicates that the average radium-226 concentration for 100 square meter (m²) areas did not exceed the criteria specified in the section titled "Release of sites (open areas with soil) to unrestricted use" in Table 1 "Applicable Standards and Requirements Related to Topics Discussed in the CRR" of Section I of this report, and the radium benchmark dose for the resident rancher scenario was not exceeded as determined using the radium benchmark dose approach (NRC - 2003). More details regarding the surveys and soil sample collection and analysis are provided in Section 5 of Part II of this report.

Although the method for decommissioning of open areas (e.g., wellfields, irrigation areas) at the site may be construed as disposal of radioactive materials, no land is to be transferred to the State or the Federal Government as the decommissioning method of homogenization is consistent with the NRC's position espoused in SECY-04-0035 (NRC – 2004).

2. Information which demonstrates that the groundwater has been restored to meet applicable standards and requirements.

Injection authorization associated with the leaching (mining) of uranium and restoration of the groundwater in the mining zones is the jurisdiction of the Underground Injection Control (UIC) Program. The UIC Program resided within the Texas Water Commission (TWC), which subsequently became the Texas Natural Resource Conservation Commission (TNRCC) and now the TCEQ. Thus, all data pertaining to the restoration of the groundwater was reviewed by the UIC Program. The Uranium Section (US) of the Radioactive Materials Division of the TCEQ has reviewed correspondence from the TNRCC to Everest stating that the TNRCC has determined that the aquifer has been restored in accordance with 30 TAC §331.107, and all Class III wells were plugged and abandoned in accordance with permit requirements and 30 TAC §331.46, as certified by an independent registered professional engineer and confirmed by inspection of the site by the staff of the TNRCC. Thus, the referenced correspondence from TNRCC to Everest implies that the groundwater has been restored to meet applicable standards and requirements. (TNRCC – 1999)

3. Documentation that the production, injection and monitoring wells have been closed and plugged in accordance with applicable standards and requirements

As discussed in Section II.2 above, the UIC Program had sole jurisdiction over the production, injection and monitoring wells at uranium recovery operations. Consequently, no data pertaining to such wells were reviewed by the US. Instead, the US relied on the UIC Program to determine that the wells had been plugged and abandoned in accordance with the applicable standards and requirements. The US reviewed a permit cancellation dated March 23, 1999. The permit cancellation stated that the aquifer at the Tex-1 site had been restored in accordance with 30 TAC §331.107, and that all Class III wells were plugged and abandoned in accordance with permit requirements and 30 TAC §331.46, as certified by an independent registered professional engineer and confirmed by inspection of the site by staff of the TNRCC. Thus, the referenced correspondence from TNRCC to Everest Exploration, Inc. demonstrates that the wells (i.e., production, injection and monitoring wells) at the Mt. Lucas site have been closed and plugged to meet applicable standards and requirements (30 TAC §331.46), with the exception of 11 wells which were transferred to the landowner (Lon Cartwright). The 11 wells consisted of the following:

Mt. Lucas Plant water supply well
Mt. Lucas “EA” Wellfield (UR02381-021) overlying aquifer well (#MA)
Mt. Lucas “H” Wellfield (UR02381-031) water supply well
Mt. Lucas “HM” Wellfield (UR02381-041), Well (#HMW)
Mt. Lucas “J” Wellfield (UR02381-071) overlying aquifer wells MA-20, 22 and 23
Mt. Lucas “South J” Wellfield (UR02381-081) overlying aquifer well MA-24
Mt. Lucas West Regional Baseline Wells, RM-12, RM-14 and RM-15.

The wells were transferred after groundwater restoration was completed. The water in the transferred wells is not considered to have been impacted by the uranium mining operation. (TNRCC – 1996A, TNRCC – 1999)

4. Decommissioning information which documents that all radiologically contaminated materials have been properly disposed of, transferred to licensee(s) authorized to possess such materials, or meet applicable standards and requirements for release.

During Mt. Lucas' period of operation the Licensee was required by Rule (i.e., Texas Regulations for Control of Radiation, Part 21; Title 25 of the Texas Administrative Code, Chapter 289, Section 202; and Title 30 of the Texas Administrative Code, Chapter 336, Subchapter D) and a condition on the radioactive material license (8-3068, L03068, L03626 and R03626) which prohibited the Licensee from releasing equipment and materials from the site to unrestricted use if the surface contamination on the equipment and materials exceeded the limits specified in Table 1 "Applicable Standards and Requirements Related to Topics Discussed in the CRR" in Section I of this CRR. Inspections have been made of the Licensee's operations since the issuance of the radioactive material license for compliance with the provisions of the Rules and the conditions on the license. Since the Licensee was not required to submit to the regulatory agency records of surveys made to demonstrate that equipment or materials released to unrestricted use did not exceed the prescribed limits, the record on this subject resides with the information recorded in the inspection reports. Some inspection reports have sections titled to specifically address the release of equipment and materials to unrestricted use and either note that no items were released to unrestricted use for the period of the inspection, or note with varying degrees of detail that items were released. However, a number of the inspection reports are silent with respect to the release of equipment and materials to unrestricted use. In those cases, the assumption is made that the Licensee was complying with the requirements of the Rule and the license, otherwise it would have been noted on the inspection report.

Rules under which the Licensee has operated (i.e., Texas Regulations for Control of Radiation, Part 21; Title 25 of the Texas Administrative Code, Chapter 289, Section 202; and Title 30 of the Texas Administrative Code, Chapter 336, Subchapter D) required the documentation of transfer of materials and equipment, not meeting the criteria for release to unrestricted use, to other persons. Evidence was found in some, but not all, inspection reports that records were made to document the transfer of equipment and materials which were determined to be contaminated, to licensed by-product material disposal facilities and to persons licensed to possess such material. No reports indicated that any inappropriate transfers were made. Since no record was found in the inspection reports to indicate a violation for failure to make a record of equipment or material transfers, the assumption is made that records of transfers were properly made and that equipment and materials were transferred in accordance with the requirements of rules and license conditions. (TDH – 1984A, TDH – 1984B, TDH – 1985A, TDH – 1985B, TDH – 1986B, TDH – 1987A, TDH – 1987B, TDH – 1988A, TDH – 1988B, TDH – 1989A, TDH – 1989B, TDH – 1990A, TDH – 1990B, TDH – 1991A, TDH – 1991B, TDH – 1992A, TDH – 1992B, TDH – 1993A, TNRCC – 1993, TNRCC – 1994, TNRCC – 1995, TNRCC 1996B, Everest 1996B, Everest – 1997D, TDH – 1998B, TDH – 1999, TDH – 2000, TDH – 2001, TDH – 2003A, DSHS – 2006A, TCEQ – 2008, TCEQ – 2009B, STMV - 2013)

When ownership of the license transferred from Everest Exploration, Inc. to South Texas Mining Venture L.L.P., records documenting transfer and disposal of by-product material and results of surveys conducted to demonstrate that debris, materials, equipment, and structures did not exceed the limits for release to unrestricted use were provided to the TCEQ. (STMV – 2013D)

5. Discussion of the results of radiation surveys and soil sample analyses which confirm that the licensed site meets applicable standards and requirements for release.

Pipeline Trenches

Pipelines between the East and West processing plants and the wellfields were removed and either transferred to the RGR Panna Maria mill site for disposal in the tailings impoundment or transferred to other uranium companies. The pipeline trenches were surveyed by the Licensee using the criterion of twice background as an indicator of contamination. Soil from areas exceeding this criterion were excised from the trenches and disposed of as by-product material. (Everest – 1997B, Everest – 1997D)

Irrigation Areas

Prior to the application of irrigation fluids, the Licensee conducted soil sampling in the general area and established an average Ra-226 concentration of 0.8 pCi/g and an average natural uranium concentration of 0.8 pCi/g as the baseline (Everest – 1986A). Following completion of groundwater restoration, pipelines in the irrigation areas were removed. The pipe was transferred to the Rio Grande Resources Corporation's Panna Maria mill site for disposal in the tailings impoundment. Trenches in the irrigation areas from which the pipes were removed were surveyed by the Licensee and results submitted to the TNRCC, the regulatory agency at the time. (Everest – 1997A, Everest – 1997C)

Phase IV Irrigation Area

Following completion of irrigation activities, the Licensee pursued a survey campaign of the Phase IV Irrigation Area. A 10 meter by 10 meter grid was established over the area. The gridlines were walked and survey readings made using Ludlum Model 18 survey meters coupled to a lead shielded one-by-one inch sodium iodide detector. The detector was held a few inches above the ground. In addition to the grid line surveys, surveys were made around locations of sprinkler heads. The survey results were then reviewed for variability in gamma magnitude and relative percentage of each to the total number of readings. Soil sample locations were then selected to be representative of each gamma magnitude. From the survey data and prior establishment of background concentration, 400 cpm was estimated to correlate to the background concentration of radium in the soil. Soil locations were then selected to ensure that 21% of the soil samples to be collected were from areas with 3% of the highest gamma readings. Soil samples were collected to depths of surface to six (6) inches, and six (6) inches to 12 inches. Analysis indicated the highest Ra-226 result to be 4.4 pCi/g with a uranium concentration of 5.3 mg/kg (3.6 pCi/g). Following the soil sampling campaign, the Licensee conducted a final gamma survey using a Ludlum Model 12S MicroR meter, followed by a request to the TNRCC that the irrigation area be released to unrestricted use. (Everest – 1996C)

Phase II and III Irrigation Areas

The Licensee conducted an initial survey of the Phases II and III Irrigation Areas. The survey was conducted using a Ludlum Model 2221 Rate Meter, equipped with a 2 X 2 inch sodium iodide probe, interfaced with a Trimble GPS system and mounted on an all-terrain vehicle (ATV). The system collected data (x - y coordinates, and gamma readings) while covering the irrigation areas on 3 to 5 meter spacing. Survey results ranged from less than 11,000 cpm to greater than 20,000 cpm.

Historical soil sampling and analysis indicated that there were areas which might exceed the soil concentration release criteria for radium. As previously mentioned, due to limited financial resources the Licensee sought to avoid the expense of removal and disposal of soil exceeding the release criteria. Therefore, the Licensee sought and obtained an authorization via license amendment to employ homogenization of the soil in Irrigation Area Phase I, II and III as a means of reducing the concentration of radium in the soil to levels not exceeding the criteria for release to unrestricted use. The authorized method of soil homogenization, referred to as *in situ* soil homogenization, involved laterally distributing areas where Ra-226 concentration in soil exceeded 13 pCi/g to other areas within the irrigation area. The license condition prohibited the Licensee from bringing soil from outside the irrigation area into the irrigation area for blending with the soil in areas that exceeded 13 pCi/g. The Licensee was required to conduct a survey following lateral distribution to demonstrate that no area exceeded 13 pCi/g of radium. Once lateral distribution was demonstrated to have been achieved the desired soil concentration, a Rotomixer, or equivalent, was used to vertically mix the soil to a maximum depth of 18 inches (TDH – 2002B). Following vertical mixing of the soil, the Licensee performed a verification survey, and requested the TDH to conduct a confirmatory survey and to release the irrigation areas to unrestricted use. (Everest – 2003, Everest - 2004)

Phase I Irrigation Area

Although the Licensee was authorized to conduct *in situ* soil homogenization (the same methodology used in Phase II and III Irrigation Areas) in the Phase I Irrigation Area, the magnitude of contamination proved to be too great to achieve the desired result. Consequently, the Licensee made application for an alternative method of soil homogenization. The alternative method, referred to as *ex situ* soil homogenization, involved lateral distribution of surficial soil within the irrigation area; followed by excavation of a trench to a depth of four (4) feet and windrowing of the excavated soil; homogenization of the windrowed soil using a straddle mixer (employing several passes over a windrow of soil to ensure homogeneity); surveying the homogenized-windrowed soil (with a shielded 2 X 2 inch sodium iodide detector, attached to the end of a boom, connected to a Ludlum Model 2241-3 rate meter mounted on an ATV), and sample collection and analysis of the homogenized windrowed soil to ensure homogeneity. If the results indicated that the Ra-226 concentration did not exceed the release criteria, the homogenized soil was placed back into the trench; and compacted and graded to a near level surface. The *ex situ* soil homogenization method was approved, following successful demonstration in a pilot test (DSHS – 2004, Everest - 2005), by amendment of Radioactive Material License No. L03626 (DSHS – 2006B). The Licensee utilized the *ex situ* soil homogenization method to remediate the Phase I Irrigation Area.

Subsequent to the *ex situ* soil homogenization effort the Licensee conducted a verification survey of the irrigation area utilizing a gamma detector (a shielded 2 X 2 inch sodium iodide detector) coupled to a Ludlum model 2241-3 rate meter interfaced with a Trimble GPS system, recording x-y coordinates and gamma counts, mounted on an all-terrain vehicle. The survey was performed by making passes over the irrigation area using one (1) to two (2) meter spacing between passes. Following the verification survey, the Licensee collected verification soil samples from 25 locations, sampling at the surface to six (6) inch depth and six (6) inch to 12 inch depth at each location. Results, including the raw gamma count data of the final survey, were submitted to the TCEQ with a request that the area be released to unrestricted use. (STMV – 2011, STMV – 2012A, STMV – 2012B, STMV – 2013A, STMV – 2013B)

For clarification regarding the difference between *in situ* and *ex situ* soil homogenization, *in situ* soil homogenization homogenizes the soil in place, to a maximum depth of 18 inches. Whereas, *ex situ* soil homogenization involves excavating the soil to a depth of four (4) feet from a four (4) to five (5) foot wide trench, placing the excavated soil in a windrow parallel to the trench from which the soil was excavated, passing a straddle mixer over the length of the windrowed soil several times until the windrowed soil is sufficiently homogenized, then placing the homogenized soil back into the trench from which it had been excavated. The *ex situ* soil homogenization method provides for a greater depth of soil homogenization and was used only in the Phase I Irrigation Area. The *in situ* soil homogenization method was used only in the Phase II and III Irrigation Areas, and in the wellfields (except for the J Wellfield). The greater level of contamination in the Phase I Irrigation Area precluded the use of the *in situ* soil homogenization method.

Area Adjacent to the Phase I Irrigation Area

In the course of making inspection and complaint investigation visits to the Mt. Lucas site, it was discovered that the Licensee had engaged in digging a trench in an area adjacent to the Phase I Irrigation Area. The purpose of the trench was presumably to enhance drainage from the Phase I Irrigation Area. This raised concern regarding possible contamination of the adjacent area. A subsequent review of the license file revealed that in the 1980s, TDH staff had noted contamination in this area (TDH – 1986C). The Licensee was requested to include this area in its assessment of the site to verify that the area met release criteria. The Licensee conducted a survey of the area using the same instrumentation and method as employed in the survey of the Phase I Irrigation Area and collected soil samples (at the surface to 6" depth and 6" to 12" depth) from 20 locations. Soil sample results indicated that areas within the adjacent area exceeded the uranium soil concentration limit for the surface to 6" soil horizon specified at 30 TAC §335.1115(e)(3) (note: the cited rule has since been changed to remove the uranium concentration limits, and replaced with the radium benchmark dose approach). The Licensee had an analysis performed with RESRAD using a resident rancher scenario to establish a radium benchmark dose for the Mt. Lucas site. This benchmark was stated to be established in accordance with the radium benchmark dose approach specified in Appendix E "Guidance to the U.S. Nuclear Regulatory Commission Staff on the Radium Benchmark Dose Approach" of NUREG-1569 "Standard Review Plan for In Situ Leach Uranium Extraction License Applications." None of the samples yielded results which exceeded unity when compared to the radium benchmark dose. (STMV – 2011, STMV – 2012A, STMV – 2012B, STMV – 2013A, STMV – 2013B)

Wellfields

The following describes the Licensee's general protocol with respect to the wellfields at the Mt. Lucas site. The Licensee conducted an initial survey of each wellfield. The survey methodology consists of a shielded 2 X 2 inch sodium iodide detector coupled to a Ludlum Model 2241-2 rate meter interfaced with a Trimble GPS system and a data logger all mounted on an all-terrain vehicle (ATV). The detector is positioned approximately one (1) foot above the ground. The ATV makes passes across a wellfield. The passes are separated on two (2) to three (3) meter spacing. Data is collected in one (1) second intervals consisting of x-y (i.e., latitude and longitude) coordinates and gamma readings (in counts per minute).

To analyze the data, the wellfields are divided into 100 square meter (m²) blocks. The survey results for a 100 m² block are then averaged. Areas with averaged survey results for the blocks

indicating the potential for Ra-226 concentration in the soil exceeding 5 pCi/g are subjected to *in situ* soil homogenization to reduce the Ra-226 concentration in soil to levels below 5 pCi/g. As with the Phase II and III Irrigation Areas, the Licensee was authorized by license amendment to engage in *in situ* soil homogenization in the wellfields, with the exception of the J Wellfield. An analysis, by TDH staff, of the soils in the wellfields at the Mt. Lucas site determined that the soil in the J Wellfield would not be conducive to immobilization of radium. (TDH – 2004B)

The procedure for *in situ* soil homogenization in the wellfields involved laterally distributing the soil within the wellfield to achieve a Ra-226 concentration no greater than 13 pCi/g. A hand-held survey meter (Ludlum Model 2221, equipped with a shielded 2 X 2 inch sodium iodide detector) was used to direct lateral distribution of the soil. The Licensee was prohibited from mixing soils between wellfields or bringing soil in from outside a wellfield. Following lateral distribution of soil, an intermediate survey was made of the wellfield to ensure that no areas were likely to exceed 13 pCi/g of Ra-226. The impacted area was then vertically mixed, using a Rotomixer, or equivalent, to a maximum depth of 18 inches. A final verification survey was conducted to demonstrate that no areas were likely to exceed 5 pCi/g of Ra-226. The verification survey results were analyzed, and soil samples were then collected for analysis to verify the concentration of Ra-226.

The condition on the license authorizing *in situ* soil homogenization specifies the following:

- A. soil in a wellfield could be laterally distributed to achieve a concentration not to exceed 13 pCi/g of Ra-226;
- B. following lateral mixing, an intermediate survey of the wellfield would be made to ensure that no areas exceeded 16,500 cpm (which indicated that the Ra-226 concentration did not exceed 13 pCi/g;
- C. following lateral mixing, the soil would be vertically mixed to a depth not to exceed 18 inches using a Rotomixer, or equivalent;
- D. at the conclusion of the vertical mixing, the soil was to be compacted to 90% of optimum density;
- E. Within 30 days following soil homogenization the Licensee was to make a survey of the wellfield using a limit of 12,000 cpm as an indicator that Ra-226 did not exceed 5 pCi/g in the soil;
- F. no mixing of soils between wellfields or bringing soil in from outside a wellfield.

The Licensee employed the *in situ* soil homogenization method, as needed, in the wellfields. Reports of the Licensee's reclamation activities in the wellfields were submitted to the TCEQ. The reports described the Licensee's activities regarding *in situ* soil homogenization as follows:

Areas possibly exceeding Ra-226 soil concentration release criteria (impacted areas) are identified from the survey data. Soil within the impacted areas is laterally distributed. A hand-held survey meter (Ludlum Model 2221, equipped with a shielded 2 X 2 inch sodium iodide detector) is used to direct lateral distribution of the soil. Following lateral distribution of soil, an intermediate survey is made of the wellfield to ensure that no areas are likely to exceed 13 pCi/g of Ra-226. The

impacted area is then vertically mixed to a maximum depth of 18 inches. A final confirming survey is conducted to demonstrate that no areas are likely to exceed 5 pCi/g of Ra-226.

The Licensee divides the wellfield into 100 square meter (m^2) blocks. The gamma counts within each block are averaged. The 100 m^2 blocks are then arranged in order from highest to lowest averaged gamma counts. A number (typically 5) of the blocks with the highest averaged gamma counts are selected for collection of verification soil samples. A number (typically 10) of additional 100 m^2 blocks from the remaining blocks are selected at random for sampling. Verification soil samples are collected in the following manner:

- A 100 square meter (m^2) area is established around the area (i.e., 100 m^2 block) selected for sampling.
- Five sampling locations are selected within the 100 m^2 area
- One sample is collected at the center, and the remaining four (4) samples are collected near the corners of the 100 m^2 area.
- A hydraulic hammer drives a geo-probe type sampling unit to a depth of six (6) inches to collect each sample.
- The five (5) samples are composited and a portion withdrawn for analysis. (Everest – 2009A, Everest – 2009B, Everest – 2009C, Everest – 2009D, Everest – 2009E).

Reclamation details for individual or groups of wellfields are described below.

Lillian, EA-North and EA-South Wellfields

Soil samples for establishing background were collected from 10 locations outside the monitor well rings for the wellfields. Background counts for the three (3) wellfields ranges from 1,737 to 2,427 cpm, with an average of 2,000 cpm. Background soil sample analysis results for Ra-226 ranged from 0.4 pCi/g to 0.8 pCi/g, with an average of 0.5 pCi/g.

The Licensee engaged in remediation of these wellfields in the 2004 to 2008 time period. Following remediation activities (i.e., *in situ* soil homogenization), the Licensee collected gamma survey data points for the verification survey of the wellfields. Counts for the three (3) wellfields are summarized as follows:

- Lillian Wellfield - 12,484 gamma survey data points for the survey of the 7.3 acre tract of the wellfield, or approximately 42 counts per 100 m^2 area. Counts ranged from 1,493 to 5,693 cpm.
- EA-North Wellfield - 5,351 gamma survey data points with the survey of the 2.85 acre tract of the wellfield, or approximately 46 counts per 100 m^2 area. Counts ranged from 1,803 to 2,953 cpm.
- EA-South Wellfield - 2,879 gamma survey data points with the survey of the 1.15 acre tract of the wellfield, or approximately 62 counts per 100 m^2 area. Counts ranged from 1,663 to 3,033 cpm.

Five (5) 100 m^2 blocks with the highest gamma average from the three (3) wellfields were selected for collection of verification soil samples. Ten (10) additional verification sample locations were randomly selected from the remaining 100 m^2 blocks in the wellfields. Results for the soil samples collected from the five (5) highest gamma readings ranged from 0.7 pCi/g to 2.1 pCi/g. Results for

the soil samples collected from the 10 randomly selected locations ranged from 0.5 pCi/g to 1.7 pCi/g.

Reclamation activities, survey and soil sample data, and analysis of results were presented to the TCEQ in a report with a request that the wellfields be released to unrestricted use. (Everest – 2009A)

HM - East and HM - West Wellfields

Soil samples for establishing background were collected from 10 locations outside the monitor well rings for the wellfields. Background samples results ranged from 0.4 pCi/g to 0.7 pCi/g, with an average of 0.6 pCi/g for Ra-226.

The Licensee engaged in remediation of the HM-East and HM-West wellfields in the 2004 to 2009 time period. Following remediation activities (i.e., *in situ* soil homogenization), the Licensee conducted a verification survey of the wellfields. Counts for the two (2) wellfields are summarized as follows:

- HM-East Wellfield - 9,678 gamma survey data points for the survey of the 6.7 acre tract of the wellfield, or approximately 36 counts per 100 m² area. Counts ranged from 1,643 to 3,833 cpm.
- HM-West Wellfield - 21,036 gamma survey data points for the survey of the 13.73 acre tract of the wellfield, or approximately 38 counts per 100 m² area. Counts ranged from 1,043 to 14,430 cpm.

Ten blocks, with the highest gamma average were selected for collection of verification soil samples from the two (2) wellfields. Ten (10) additional verification sample locations were randomly selected from the remaining 100 m² blocks in the wellfields. Results for the soil samples collected from the 10 highest gamma readings ranged from 1 pCi/g to 2.8 pCi/g. Results for the soil samples collected from the 10 randomly selected locations ranged from 0.6 pCi/g to 2.4 pCi/g.

Reclamation activities, survey and soil sample data, and analysis of results were presented to the TCEQ in a report with a request that the wellfields be released to unrestricted use. (Everest – 2009B)

H, H-Extension, H-Expansion, J-6 and J-7 Wellfields

Background for the wellfields was established by collecting five (5) soil samples outside the boundary of the monitor well rings around each the H series, the J-6/J-7 and J wellfields. Background counts ranged from 1,166 to 1,981 cpm. Background soil sample results for Ra-226 ranged from 0.3 pCi/g to 0.7 pCi/g, with an average of 0.6 pCi/g.

The Licensee engaged in remediation of these wellfields in the 2004 to 2009 time period. Following remediation activities (e.g., *in situ* soil homogenization), the Licensee conducted a verification survey of the wellfields. Counts for the wellfields are summarized as follows:

- H Wellfield Series (i.e., H, H-Extension & H-Expansion) - 47,179 gamma survey data points for the survey of the 12.66 acre tract of the H Wellfield series, or approximately 92 data points per 100 m² block.
- J6 and J 7 Wellfields - 10,721 gamma survey data points for the survey of the 4 acre tract for the combined J-6 and J-7 wellfields, or approximately 66 data points per 100 m² block.

Soil samples were collected in Wellfield H from each of the five 100 m² blocks with the highest average gamma counts. An additional six (6) samples were collected in Wellfield H from randomly selected 100 m² blocks. Two (2) samples were collected at randomly selected locations from the H-Expansion Wellfield, and one (1) sample was collected at a randomly selected location from each of the H-Extension, J-6 and J-7 Wellfields.

Results for the soil samples collected from the five (5) highest gamma readings 100 m² block areas in the H Wellfield ranged from 3.1 pCi/g to 8.2 pCi/g. Results for the soil samples collected from the 10 randomly selected locations of these H-series and J-6 and J-7 wellfields ranged from 0.3 pCi/g to 2.5 pCi/g.

Reclamation activities, raw gamma counts from the survey and soil sample data were presented to the TCEQ in a report with a request that the wellfields be released to unrestricted use. (Everest – 2009C)

However, three of the samples from the H Wellfield were noted to yield results that exceeded five (5) pCi/g for Ra-226 in the surface to six (6) inch depth. The Licensee re-sampled these areas, and provided a report of the analytical results, when requested by the TCEQ. The analysis of the re-sampled areas gave results that ranged from 1.9 to 2.8 pCi/g. (STMV – 2013C)

EA-Center, J, NJ, SJ, and M Sand Wellfields

EA-Center Wellfield

Background for the EA-Center wellfield is based on samples collected around the EA, Lillian and E wellfields. The results averaged 0.5 pCi/g. (STMV – 2013B).

The Licensee engaged in remediation of this wellfield in the 2004 to 2009 time period. Following remediation, the Licensee conducted a verification gamma survey of the wellfield. The Licensee reported 7,300 gamma survey data points for the survey of the 4.56 acre tract of the EA-Center wellfield, or approximately 40 counts per 100 m² area. Counts ranged from 1,783 to 4,953 cpm.

Three (3) 100 m² blocks with the highest average gamma counts were selected for the collection of verification soil samples. Five (5) additional 100 m² blocks were selected at random for the collection of additional verification soil samples. Ra-226 concentration in the verification soil samples ranged from 1.7 to 2.9 pCi/g.

Reclamation activities, raw gamma counts from the survey and verification soil sample data, and analysis of results were presented to the TCEQ in a report, and in an addendum to a component of the initial report, with a request that the wellfield be released to unrestricted use. (Everest – 2009D, STMV – 2013B)

J and North J Wellfields

Background for the J and North J wellfields is based on the work performed to establish the background for the H series and the J-6/J-7 wellfields (refer to the above discussion of the H series and the J-6/J-7 wellfields). A background of 0.6 pCi/g is used.

The Licensee engaged in remediation of these wellfields in the 2004 to 2009 time period. Unlike the other wellfields at the Mt. Lucas Project, *in situ* soil homogenization was not authorized as a remediation method due to the soil type within the J wellfield, although it was authorized in the North J wellfield. Thus, any contaminated soil in the J wellfield would need to be removed and disposed of as by-product material. The Licensee acknowledges that no *in situ* soil homogenization occurred in the J wellfield.

Following remediation, the Licensee conducted a verification gamma survey of the wellfields. Counts for the wellfields are summarized as follows:

- J Wellfield - 17,317 gamma survey data points, with counts ranging from 1,113 to 7,083 cpm, for the survey of the 10 acre tract of the J Wellfield, or approximately 43 counts per 100 m² area.
- North J Wellfield - 8,777 gamma survey data points, with counts ranging from 1,103 to 4,098 cpm, for the survey of the 4 acres of the North J Wellfield, or approximately 43 counts per 100 m² area.

The five (5) blocks with the highest average gamma reading were selected for the collection of verification soil samples between the two (2) wellfields. Three (3) of the blocks were in the J Wellfield, and the remaining two (2) in the North J Wellfield. Ten additional blocks were selected at random for the collection of additional verification soil samples (7 in the J Wellfield and 3 in the North J Wellfield). Radium concentrations ranged from 0.5 to 5.7 pCi/g. A re-analysis of the sample, which initially yielded a result of 5.7 pCi/g, gave a result of 3.1 pCi/g of Ra-226.

Reclamation activities, raw gamma counts from the survey and verification soil sample data, and analysis of results were presented to the TCEQ in a report, and an addendum to a component of the initial report, with a request that the wellfield be released to unrestricted use. (Everest – 2009D, STMV – 2013B)

M Sands and South J Wellfields

Radium-226 background concentration in the soil was presented as 0.5 pCi/g, as determined from samples collected from un-impacted areas around the M Sands and South J wellfields. (STMV – 2013B)

The Licensee engaged in remediation of these wellfields in the 2004 to 2009 time period. Following remediation, the Licensee conducted a verification gamma survey of the wellfields. Counts for the wellfields are summarized as follows:

- M Sands Wellfield - 20,284 gamma survey data points for the survey of the 14.39 acre tract of the wellfield, or approximately 35 counts per 100 m² area. Counts ranged from 773 to 6,293 cpm.
- South J Wellfield - 14,122 gamma survey data points for the survey of the 7.2 acre tract of the wellfield, or approximately 48 counts per 100 m² area. Counts ranged from 793 to 4,553 cpm.

The five (5) 100 m² blocks with the highest average gamma counts were selected for the collection of verification soil samples. Seven (7) additional 100 m² blocks were selected at random for the collection of verification soil samples. All five (5) of the blocks with the highest average gamma counts were located in the M Sands Wellfield, as well as two (2) of the randomly selected 100 m² blocks. Three (3) of the randomly selected 100 m² blocks were located in the South J Wellfield. Radium concentrations ranged from 0.6 to 2.3 pCi/g.

Reclamation activities, survey and soil sample data, and analysis of results were presented to the TCEQ in a closure report, that was supplemented with an addendum to a component of the closure report, with a request that the wellfields be released to unrestricted use. (Everest – 2009D, STMV – 2013B)

E Wellfield

The background concentration for Ra-226 in soil was determined in conjunction with the EA and Lillian wellfields as 0.5 pCi/g. Background samples results ranged from 0.4 pCi/g to 0.8 pCi/g, with an average of 0.5 pCi/g for Ra-226. (Everest – 2009E)

The Licensee engaged in remediation of this wellfield in the 2004 to 2009 time period. Following remediation, the Licensee conducted a verification gamma survey of the wellfield. The verification survey yielded 15,769 gamma survey data points ranging from 1,403 to 6,923 cpm. This translates into approximately 40 counts per 100 m² area for the survey of the 9.6 acre tract of the E wellfield.

Five (5) 100 m² blocks with the highest average gamma reading were selected for the collection of verification soil samples. An additional 10 100 m² blocks were selected at random for the collection of verification soil samples. Radium concentrations ranged from 0.6 to 1.8 pCi/g.

Reclamation activities, survey and soil sample data, and analysis of results were presented to the TCEQ in a closure report, that was supplemented with an addendum to a component of the closure report, with a request that the wellfields be released to unrestricted use. (Everest – 2009E, STMV – 2013B)

Although the Licensee conducted extensive surveys of and soil samplings in the wellfields, the TCEQ decision is based on the TCEQ's confirmatory data, not the licensee's. A discussion of the TCEQ's confirmatory efforts and data is provided Section 6 of this Report.

Plant Sites

West Plant

Equipment (tanks, pipes, etc.) from the West Plant were transferred in 1987 to the Licensee's Tex-1 facility, a uranium recovery facility authorized on License No. L03626 (Everest – 1996B). Decommissioning of the process pad at the West Plant was completed in 2010 with the removal of contaminated materials left behind in 1987. The material removed from the former process pad was shipped to Denison Mines' White Mesa Mill near Blanding, Utah. (STMV – 2013B, STMV – 2013E)

East Plant

Decommissioning of the plant site took place over a number of years. Most of the structures (primarily tanks) on the plant pad were removed prior to February of 1999. (TDH – 1999)

A few of the structures (lab/office building trailer, valve storage shed, office building) and debris remaining at the plant site were surveyed and found to comply with the surface contamination release criteria, specified at 30 TAC §336.364.

The plant process pad (a concrete structure) was cleaned (twice with hydrochloric acid and once with sand blasting) and surveyed for fixed and removable beta-gamma and alpha radiation. When it was determined that the process pad did not exceed the surface contamination release criteria, as specified at 30 TAC §336.364, the process pad was demolished, removed and disposed of, with the landowners approval, in a low area at the Mt. Lucas site. (STMV – 2012B, STMV – 2013B)

The only structure remaining at the East Plant site is the metal maintenance building. The Licensee reviewed the use history of the building and determined that it had little potential for being contaminated. Consistent with the MARSSIM recommendation for categorizing an area with respect to its probability for being contaminated, the licensee made a survey of the building for alpha and beta-gamma contamination. The results indicated that the building did not exceed the surface contamination limits specified at 30 TAC §336.364.

Septic Tank

A septic tank measuring 3 X 3 X 3 feet was used at the East Plant. The contents of the septic tank were sampled and analyzed yielding the following results:

Ra-226: 1.6 pCi/l, or 1.6 E -3 pCi/ml or /g
Uranium: 130 mg/kg, or 89 pCi/g

The contents were subsequently removed and shipped as by-product material to the Denison Mines White Mesa Mill near Blanding, Utah for disposal.

The septic tank was surveyed with a survey meter equipped with a sodium iodide probe. Results were reported not to exceed background. The Licensee referred to NUREG 1757 "Consolidated Decommissioning Guidance" Appendix G "Special Characterization and Survey Issues" as applicable guidance regarding the septic tank and its disposition. The results from the contents of the septic tank, and the guidance from NUREG-1757 were the justification used by the Licensee to collapse the septic tank in place and bury it under three and a half feet of soil cover. (STMV – 2013B, STMV – 2013E)

Treatment Ponds

Decommissioning of the ponds began in March of 1996 and by September of 1996 the liner of the East Pond had been removed and the under-drain piping of both ponds had been removed. The liner from the East Pond and the sludge from both ponds were removed and transferred to the Rio Grande Resources Corporation's Panna Maria mill site (Radioactive Material License No. RW02402) for disposal in the tailings impoundment. (Everest – 1996A; TNRCC – 1996B)

Final demolition of the ponds and removal of contaminated soil occurred after STMV took over operation of the site under R03626 from Everest. Contaminated soil was transferred to the White Mesa Uranium Mill near Blanding, Utah operated by Denison Mines. (STMV – 2012B, STMV 2013B)

After demolition and removal of the processing plant pad, and demolition of the ponds and removal of contaminated soil, the combined area of the plant site (process pad and surrounding area, and treatment ponds) was surveyed and soil samples collected and analyzed for Ra-226. A brief description of decommissioning activities, the raw gamma survey data of the area, and the soil sampling results were provided to the TCEQ in a report, with a request that the area be released to unrestricted use. (STMV – 2012B)

The Licensee provided copies of 128 shipping manifests to document shipment of by-product material from the Mt. Lucas site to the White Mesa Mill near Blanding, Utah. The shipping manifests indicate that the volume of material in each shipment ranged from 20,000 to 30,000 pounds. (STMV – 2013B)

6. Discussion of results of the State Regulatory Agency's Site Closure Inspections

General Information

Regulation of uranium recovery facilities in Texas has been transferred, by legislative fiat, among several state agencies over the last 30 years. The Texas Department of Health (TDH) regulated the radioactivity aspect of uranium recovery until 1993, when it was transferred to the Texas Natural Resource Conservation Commission (TNRCC). The regulatory program was returned to the TDH in 1997 where it remained until 2007, when it was transferred to the Texas Commission on Environmental Quality (TCEQ). During that time interval, regulations, rules, guidance and technologies have changed. An example of those changes is the regulations/rules pertaining to the release of soil to unrestricted use, and the methodology for making the determination that the criteria for release were met. In the 1990s, the release criteria for soil involved demonstrating that the soil did not exceed a Ra-226 concentration of 5 pCi/g and 15 pCi/g for soil at the surface to six (6) inch depth and the six (6) to 12 inch depth, respectively, and did not exceed 30 pCi/g for natural uranium. These limits were a mixture of regulation and guidance at the Federal level. In the latter part of the 1990s, the State of Texas was codified the limits for natural uranium, including a limit of 150 pCi/g for uranium in the soil below six (6) inches. However, the Federal government was at that time changing the regulations with respect to uranium, to leave the limits for radium, but implement a dose based limit for additional radionuclides which may be present at a uranium recovery site (i.e., natural uranium). The Texas rules made a step in that direction in 2008 when a dose limit was included in the release criteria for soil. However, the concentration limits for both radium and uranium also remained in the rule. The Texas rule was finally made

consistent with the Federal regulation in 2013 when the concentration limits for uranium were removed and replaced with a dose limit based on the Federal regulation. Consequently, the types of surveying, soil sampling and analysis have changed with the varying regulations/rules and guidance. Until the end of the 20th Century, open areas at a uranium recovery site were surveyed in a labor intensive, methodical manner. A grid (usually on 10 meter spacing) was established on an area (e.g., wellfield). Personnel with hand-held survey instruments would walk the grid lines, stopping at the nodes to take and record readings and grid location. Locations with readings exceeding twice background would be flagged for sampling. Sampling may involve collecting only a single sample at each the surface to six (6) inch depth and at the six (6) to 12 inch depth. Regulatory agencies would then conduct confirmatory surveys which would essentially repeat the survey conducted by the Licensee. Over the last 30 years, technology and methodology have evolved. At the beginning of the 21st Century, surveys made by a licensee had progressed to where they were conducted with gamma detector instrumentation, global positioning system (GPS) and data logging were all mounted on an all-terrain vehicle (ATV). This system could make passes across an open area (e.g., wellfield) separated by one (1) to two (2) meter intervals, collecting gamma counts at one (1) second intervals. Thus, where walking a grid pattern yielded four (4) counts per 100 square meter (m²) area, the ATV-mounted survey system could collect approximately 40 counts per 100 m² area. The Licensee can then analyze the data to look for areas which survey readings that exceed certain limits as indicators of the potential to exceed the regulatory limits for Ra-226 concentration in soil. Once located, the Licensee now typically utilizes a five-spot sampling method. The five-spot sampling method involves centering a 100 m² area on the area with the highest gamma reading, and collecting a soil sample. Four (4) additional soil samples are collected within the established 100 m² area. The samples from the 100 m² area may be analyzed individually and the results averaged, or the samples may be combined and homogenized, and a sample aliquot withdrawn for analysis.

From the regulatory agency perspective, this higher density of data collection for verification surveys led to a greater confidence that the Licensee would successfully locate areas which may potentially exceed the radium concentration limits. Thus, the regulatory agency did not feel compelled to replicate the Licensee's survey, but only to confirm the results with judicious selection of areas to survey and sample. The regulatory agency's confirmatory survey has evolved to use the Licensee's raw count data to identify areas for conducting a targeted confirmatory survey. Importation of the Licensee survey data into tools such as Google Earth Pro can project each data point onto an image of the area surveyed to give a visual image of the survey path. Areas that may have been missed are thus revealed. Also, selecting a screening level of survey results can reveal areas of elevated counts for targeted confirmatory surveys. The targeted confirmatory surveys are supplemented by roving walking surveys which crisscross an open area without following a strict grid pattern. The roving survey also includes surveying along fence lines or under vegetation where an ATV may have difficulty in reaching.

In conducting a regulatory confirmatory survey, when an area is suspected (i.e., exceeds twice the background survey reading) of potentially exceeding the Ra-226 concentration limit, a confirmatory five-spot soil sample is collected. A confirmatory five-spot soil sample is collected by establishing a 100 m² area on the area exceeding twice background. One (1) sample is collected in the center of the 100 m² area, while the four (4) remaining samples are collected one (1) meter in from each of the corners. The samples are collected using a bucket auger. The first set of samples are collected to a depth of six (6) inches. The second set of samples are collected at a depth of six (6) to 12 inches. The first set of samples (collected to a depth of six (6) inches) are composited,

homogenized, and a sample aliquot of 500 grams extracted. The second set of samples (collected from the six (6) to 12 inch depth) are also composited, homogenized and a sample aliquot of 500 grams removed. The composited samples are each identified as to a unique identification number, sample collection depth, date and time of collection, and location (GPS coordinates) of collection. Chain of custody is maintained until the samples are transferred to the analytical laboratory.

The samples are analyzed for Ra-226 and natural uranium concentration. The sample results are reviewed for compliance with the concentration limits for Ra-226 for each the six (6) inch depth sample and the six (6) to 12 inch depth sample [re: 30 TAC §336.1115(e)(1)].

The results for natural uranium and Ra-226 are used to determine if the radium benchmark dose limit has been exceeded. The radium benchmark dose is established for the site using RESRAD version 6.5. The input parameters in RESRAD are adjusted for the specific site, and based on a scenario that seems appropriate for future use of the site. The radium benchmark dose is established by summing the dose obtained for 5 pCi/g of Ra-226 in soil to a depth of six (6) inches and the dose obtained for 15 pCi/g of Ra-226 in soil with a cover of six (6) inches of soil.

The dose for the radionuclides at the site is estimated by using the Ra-226 and natural uranium results obtained from samples collected at each sample location. Separate runs are made in RESRAD using the soil concentration results for Ra-226 in each of the surface to six (6) inch and the six (6) to 12 inch depths and for natural uranium in each of the surface to six (6) inch and the six (6) to 12 inch depths. The dose for each of these runs is then summed and divided by the radium benchmark dose to see if unity is exceeded.

As previously mentioned, The TCEQ rules have recently changed to replace the uranium concentration limits in soil with the radium benchmark dose approach. Therefore, as part of the technical evaluation of the Licensee's request to release the Mt. Lucas site to unrestricted use, TCEQ staff evaluated the Licensee's method for deriving a radium benchmark dose. Guidance from NRC NUREG 1569 "Standard Review Plan for In Situ Leach Uranium Extraction License Applications," Appendix E "Guidance to the U.S. Nuclear Regulatory Commission Staff on the Radium Benchmark Dose Approach," and information obtained from a communication with Jim Webb of the NRC was used in the evaluation. RESRAD Version 6.5 was used in the evaluation. TCEQ staff reviewed the inputs used by the Licensee for the Resident Rancher scenario, which deviated from the default inputs of RESRAD. The assumptions made by the Licensee and the inputs which were different from the default inputs of RESRAD were determined to be acceptable, or of little consequence to the output dose estimate. The TCEQ confirmed the radium benchmark dose estimate obtained by the Licensee. The radium benchmark dose was determined to be 61.1 mrem/yr. This was obtained by summing the dose derived from RESRAD runs for 5 pCi/g of Ra-226 in the surface to six (6) inch soil depth, and for 15 pCi/g in the six (6) to 12 inch soil depth, with six (6) inches of soil cover. To confirm unity, the summed dose from the Ra-226 concentration and the natural uranium (i.e., U-238, U-235 and U-234) concentration in each of the surface to six (6) inch and six (6) to 12 inch soil depth layers from either TCEQ confirmatory soil samples or the Licensee's verification soil samples are divided by the radium benchmark dose to determine if unity has been exceeded.

However, there was an exception to the above described method of evaluating dose from radionuclide concentrations (i.e., Ra-226 and natural uranium) to the radium benchmark dose. The evaluation of the of the Phase IV Irrigation Area relied on soil sampling results obtained in

1997. At that time, soil samples were collected and analyzed only in the surface to six (6) inch depth interval. Lacking soil sample results in the six (6) to 12 inch depth interval, an assumption was made by the TCEQ that the concentration of Ra-226 and natural uranium in the six (6) to 12 inch soil depth would be the same as the results obtained from the surface to six (6) inch soil depth would be the same concentrations in the six (6) to 12 inch soil depth. (Shaver – 2013, TCEQ – 2013B)

Specific Site Features

Pipeline Trenches

Following notification by the Licensee that pipeline trenches had been surveyed and considered to meet release criteria, Texas Department of Health staff conducted confirmatory surveys of the Licensee's pipeline trenches. Surveys were made using gamma detection instrumentation. Twice background was used as a presumptive indicator of contamination which might exceed the radium in soil criterion for release to unrestricted use. Based on the results of the verification surveys conducted by TDH staff, the Licensee was advised that the pipeline trenches could be backfilled. (TDH – 1997A, TDH – 1997B)

Irrigation Areas

- **Phase IV Irrigation Area**
Texas Department of Health staff conducted a confirmatory survey of the Phase IV irrigation area on October 20 to 23, 1997, following notification by the Licensee that the Phase IV irrigation area had been surveyed, soil samples had been collected and analyzed, and found not to exceed the release criteria for radium in soil. The survey was made using gamma detection instrumentation (sodium iodide detector with a Ludlum Model 14C survey meter). The survey was conducted on a 10-meter grid spacing across the 27 acre irrigation area. Twice background (4,000 counts per minute) was used as a presumptive indicator of contamination which might exceed the radium in soil criteria for release to unrestricted use. The Licensee was permitted to conduct additional remediation of those areas found to exceed twice background, after which TDH staff collected soil samples. The sampling methodology consisted of five (5) soil samples collected in a 100 square meter area in a manner considered to be representative of the area. Samples were collected to a depth of 15 centimeters for each area identified as exceeding twice background. Analysis of the samples yielded results which did not exceed 5 pCi/g for Ra-226 or 30 pCi/g for natural uranium, the release criterion for uranium under the TDH rules in 1997. The Phase IV irrigation area was authorized for release to unrestricted use by the TDH on April 28, 1998 (TDH – 1997C, TDH – 1998A). TCEQ staff also recently evaluated the confirmatory soil sample results (obtained in 1997) for compliance with the Radium Benchmark Dose Approach. An analysis using the Mt. Lucas site-specific parameters and data from the TDH confirmatory soil sampling generates a dose that does not exceed unity when compared with the radium benchmark dose established for the Mt. Lucas site. (TCEQ – 2013B)
- **Phase II and III Irrigation Areas**
The report of decommissioning work conducted in the Phase II and III Irrigation areas by the Licensee was reviewed by staff of the Texas Department of Health. Based on the findings of that review, the conclusion was reached that the subject irrigation areas did not exceed the release criteria for radium-226 and natural uranium. Subsequently, TDH Division of Compliance and Inspection staff conducted confirmatory surveys of the Phases II and III

Irrigation areas on August 21, 2002, and collected confirmatory samples on September 27, 2002, and conducted additional confirmatory surveys on January 7 2004 (Phase II), and February 19, 2004 (Phase III). Based on the findings of the surveys the recommendation was made that the subject irrigation areas be released to unrestricted use. In conformance with the Rules and Regulations in effect at that time, Phase II and III Irrigation Areas were authorized for release to unrestricted use by the TDH on March 8, 2004, with amendment No. 09 to Radioactive Material License No. L03626. (TDH – 2003B, TDH – 2004A, TDH – 2004B)

TCEQ staff also evaluated the confirmatory soil sample results (obtained in 2002) for compliance with the Radium Benchmark Dose Approach. An analysis using the Mt. Lucas site-specific parameters and data from the TDH confirmatory soil sampling generates a dose that does not exceed unity when compared with the radium benchmark dose established for the Mt. Lucas site. (TCEQ – 2013B)

Wellfields

The Closure Reports submitted by the licensee for the wellfields, that is, the Lillian, EA-North, EA-South, HM-East, HM-West, H, H-extension, H-Expansion, J-6, J-7, J, North J, South J, M Sands, EA-Center and E (Everest – 2009A, Everest – 2009B, Everest – 2009C, Everest – 2009D, Everest – 2009E and STMV – 2013B) were reviewed by TCEQ staff. A discussion of the Licensee's remediation efforts as described in the closure reports has previously been discussed in Part 6 of Section II of this CRR.

The method used by the Licensee to select verification sample locations was reviewed by TCEQ staff and found to be acceptable. The Licensee collected verification soil samples to a depth of six (6) inches. The soil samples were analyzed for Ra-226. For an area which has been homogenized to a depth of 18 inches, a sampling depth of six (6) inches was considered by the TCEQ to be representative of Ra-226 concentrations in soil at greater depths. This hypothesis will be tested and confirmed by the TCEQ confirmatory sampling and analysis regime. Conformance with unity with the radium benchmark dose will also be confirmed with the data obtained by the TCEQ's confirmatory and analysis regime.

The lack of an analysis for natural uranium is also considered reasonable again given that the site is an *in situ* leach uranium recovery facility. Spills that occurred at the site that were reportable were documented, and clean-up and sampling were done at the time of the spill to ensure that soil was not contaminated in excess of the soil limits (for both radium and natural uranium) in effect at the time of the spill. In most instances these would have been the current limits of 5 and 15 pCi/g for Radium-226, and the then limit of 30 pCi/g for natural uranium. Additional discussion of the analytical results with respect to the radium benchmark dose approach is provided in more detail in this section. (TCEQ 2013B)

In addition to the closure reports, the Licensee also provided raw survey data (i.e., gamma counts and GPS coordinates) obtained during the verification surveys conducted by the Licensee. The TCEQ used the raw survey data to identify the areas with the highest count rates in each wellfield. These areas were then selected as targeted sites for surveys during a confirmatory survey of each wellfield by TCEQ staff. In addition to the targeted surveys conducted based on areas identified from the Licensee's raw survey data, additional roving surveys were conducted in each wellfield in

a more or less random pattern, with extra attention given to areas along fence lines and under trees where the Licensee's ATV-mounted survey equipment may have had difficulty in surveying.

The TCEQ used twice background as an indicator for sampling. If an area exceeded twice background, a soil sample was collected. In the event that no areas exceeded twice background during the verification survey in a wellfield, an area in the wellfield was selected, based on having the highest survey reading, from which to collect a soil sample. Soil samples were collected using a hand-auger, core sampler. Samples were collected using a five-spot sampling technique. The Five-spot sampling technique involves establishing a 100-square meter area centered on the spot yielding the highest survey reading. One sample is collected from the center, and four additional samples are collected approximately one meter in from each corner of the 100-square meter area. Samples are collected at surface to six (6) inch and six (6) to 12 inch soil depths. The five (5) samples collected from each soil depth are then combined and homogenized. A sample aliquot of approximately 500 grams is then withdrawn from each homogenized sample depth. The sample container is marked to identify the sample location, depth, date and time of collection, and sealed. Chain of custody is maintained with the sample ultimately transferred to the laboratory for analysis. If requested, the sample is split with the Licensee at the time of removal of a sample aliquot from the combined and homogenized samples in the field.

- **Lillian Wellfield**

On May 7, 2009, a confirmatory survey was performed by TCEQ staff in the Lillian Wellfield. Ludlum Model 2241-3i, with one inch by one inch sodium iodide probes, and a Model 19 survey instruments were used to conduct the surveys. Background was determined to be 500 counts per minute and 8 microR per hour, respectively. Targeted areas of interest to investigate were identified from the raw survey data provided by the Licensee. Additional roving surveys were performed. An area reading 1,500 cpm, measuring six (6) feet by six (6) feet, was located. A five-spot sample was collected from this area. Sample results of 3.6 and 5.5 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 5.7 and 5.3 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained. The results yielded a dose that did not exceed unity for the radium benchmark dose. The wellfield was recommended for release to unrestricted use. (TCEQ – 2012D, TCEQ – 2013B)

- **HM-East and HM-West Wellfields**

A confirmatory survey was performed by the TCEQ staff in the HM-East and HM-West Wellfields on May 7, 2009. A Ludlum Model 2241-3i and a Model 19 survey instruments with 1 X 1 inch sodium iodide probes were used to conduct the surveys. Background was determined to be 500 counts per minute and 8 microR per hour, respectively. No areas were found to exceed twice background. An area in each HM-East and HM-West were selected, based on the highest readings obtained from the Licensee's raw count data, for collection of soil samples. Sample results of 1.9 and 5.7 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 2.4 and 6.4 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained for the HM-East Wellfield. Sample results of 2.3 and 2.26 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 2.5 and 2.9 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained for the HM-West Wellfield. The results yielded a ratio that did not exceed unity for the radium benchmark

dose. The wellfields were recommended for release to unrestricted use. (TCEQ – 2012D, TCEQ – 2013B)

- EA-North Wellfield

A confirmatory survey was performed by the TCEQ staff in the EA-North Wellfield on May 7, 2009. A Ludlum Model 2241-3i, with a 1 X 1 inch sodium iodide probe, and a Model 19 survey instrument were used to conduct the surveys. Background was determined to be 500 counts per minute and 8 microR per hour, respectively. The wellfield was found to contain a pile of debris with readings exceeding twice background. The confirmatory survey of the wellfield was halted. (TCEQ – 2012D)

A second confirmatory survey of the EA-North Wellfield was conducted on May 3, 2010. Ludlum Model 2241-3i survey instruments with 1 X 1 inch sodium iodide probes were used to conduct the surveys. The two (2) Model 2241-3i instruments were set to read in units of counts per minute (cpm), while the Model 19 read in units of microR/hr ($\mu\text{R/hr}$). Background was determined to range between 1,060 and 1,320 cpm for the two (2) Model 2241-3i instruments and 6.9 $\mu\text{R/hr}$ for the Model 19 instrument. Most of the readings obtained in the confirmatory survey of the EA-North Wellfield were around background. However, two (2) areas gave readings at almost twice background. Samples were collected from these two (2) areas at the surface to six (6) inch depth on May 3, 2010, and from the six (6) inch to 12 inch depth on August 11, 2010. Sample results of 5.0 and 0.9 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 7.7 and 1.8 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained for the first sample site. Sample results of 4.6 and 1.4 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 6.8 and 3.3 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained for the second sample site. The results were found to yield a ratio that did not exceed unity for the radium benchmark dose. The wellfields were recommended for release to unrestricted use. (TCEQ – 2010B, TCEQ – 2010C, TCEQ – 2010D, TCEQ – 2010E, TCEQ – 2012E, TCEQ – 2013B)

- H-Series Wellfields

TCEQ staff initiated a confirmatory survey of the H-series (H, H-Extension and H-Expansion) wellfields on August 25, 2009. Survey instruments for this expedition included two (2) Ludlum Model 19, reading in microR/hr, two (2) Ludlum Model 14c, reading in counts per minute, and a Ludlum Model 2241, reading in counts per minute. The Ludlum Model 14c and Model 2241 were equipped with a 1 X 1 inch sodium iodide detector. Background for the instruments was determined at an area considered to be un-impacted by uranium recovery operations near the entrance to the Mt. Lucas site. Background for the two (2) Ludlum Model 19 was 8 microR/hr, for the Ludlum Model 2241 it was 1,300 counts per minute and for the two (2) Ludlum Model 14c the readings were 1,000 and 2,800 counts per minutes. Areas in all three (3) wellfields were located exceeding four-times background. Further confirmatory surveying was halted. No samples were collected. (TCEQ – 2009A)

TCEQ staff returned to the H-series of wellfields on June 2, 2010 to conduct the confirmatory surveys. Two (2) Ludlum Model 2241-3i survey instruments, with 1 X 1 inch sodium iodide detectors were used to conduct the surveys. Background readings of 1,000 cpm, were made at the entrance to the Mt. Lucas site. Survey readings in the H-Expansion and H-Extension

Wellfields did not exceed twice background. A single sample was collected in each the H-Expansion and H-Extension Wellfields at the location of the highest reading (1,790 and 1,800 cpm, respectively). In the H-Expansion Wellfield, sample results of 2.5 and 4.2 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 2.3 and 4.2 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained. While in the H-Extension Wellfield, sample results of 2.9 and 2.8 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 1.3 and 2.5 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained. The confirmatory survey of the H Wellfield located an area with a reading three (3) times background. The area was sampled and yielded the following results: 3.3 and 2.2 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 0.7 and 2.3 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths. The results from each of the three (3) sample locations from all three (3) wellfields were found to yield ratios that did not exceed unity for the radium benchmark dose. (TCEQ – 2012B, TCEQ – 2013B)

- J6 and J7 Wellfields

TCEQ staff initiated a confirmatory survey of the J6 and J7 wellfields on August 26, 2009. The same survey instruments used for the H-series of Wellfields were used for the J6 and J7 wellfields. Areas exceeding multiples of background were encountered immediately at the J6 Wellfield. Areas of contamination were also encountered in the J7 Wellfield. The confirmatory surveys were terminated and no samples collected. (TCEQ – 2009A)

TCEQ staff returned on June 1, 2010, to conduct confirmatory surveys in the J6 and J7 Wellfields. Instrumentation used and background determinations have previously been described in the above section on the surveys conducted in the H-Series Wellfields on June 1, 2010. Survey readings in the J6 and J7 Wellfields did not exceed 1,020 and 1,250 cpm, respectively. A soil sample was collected from each of the wellfields. The J6 Wellfield yielded samples results of 2.7 and 3.3 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 1.5 and 2.3 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively. The J7 Wellfield yielded sample results of 1.5 and 2.4 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 1.5 and 2.9 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively. The results from each of the two (2) sample locations were found to yield a ratio that did not exceed unity for the radium benchmark dose. (TCEQ – 2012B, TCEQ - 2013B)

- North J Wellfield

TCEQ staff initiated a confirmatory survey of the North J Wellfield on August 25, 2009. Survey instruments used and survey background data obtained were previously described in the above section's verification survey campaign for the H-Series of Wellfields in August 2009. Three (3) areas were found to exceed four-times background. Further remediation in the wellfield was recommended to the Licensee. Staff returned to the North J on August 26, 2009. Other areas of contamination were noted, and the Licensee again advised that additional remediation was needed. (TCEQ – 2009A)

TCEQ staff returned to the North J Wellfield on May 4, 2010 to resume confirmatory surveying. Two areas of interest were noted. One of the areas, with a reading in excess of three times

background, was centered around a pipe (thought to be a former monitor well left in place at the request of the landowner). A 100-square meter area was established, centered on the pipe, from which a five-spot sampling was made. The second area was located in the southern end of the wellfield with a reading of approximately twice background. A five-spot sampling was made in this area. Results from the sample analysis did not support release of the wellfield to unrestricted use. (TCEQ – 2012E)

After the Licensee engaged in further remediation efforts, TCEQ staff returned on February 22, 2011, for re-sampling of the areas. Results from the sample location centered on the pipe yielded Ra-226 concentrations of 4.1 and 1.4 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 5.2 and 4.3 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively. Results from the sample location at the southern end of the wellfield gave Ra-226 concentrations of 1.7 and 1.5 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 4.2 and 4.1 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively.

The final sample analysis results from each of the two (2) sample locations were found to yield a ratio that did not exceed unity for the radium benchmark dose. Sample analysis results supported release of the wellfield to unrestricted use. (TCEQ – 2012F, TCEQ - 2013B)

- J Wellfield

TCEQ staff initiated a confirmatory survey of the J Wellfield on August 25, 2009. Survey instruments used and survey background data obtained were previously described in the above section's verification survey campaign for the H-Series of Wellfields in August 2009. Two (2) areas were found to exceed four-times background. Further remediation in the wellfield was recommended to the Licensee. (TCEQ – 2009A)

TCEQ staff returned on May 4, 2010, to the J Wellfield to re-initiate the verification survey. Two (2) Model 2241-3i instruments, reading in units of counts per minute (cpm), were used to conduct the survey. Background was determined to range between 1,060 and 1,320 cpm between the two instruments. One area of interest gave a reading around four times background. In conducting the sampling of the area, gamma readings increased with increasing depth of sampling. The Licensee requested that sampling cease and offered to conduct further remediation of the area. Subsequent communication from the licensee revealed that the general area was the former site of the West Satellite Ion Exchange facility. (TCEQ – 2012E)

TCEQ staff returned to the J Wellfield on February 22, 2011. The wellfield, including the former satellite ion exchange facility site, was re-surveyed. No areas above background were noted. Random samples were collected from each of the wellfield proper and the former site of the satellite ion exchange facility. Sample results from the pad site of the former ion exchange plant gave Ra-226 concentrations of 0.6 and 0.9 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of <1.4 and 1.4 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively. Results from the sample location located in the wellfield gave Ra-226 concentrations of 0.8 and 0.7 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 4.0 and 3.8 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively.

The sample analysis results from each of the two (2) sample locations yielded a ratio that did not exceed unity for the radium benchmark dose. Results of the confirmatory survey, sample analysis, and radium benchmark dose assessment support the release of the J Wellfield, including the former satellite ion exchange facility, to unrestricted use. (TCEQ – 2012F, TCEQ – 2013B)

- South J Wellfield

TCEQ staff conducted a confirmatory survey of the South J Wellfield on August 10, 2010. Two (2) Ludlum Model 2241-3i survey instruments, with 1 X 1 inch sodium iodide detectors, were used to conduct the survey. Background for the site, determined at the entry gate to the Twin Oaks Ranch, was 1,300 cpm. Only one area in the wellfield was selected for confirmatory sampling. Sample results of 2.6 and 2.6 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 2.9 and 3.0 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained.

Results from the confirmatory sample were found to yield a ratio that did not exceed unity for the radium benchmark dose. Results of the confirmatory survey, sample analysis, and radium benchmark dose assessment support the release of the South J Wellfield to unrestricted use. (TCEQ – 2012G, TCEQ – 2013B)

- M Sands Wellfield

TCEQ staff initiated a confirmatory survey of the M Sands Wellfield on August 25, 2009. Survey instruments used and survey background data obtained were previously described in the above section's verification survey campaign for the H-Series of Wellfields in August 2009. With the exception of two areas with readings in excess of 2 to 3 times background, no areas were found that exceeded the background count rates. However, a sample was collected at only one of the locations, and was collected only at the surface to six (6) inch depth. (TCEQ – 2009A)

TCEQ staff re-visited the M Sands Wellfield on June 2, 2010, for the purpose of collecting a soil sample at the six (6) inch to 12 inch depth at the location where the sample from the surface to six (6) inch depth was collected on August 25, 2009. Samples results of 3.4 and 0.8 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 5.5 and 3.2 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained. (TCEQ – 2012B)

Results from the confirmatory samples were found to yield a ratio that did not exceed unity for the radium benchmark dose. Results of confirmatory surveys, sample analysis and radium benchmark dose assessment support the release of the M Sands Wellfield to unrestricted use. (TCEQ – 2013B)

- E Wellfield

TCEQ staff conducted a confirmatory survey of the E Wellfield on August 10, 2010. Two (2) Ludlum Model 2241-3i survey instruments, with 1 X 1 inch sodium iodide detectors, were used to conduct the survey. Background for the site, determined at the entry gate to the Twin Oaks

Ranch, was 1,300 cpm. Only one area in the wellfield was found to exceed twice background, and was selected for sampling. Sample results of 4.6 and 1.3 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 1.7 and <1.4 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained.

Results from the sample were found to yield a ratio that did not exceed unity for the radium benchmark dose. Results of the verification survey, sample analysis and radium benchmark dose assessment support the release of the South E Wellfield to unrestricted use. (TCEQ – 2012G, TCEQ – 2013B)

Plant Site and Ponds

After the Licensee surveyed the plant slab, the slab was broken up, and placed, at the request of the landowner, in a low area on the Twin Oaks Ranch. TCEQ staff made a confirmatory survey of pieces of the slab and observed the placement of the slab pieces. (Shaver – 2010)

The Closure Report for the Plant site, ponds, Irrigation Area Phase I and the area adjacent to the Phase I Irrigation Area, referred to by the Licensee as the “Annex,” was reviewed by TCEQ staff. TCEQ staff conducted a verification survey on January 25, 2011. Two (2) Ludlum Model 2241-3i survey instruments, with one inch by one inch sodium iodide detectors, were used to conduct the survey. Background for the site, determined at the entry gate to the Twin Oaks Ranch, was 1,300 cpm. Both targeted (based on the Licensee’s raw survey data) and roving surveys of the plant site and the ponds were conducted. Only one location in the plant site area exceeded twice background. A five-spot soil samples was collected at that location. In the pond area, one sample was collected from the location with the highest gamma survey reading. Samples results of 1.4 and 5.2 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 6.0 and 13.0 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained for the plant site sample. Samples results of 2.6 and 2.2 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 2.4 and 2.7 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained for the pond site sample. (TCEQ – 2012C)

TCEQ staff evaluated the Licensee’s submissions and rationale for disposal of the septic tank on site. The Licensee based their decision on NUREG-1757, Appendix G. However, the foreword of NUREG-1757 refers to NUREG 1620 for decommissioning guidance for uranium recovery facilities. Unfortunately, NUREG 1620 does not give specific guidance regarding septic tanks or sewage systems. Consequently, the TCEQ staff relied on the guidance in NUREG-1757 regarding disposition of the septic tank. Section G.1.3 of NUREG-1757 recommends evaluation of sewage system items left in place either by evaluating the dose, using an acceptable scenario, or as subsurface residual radioactivity. The Licensee took the approach of using concentration limits for subsurface residual radioactivity. Alternatively, the TCEQ evaluated the septic tank using the radium benchmark dose approach. The estimated dose does not exceed unity. (NRC – 2006, NRC – 2003B, STMV – 2013B, STMV – 2013E, TCEQ – 2013B)

Results from the samples were found to yield a ratio that did not exceed unity for the radium benchmark dose for each of the plant site and the pond site. Results of confirmatory surveys, sample analysis, and radium benchmark dose assessment support the release of the plant site and the pond site to unrestricted use. (TCEQ – 2013B)

Irrigation Area Phase I

The TCEQ examined the closure report submitted by the Licensee (STMV – 2012B). TCEQ staff conducted an initial confirmatory survey of the area on August 10, 2010. Two (2) Ludlum Model 2241-3i survey instruments, with one inch by one inch sodium iodide detectors, were used to conduct the survey. Background for the site, determined at the entry gate to the Twin Oaks Ranch, was 1,300 cpm. Both targeted and roving surveys were conducted. Two locations exceeded background, and were selected for collection of soil samples. Sample results are presented in the following table:

Sample ID	Ra-226 (pCi/g)		Natural Uranium (pCi/g)	
	0 – 6"	6 – 12"	0 – 6"	6 – 12"
SO1	6.3	5.1	5	5.1
SO2	4.4	6.5	8.9	10.3

Results from Sample SO-1 shows that the location exceeds the release criteria for Ra-226. (TCEQ – 2012G)

Following additional remediation work by the Licensee, TCEQ staff re-visited the area on February 22, 2011. A sample was collected at the location where the sample collected on August 10, 2010, exceeded the Ra-226 limit in the surface to six (6) inch depth soil horizon. Results are depicted in the following table:

Sample ID	Ra-226 (pCi/g)		Natural Uranium (pCi/g)	
	0 – 6"	6 – 12"	0 – 6"	6 – 12"
SO1	4.1	3.7	6	5.7

The location is now indicated to comply with the Ra-226 soil concentration release criteria. (STMV – 2012F)

Results from the samples were found to yield a ratio that did not exceed unity for the radium benchmark dose. Therefore, results of verification surveys, sample analysis and radium benchmark dose assessment support the release of the plant site and the pond site to unrestricted use. (STMV – 2013B)

Irrigation Area Phase I off-site area referred to by the Licensee as the "Annex."

TCEQ staff conducted a confirmatory survey of, and collected soil samples in the area adjacent to the Phase I Irrigation Area, referred to by the Licensee as the Annex, on January 25, 2011. Two (2) Ludlum Model 2241-3i survey instruments, with one inch by one inch sodium iodide detectors, were used to conduct the survey. Background for the site, determined at the entry gate to the Twin Oaks Ranch, was 1,300 cpm. Only half of the "Annex" area could be surveyed due to the other half

being covered by water. The highest reading noted in the survey was 2,750 cpm. A sample was collected at this location. Sample results of 3.0 and 2.8 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 35.6 and 37.7 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained. (TCEQ – 2012C)

TCEQ staff conducted a survey of the previously un-surveyed half on February 22, 2011. Soil samples were collected on November 13, 2012. Two (2) Ludlum Model 2241-3i survey instruments, with one inch by one inch sodium iodide detectors, were used to conduct the survey. One of the instruments gave readings in cpm, while the other instrument was set to provide readings in $\mu\text{R/hr}$. Background, determined at the entry gate to the Twin Oaks Ranch, was 1,310 cpm and 6 $\mu\text{R/hr}$. The highest reading noted was 3,000 cpm. A soil sample was collected at this location. Samples results of 4.1 and 3.7 pCi/g of Ra-226 at the surface to six (6) inch and six (6) to 12 inch depths, respectively, and natural uranium concentrations of 6.0 and 5.8 pCi/g at the surface to six (6) inch and six (6) to 12 inch depths, respectively, were obtained. (TCEQ – 2012F)

On November 13, 2012, TCEQ staff collected three (3) additional samples in the area of the “Annex” previously surveyed, but not sampled, and four (4) additional samples from areas trending south-southeast from the Annex surveyed area. The four (4) additional samples were collected following a swale in the land and terminating at a gate in a dike, constructed to control flow of water from the general area into the nearby lake. Sample results for the TCEQ confirmatory sample results for Ra-226 in the surface to six (6) inch soil depth ranged from a low of 1.4 pCi/g to a high of 3.8 pCi/g and for the six (6) to 12 inch soil depth from a low of 1.0 pCi/g to a high of 2.8 pCi/g. Natural uranium results in the surface to six (6) inch soil depth ranged from a low of 6.5 pCi/g to a high of 50 pCi/g and for the six (6) to 12 inch soil depth from a low of 2.2 pCi/g to a high of 36 pCi/g. Results of the samples indicated that radium-226 concentrations in soil did not exceed the soil concentration criteria specified at 30 TAC §336.1115(e)(1). An evaluation of the combined dose resulting from the maximum Ra-226 and natural uranium concentrations in the soil demonstrated that unity, compared to the radium benchmark dose for the Mt. Lucas site, was not exceeded.

TCEQ staff evaluated both the data generated from the Licensee’s collection and analysis of soil samples and the data obtained from the analysis of TCEQ’s confirmatory samples to evaluate compliance with both the Ra-226 concentration in soil limits and compliance with unity (using the summed dose from both Ra-226 and natural uranium soil concentrations obtained from verification and confirmatory soil samples) with the radium benchmark dose. The TCEQ found that the Ra-226 concentration in soil limits and unity with the radium benchmark dose were not exceeded in the Phase I Irrigation Area off-site area, referred to by the Licensee as the “Annex”. (TCEQ – 2012A, TCEQ – 2013A, TCEQ – 2013B)

On-site disposal of solid radioactive material or by-product material was not authorized at the Mt. Lucas site, thus there is no land to be transferred to the State or the Federal Government. As a result of these findings, the Texas Commission on Environmental Quality is proposing to remove the Mt. Lucas site from the license.

7. For partial terminations, documentation that release of a portion of the site will not negatively impact the remainder of the site to be closed at a later date.

The TCEQ has determined that the release for unrestricted use and removal of Mt. Lucas site will not negatively impact the remainder site (Hobson ion exchange processing plant) associated with Radioactive Material License No. R03626, which will be released for unrestricted use and removed from the license at a later date. The TCEQ based its decision on the following: The site being removed from the license is not contiguous with the other site associated with licensed activities that may lead to recontamination of the released site; and removal of the site from its associated license will not in any way prevent or hinder the licensee's ability to complete decommissioning of the remaining licensed site on the license.

III. REFERENCES

DSHS - 2004	Memorandum from Shaver to License File L03626, dated November 4, 2004 Subject: Field Trip to the Everest Mt. Lucas site to observe pilot test of <i>ex situ</i> soil homogenization
DSHS – 2006A	Report of an inspection on January 25, 2006 Subject: Does not note the release of any equipment or materials to unrestricted use.
DSHS – 2006B	License Amendment No. 12, dated October 6, 2006 Subject: Authorization of <i>ex situ</i> soil homogenization in Irrigation Area Phase I
Everest – 1986A	Letter dated March 17, 1986, from Everest (Larry McGonagle) to TDH (Joseph Klinger) Subject: Baseline soil sample results in the irrigation area.
Everest – 1986B	Letter dated July 22, 1986, from Everest (Michael Buckley) to TDH (Ed Bailey) Subject: Renewal application for License No. 8-3068.
Everest – 1986C	Mt. Lucas Project Survey Report dated 11/20/86 Subject: Depicts features at the Mt. Lucas East Plant site.
Everest - 1987	Memorandum, dated January 28, 1987 from Larry McGonagle to G. L. Rocha Subject: Mt. Lucas Radiation Survey for December for the Mt. Lucas West Project
Everest - 1989	Memorandum dated August 7, 1989 from McGonagle (Everest) to Rocha (Everest) Subject: Attached survey records depict features at the Mt. Lucas – West process plant.
Everest – 1996A	Letter dated May 24, 1996, from Everest (Michael Buckley) to TNRCC (Dale Kohler) Subject: <ul style="list-style-type: none"> • Aquifer restoration pumping completed 10/2/1995. • Pipelines cleaned and sediments pumped into the ponds. • Ponds dewatered and the sediments removed and transported to the Rio Grande Resources facility (Panna Maria Mill Site) for disposal in the tailings impoundment)

Everest – 1996B	Letter dated June 3, 1996, from Everest (David Bedford) to TNRCC (Dale Kohler) Subject: Transfer of Mt. Lucas West equipment and vessels to Tex-1 in 1987.
Everest – 1996C	Letter dated August 2, 1996, from Everest (Michael Buckley) to TNRCC (Dale Kohler) Subject: Request for release of Phase IV irrigation area submitting results of surveys and soil sample analysis results to demonstrate that release criteria was not exceeded.
Everest – 1996D	Letter dated August 8, 1996, from Everest (Michael Buckley) to TNRCC (John Santos) Subject: Transfer of wells associated with UIC Permit UR02381-001 to the Mt. Lucas landowner (Lon Cartwright).
Everest – 1996E	Letter dated August 29, 1996, from Everest (David Bedford) to TNRCC (John Williamson). Subject: Provides size of irrigation areas and time of use
Everest – 1997A	Letter dated February 13, 1997, from Everest (Michael Buckley) to TNRCC (Dale Kohler). Subject: <ul style="list-style-type: none"> • Notes the removal of pipelines from Irrigation Areas I, II, III and IV. • Notes the transfer of the removed pipe to the RGR byproduct disposal facility • Provides survey results.
Everest – 1997B	Letter dated March 21, 1997, from Everest (Michael Buckley) to TNRCC (Dale Kohler) Subject: Advises of the removal of the pipeline from the Mt. Lucas East Plant to Longhollow Creek west of the Mt. Lucas West Plant; providing survey data, and noting the removal of soil from eight (8) areas in the pipeline trench.
Everest – 1997C	Letter dated March 24, 1997, from Everest (Michael Buckley) to TNRCC (Dale Kohler) Subject: Provides survey and soil sample analysis results from pipeline trenches in irrigation areas.
Everest – 1997D	Letter dated August 22, 1997, from Everest (James T. Clark) to the TDH (Richard Ratliff) Subject: Notes that pipelines between the Mt. Lucas East and West process areas have been removed and sold to other uranium companies.
Everest - 2003	Letter dated June 6, 2003, from Everest (James T. Clark) to TDH (Chuck Flynn)

	Subject: Request for Release of Phase II and III Irrigation Areas to unrestricted use.
Everest - 2004	Letter dated January 26, 2004, from Everest (James T. Clark) to TDH (Phillip Shaver) Subject: Request for release of Phase II and Phase III Irrigation Areas to unrestricted use.
Everest - 2005	Letter dated May 13, 2005, from Everest (James T. Clark) to DSHS (Phillip Shaver) Subject: Results of <i>ex situ</i> soil homogenization pilot study.
Everest – 2009A	Letter, dated March 30, 2009, from Everest (James T. Clark) to TCEQ (Jablonski) Subjects: <ul style="list-style-type: none"> • Submission of Report documenting Licensee’s decommissioning activities and survey and soil sample results of Wellfields Lillian, EA-North and EA-South, Everest Exploration, Inc., March 2009. • Request for release for unrestricted use.
Everest – 2009B	Letter, dated April 27, 2009, from Everest (James T. Clark) to TCEQ (Jablonski) Subjects: <ul style="list-style-type: none"> • Submission of Report documenting Licensee’s decommissioning activities and survey and soil sample results of Wellfields HM East & West, Everest Exploration, Inc., April 2009 • Request for release for unrestricted use
Everest – 2009C	Letter, dated May 30, 2009, from Everest (James T. Clark) to TCEQ (Jablonski) Subjects: <ul style="list-style-type: none"> • Submission of Report documenting Licensee’s decommissioning activities and survey and soil sample results of Wellfields H, H-Extension, H-Expansion, J-6 and J-7, Everest Exploration, Inc., May 2009 • Request for release for unrestricted use
Everest - 2009D	Letter, dated June 30, 2009, from Everest (James T. Clark) to TCEQ (Jablonski) Subjects: <ul style="list-style-type: none"> • Submission of Report documenting Licensee’s decommissioning activities and survey and soil sample results of Wellfields EA, J, NJ, SJ, and M Sand, Everest Exploration, Inc., dated June 2009 • Request for release for unrestricted use.

Everest – 2009E	Letter, dated October 15, 2009, from Everest (James T. Clark) to TCEQ (Jablonski) Subjects: <ul style="list-style-type: none"> • Submission of Report, documenting Licensee’s decommissioning activities and survey and soil sample results of Wellfield E, Everest Exploration, Inc., dated October 15, 2009 • Request for release for unrestricted use.
NRC – 2003A	NUREG-1569 “Standard Review Plan for in situ Leach Uranium Extraction License Applications, Appendix E “Guidance to the U.S. Nuclear Regulatory Commission Staff on the Radium Benchmark Dose Approach.”
NRC – 2003B	NUREG-1620, Rev. 1 “Standard Review Plan for the Review of a Reclamation Plan for Mill Tailings Sites Under Title II of the Uranium Mill Tailings Radiation Control Act of 1978” Subject: Referred Guidance from NUREG-1757 regarding decommissioning of uranium recovery sites.
NRC - 2004	SECY-04-0035, “Results of the License Termination Rule Analysis of the Use of Intentional Mixing of Contaminated Soil,” March 1, 2004
NRC - 2006	NUREG-1757, Vol. 2, Revision 1 “Consolidated Decommissioning Guidance, Characterization, Survey, and Determination of Radiological Criteria” Subject: Appendix G “Special Characterization and Survey Issues” related to septic tanks/sewage systems.
Shaver - 2010	Notes made of a confirmatory survey of the Mt. Lucas East Plant on October 12, 2010. Subject: Survey readings on decontaminated, demolished and disposed concrete from the process plant pad slab.
Shaver - 2013	Personal communication with James (Jim) Webb of the NRC regarding application of the radium benchmark dose approach. February 20, 2013
STMV - 2011	Closure Report for Plant/Pond Site, Phase I Irrigation Area and Annex Area, South Texas Mining Venture, November 2011
STMV – 2012A	Letter, dated April 5, 2012, South Texas Mining Venture. Subject: Revised Closure Report for the Plant/Pond site, Phase I Irrigation Area and Annex Area dated March 30, 2012
STMV – 2012B	Letter, dated December 21, 2012, from STMV (Wall and Dziuk) to TCEQ (Maguire) conveying the document titled “Closure Report for Plant/Pond Site, Phase I Irrigation Area and Annex Area,” South Texas Mining Venture, November 2011, Revised December 21, 2012. Subject:

	<ul style="list-style-type: none"> Decommissioning activities and results for the Plant and Ponds, the Phase I Irrigation Area and the Annex Area at the Mt. Lucas site. Request for release to unrestricted use.
STMV – 2013A	<p>Letter, dated March 15, 2013, from STMV (Wall) to TCEQ (Maguire) conveying revised segments of the document titled “Closure Report for Plant/Pond Site, Phase I Irrigation Area and Annex Area,” South Texas Mining Venture, November 2011, Revised December 21, 2012, Revised March 13, 2013.</p> <p>Subject:</p> <ul style="list-style-type: none"> Advises that equipment and materials which does not exceed the surface contamination limits is released to unrestricted use, and equipment and materials which exceeds the surface contamination limits is disposed as by-product material. Advises of the decontamination, survey and disposition of the concrete slab of the processing facility.
STMV – 2013B	<p>Letter, dated August 9, 2013, from STMV (Wall) to TCEQ (Maguire)</p> <p>Subject:</p> <ul style="list-style-type: none"> conveys revised document titled “Closure Report for Mt. Lucas Project, East & West Plant Pond Site, Phase I Irrigation Area, and Annex Area” Revised August 9, 2013 conveys letter dated August 9, 2013, from STMV (Wall) to (Maguire) with conveying the following memoranda from SENES Consultants: <ul style="list-style-type: none"> Addendum for Confirmation of Remediation on E Well Field and E-MWR dated 27 June 2013 Addendum for Confirmation of Remediation on EA Centre Well Field dated 27 June 2013. Addendum for Confirmation of Remediation on J and NJ Well Fields dated 8 August 2013. Addendum for Confirmation of Remediation on M Sands and S(outh) J Well Fields dated 15 July 2013.
STMV – 2013C	<p>Letter, dated October 17, 2013, from STMV (Dziuk) to TCEQ (Maguire)</p> <p>Subject: conveys Lab reports for samples collected from the H Wellfield on May 29, 2009, and June 1, 2009.</p>
STMV – 2013D	<p>Letter dated October 18, 2013, from STMV (Wall) to TCEQ (Maguire).</p> <p>Subject: Provides additional information requested in an email on September 26, 2013.</p>
STMV – 2013E	<p>Letter, dated November 20, 2013, from STMV (Wall) to TCEQ (Maguire).</p> <p>Subject: Provides additional information regarding the following:</p> <ul style="list-style-type: none"> East Plant Site Maintenance Building Identity of contents of by-product material shipments

	<ul style="list-style-type: none"> Coordinates for re-sampling in the H Wellfield Septic tank
TCEQ - 2008	Report of an inspection on January 30, 2008 Subject: Does not note the release of any equipment or materials to unrestricted use.
TCEQ – 2009A	Gonzalez Memorandum, 9/21/2009 Subject: Confirmatory surveys of H, H-Expansion, H-Extension, M Sand, NJ, J, J6 and J7 wellfields on August 25 – 26, 2009.
TCEQ – 2009B	Report of an inspection on November 11, 2009 Subject: Does not note the release of any equipment or materials to unrestricted use.
TCEQ – 2010A	Radioactive Material License No. R03626, Amendment No. 17, dated July 8, 2010 Subject: Changes the licensee from Everest Exploration, Inc. to South Texas Mining Venture L.L.P.
TCEQ – 2010B	TCEQ Radionuclide Analysis Laboratory Report, dated July 26, 2010 Subject: Analytical results for sample collected from Mt. Lucas EA-North Wellfield on May 3, 2010 at site SO-01 at 0 – 6 inch depth.
TCEQ – 2010C	TCEQ Radionuclide Analysis Laboratory Report, dated July 26, 2010 Subject: Analytical results for sample collected from Mt. Lucas EA-North Wellfield on May 3, 2010 at site SO-02 at 0 – 6 inch depth.
TCEQ – 2010D	TCEQ Radionuclide Analysis Laboratory Report, dated October 26, 2010 Subject: Analytical results for sample collected from Mt. Lucas EA-North Wellfield on August 11, 2010 at site SO6B at 6 - 12 inch depth.
TCEQ – 2010E	TCEQ Radionuclide Analysis Laboratory Report, dated October 26, 2010 Subject: Analytical results for sample collected from Mt. Lucas EA-North Wellfield on August 11, 2010 at site SO5B at 6 - 12 inch depth.
TCEQ – 2012A	Gonzalez Memorandum, 12/4/2012 Subject: Supplemental Soil Sampling in the Phase I Irrigation Area Annex on November 13, 2012.
TCEQ – 2012B	Gonzalez Memorandum, 12/5/2012 Subject: Confirmatory surveys of J6, J7, M Sand, H, H-Expansion and H-Extension wellfields on June 1, 2010.
TCEQ – 2012C	Gonzalez Memorandum, 12/5/2012 Subject: Confirmatory surveys of Plant site, waste ponds and the Phase I

	Irrigation Area Annex on January 25, 2011.
TCEQ – 2012D	Gonzalez Memorandum, 12/5/2012 Subject: Confirmatory surveys of Lillian, EA North, HM-East and HM-West wellfields on May 7, 2009.
TCEQ – 2012E	Gonzalez Memorandum, 12/5/2012 Subject: Confirmatory surveys of EA North, EA-South, EA-Center, J and North J wellfields on May 4, 2010.
TCEQ – 2012F	Gonzalez Memorandum, 12/12/2012 Subject: Confirmatory surveys of J, North J wellfields, West Satellite Plant, Phase I Irrigation Field and Phase I Annex on February 22, 2011.
TCEQ – 2012G	Gonzalez Memorandum, 12/17/2012 Subject: Confirmatory Survey of Phase I Irrigation Area and EA-North, South J and E Wellfields on August 10, 2010.
TCEQ – 2013A	Gonzalez Memorandum, 5/21/2013 Subject: Supplemental Soil Sampling at the Phase I Annex on November 13, 2012.
TCEQ – 2013B	Memorandum dated November 22, 2013, from Shaver to License File R03626 Subject: Technical Evaluation Report – Mt. Lucas Release
TDH – 1984A	Report of inspection conducted 4/23/1984 Subject: <ul style="list-style-type: none"> • Notes transfer of loaded resin to the Hobson facility. • Notes transfer of by-product material to Conoco Conquista for disposal.
TDH – 1984B	Report of inspection conducted 11/28/84 Subject: <ul style="list-style-type: none"> • Notes shipment of solid waste to the Hobson facility for transfer to the Conoco Conquista site for disposal • No release of equipment and materials to unrestricted use is noted.
TDH – 1985A	Report of inspection conducted on 4/18/85 Subject: <ul style="list-style-type: none"> • Contaminated trash is noted to be placed in drums and transferred to the Hobson facility for subsequent transfer to the Conoco Conquista site for disposal. • No release of equipment and materials to unrestricted use is noted.

TDH – 1985B	Report of inspection conducted on 10/16/85 Subject: <ul style="list-style-type: none"> Contaminated trash is noted to be placed in drums and transferred to the Hobson facility for subsequent transfer to the Conoco Conquista site for disposal. No release of equipment and materials to unrestricted use is noted.
TDH – 1986A	“Environmental Assessment and License Conditions Related to Expansion of the Everest Exploration, Inc. Mt. Lucas Project” (TBRC EA-7-1S), Bureau of Radiation Control/Texas Department of Health, January 3, 1986.
TDH – 1986B	Report of inspection conducted 4/23/1986 Subject: <ul style="list-style-type: none"> Notes transfer of by-product material to the Hobson facility for subsequent disposal at the Conoco Conquista Project.
TDH – 1986C	Garcia Memorandum, 9/11/86 Subject: Notes soil samples collected south of the irrigation area exceeding release criteria.
TDH – 1987A	Report of inspection conducted 5/13/1987 Subject: Does not note the release of any equipment or materials to unrestricted use.
TDH – 1987B	Report of inspection conducted 11/18/1987 Subject: <ul style="list-style-type: none"> Notes the transfer of equipment to Conoco’s Conquista Project for disposal. Does not note the release of any equipment or materials to unrestricted use.
TDH – 1988A	Report of inspection conducted 6/6/1988 Subject: <ul style="list-style-type: none"> Notes the transfer of drummed by-product material to the (Everest) Hobson facility. Does not note the release of any equipment or materials to unrestricted use.
TDH – 1988B	Report of inspection conducted 11/15/1988 Subject: <ul style="list-style-type: none"> Notes the transfer of wellfield equipment and pond cleanout material to Conoco (Conquista Project) for disposal. Does not note the release of any equipment or materials to unrestricted

	use.
TDH – 1989A	Report of inspection conducted 5/8/1989 Subject: Does not note the release of any equipment or materials to unrestricted use.
TDH – 1989B	Report of inspection conducted 11/13/1989 Subject: Does not note the release of any equipment or materials to unrestricted use.
TDH – 1990A	Report of inspection conducted 5/15/90 Subject: Does not note the release of any equipment or materials to unrestricted use.
TDH – 1990B	Report of inspection conducted 12/11/90 Subject: Does not note the release of any equipment or materials to unrestricted use.
TDH – 1991A	Report of inspection conducted 4/25/91 Subject: Does not note the release of any equipment or materials to unrestricted use.
TDH – 1991B	Report of inspection conducted 11/7/91 Subject: Does not note the release of any equipment or materials to unrestricted use.
TDH – 1992A	Report of inspection conducted 4/28/92 Subject: Does not note the release of any equipment or materials to unrestricted use.
TDH – 1992B	Report of inspection conducted 11/10/92 Subject: Does not note the release of any equipment or materials to unrestricted use.
TDH – 1993A	Report of inspection conducted 5/26/93 Subject: Does not note the release of any equipment or materials to unrestricted use.
TDH – 1997A	Memorandum from Oscar Lessard to License File RW3626 dated November 14, 1997 Subject: Documentation of survey of pipeline trenches in Phases I, II, III Irrigation Areas, and East to West Trenches through Phases II and IV Irrigation Areas and West Side FM 534 to 50 yards past creek, with recommendation for backfilling of trenches.
TDH – 1997B	TDH letter dated December 4, 1997, from Arthur Tate, Director of Compliance and Inspection Division, TDH to Everest.

	Subject: Authorizes backfilling of pipeline trenches.
TDH – 1997C	Memorandum from Oscar Lessard to Gene Forrer/License File L03626 dated December 11, 1997 Subject: Documentation of confirmatory survey of Phase IV Irrigation Plot and recommendation for release to unrestricted use.
TDH – 1998A	License No. L03626, Amendment No. 02, dated April 28, 1998 Subject: Phase IV Irrigation Area released to unrestricted use.
TDH – 1998B	Report of inspection conducted July 23, 1998 Subject: Notes that there has been no release of equipment to unrestricted use since the last inspection.
TDH - 1999	Inspection Report for February 16, 1999 Subject: <ul style="list-style-type: none"> Notes that there has been no release of equipment to unrestricted use since the last inspection. Images document conditions of Mt. Lucas-East plant site.
TDH - 2000	Report of inspection for January 17, 2000 Subject: <ul style="list-style-type: none"> Notes the release of equipment to unrestricted use. Items surveyed and survey results noted.
TDH - 2001	Report of inspection for February 15, 2001 Subject: <ul style="list-style-type: none"> Notes that there has been no release of equipment to unrestricted use since the last inspection.
TDH – 2002A	Emergency Order issued January 14, 2002 Subject: Orders Everest to decommission the Mt. Lucas site.
TDH – 2002B	License Amendment No. 07, dated February 13, 2002 Subject: Authorizes soil homogenization in Irrigation Areas Phases I, II and III.
TDH – 2003A	Report of an inspection for March 13, 2003 Subject: Notes reviewing records for release of equipment to unrestricted use, but does not specify what is released or survey results.
TDH – 2003B	Memorandum dated June 30, 2003, from Gary Smith to License File L03626 Subject: Review of Everest’s Request for Release for Unrestricted Use: Phase II and III Irrigation Areas at Mt. Lucas.

TDH – 2004A	Memorandum dated February 23, 2004 from Bob Burkhart to Phil Shaver Subject: Recommends the release of Phase II and Phase III Irrigation Areas to unrestricted use.
TDH – 2004B	License Amendment No. 08, dated March 8, 2004 Subject: <ul style="list-style-type: none"> • Authorizes soil homogenization in wellfields. • Authorizes release of Irrigation Areas Phases II and III to unrestricted use.
TNRCC – 1993	Report of inspection conducted October 19, 1993 Subject: Notes that there has been no release of any equipment or materials to unrestricted use since the last inspection.
TNRCC - 1994	Report of inspection performed on May 26, 1994 by Muhammadali Zare a. k. with the TNRCC. Subject: <ul style="list-style-type: none"> • Notes that there has been no release of any equipment or materials to unrestricted use since the last inspection.
TNRCC - 1995	Report of inspection performed on June 7, 1995 and July 12 & 13, 1995 by Rick Munoz with the TNRCC. Subject: <ul style="list-style-type: none"> • Notes that there has been no release of any equipment or materials to unrestricted use since the last inspection.
TNRCC – 1996A	Letter dated August 8, 1996, from Everest (Michael Buckley) to TNRCC (John Santos). Subject: Transfer of wells from Everest to the Mt. Lucas landowner (Mr. Lon Cartwright).
TNRCC – 1996B	Report of inspection performed on October 15 & 16, 1996, by Muhammadali Zare. a. k. with the TNRCC Subject: <ul style="list-style-type: none"> • Notes release of equipment to unrestricted use and copies of surveys to document that the release criteria was not exceeded. • Inspection report notes disposition of East Pond liner. • Images depict equipment and vessels at Mt. Lucas-East plant site.
TNRCC - 1999	Cancellation of Permit UR02381-001 dated March 23, 1999 Subject: Cancellation of UIC permit.

APPENDIX 1
Summary of Sequence of Events

Date	Activity	Regulatory Authority	
		Radioactive Material Licensing	Underground Injection Control Permitting
January 1981	UIC Permit No. 2381 issued to Everest Mineral Corporation for in situ uranium mining at the Mt. Lucas mine.		
August 1981	License No. 8-3068 issued to Everest Minerals Corporation for <i>in situ</i> leach (ISL) uranium recovery at the Mt. Lucas Project.		
April 1986	Mining ceased and restoration of groundwater begins in Wellfields E and EA		
March 1988	Mining ceased and restoration of groundwater begins in Wellfields HM and M		
June 1988	Mining ceased and restoration of groundwater begins in Wellfield South J		
July 1988	Mining ceased and restoration of groundwater begins in Wellfields H, Lillian and J		
April 1992	Restoration completed in Wellfield E.		
July 1992	Wells plugged and abandoned in Wellfield E.		
September 1993	TWC combined with other agencies to become the Texas Natural Resource Conservation Commission (TNRCC). Regulatory authority for uranium recovery (i.e., radioactive material licensing) transferred from TDH to TNRCC.		
February 1994	Restoration completed in Wellfields EA and Lillian.		
June 1994	Wells plugged and abandoned in Wellfields EA and Lillian		

**Texas
Department
of Health
(TDH)**

**Texas Water
Commission
(TWC)**

**Texas Natural
Resource
Conservation
Commission
(TNRCC)**

**Texas Natural
Resource
Conservation
Commission
(TNRCC)**

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September 1994	Restoration completed in Wellfield HM		
December 1994	Restoration completed in Wellfield HM		
November 1995	Restoration completed in Wellfields H, M and South J.		
January 1996	Wells plugged and abandoned in Wellfield H.		
February 1996	Wells plugged and abandoned in Wellfield M		
March 1996	Wells plugged and abandoned in Wellfield South J		
May 1996	Restoration completed in Wellfield J.		
July 1996	Wells plugged and abandoned in Wellfield J		
July 1997	Regulatory authority for uranium recovery (i.e., radioactive material licensing) transferred from TNRCC to TDH.		
March 1999	Mine Area Permit UR02381-001 (for Mt. Lucas Mine) cancelled by TNRCC.		
September 2002	TNRCC changes name to Texas Commission on Environmental Quality (TCEQ)		
2004	Licensee renews surface decommissioning activities at Mt. Lucas.		
September 2004	TDH merged with other agencies to become the (Texas) Department of State Health Services (DSHS)		
January 10, 2006	Everest and Standard Uranium (URN), form a partnership (South Texas Mining Venture L.L.P.) with URN holding 99% of the interest and Everest 1% of the interest in the partnership.		
March 10, 2006	Energy Metals acquires Standard Uranium (included in the acquisition is the Standard Uranium 99%		

	portion of the STMV partnership).		
June 2007	Regulatory authority for uranium recovery (i.e., radioactive material licensing) transferred from DSHS to TCEQ.	TCEQ	
August 10, 2007	Uranium One acquires Energy Metals (included in the acquisition is the Standard Uranium 99% portion of the STMV partnership).		
December 18, 2009	Uranium Energy Corp acquires 100% of the interest in STMV (from Everest and Standard Uranium).		
July 2010	License No R03626 is amended to change from Everest Exploration, Inc. to South Texas Mining Venture L.L.P. as the licensee. Application for the change was made in January of 2010.		
2013	Licensee completes decommissioning activities at Mt. Lucas.		
November 13, 2013	Radium Benchmark Dose rule becomes effective, replacing the uranium concentration rule.		

APPENDIX 2

Figure 1: layout of the Mt. Lucas Project with the location of the major features depicted

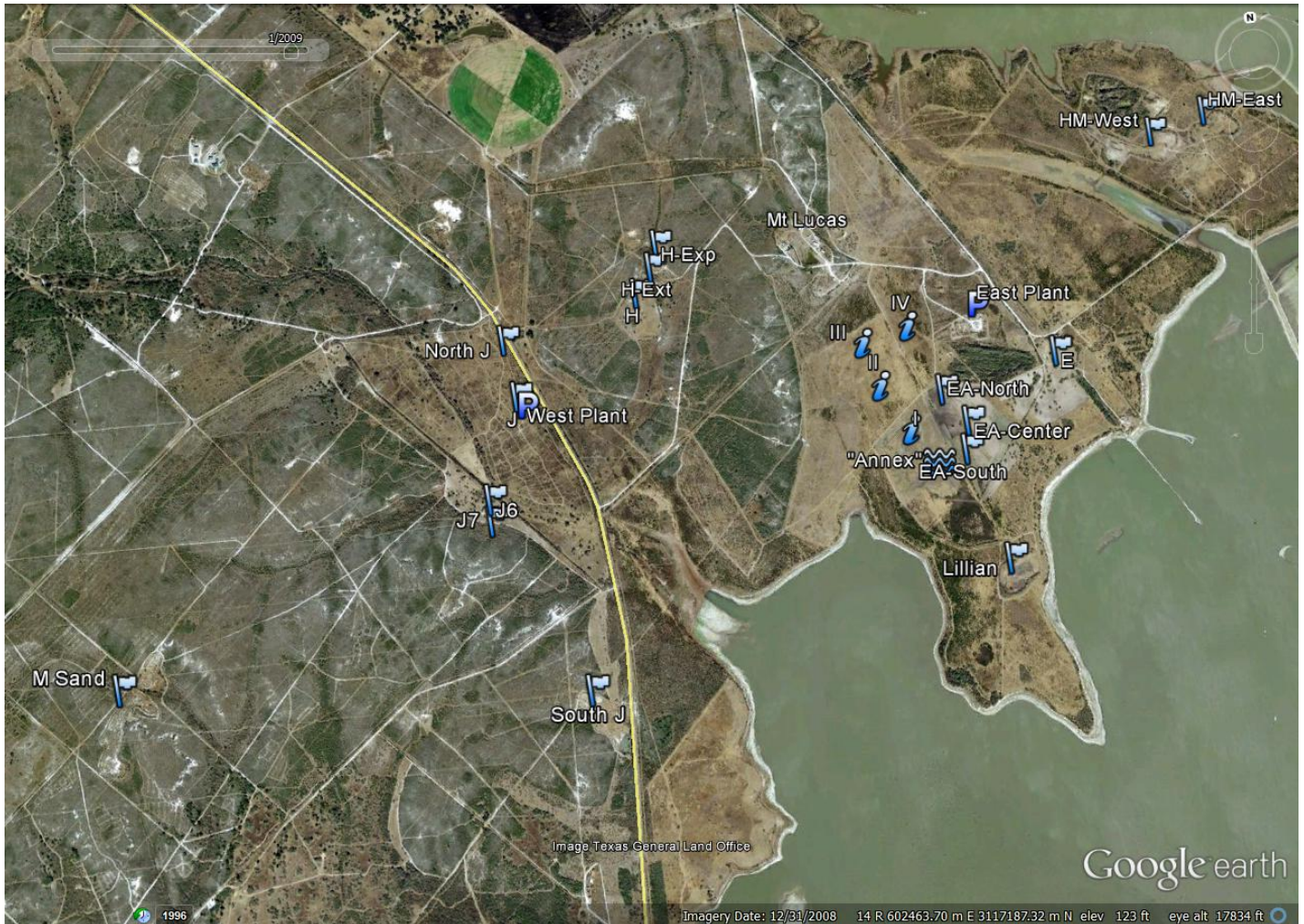


Figure 1 Legend

- The “flag” symbols indicate a wellfield and the text next to the symbol is the name associated with the wellfield.
- The letter “P” indicates the location of an ion exchange plant [the two (2) treatment ponds are associated with the East Plant].
- The italicized-lowercase “i” signifies an irrigation area and the associated Roman numerals identifies the irrigation area.
- The wavy symbol indicates the location of the area adjacent to the Phase I Irrigation Area, referred to by the current Licensee as the “Phase I Annex,” or simply the Annex.