BUREAU OF ENVIRONMENTAL REMEDIATION
REMEDIAL SECTION GUIDANCE DOCUMENT

MERCURY CONTAMINATION REMEDIATION AT GAS PIPELINE SITES

BER POLICY # BER-RS-035
DATE: 1994
Revised 2005
Revised 2008
PAGES: 10

Section Chief: _____ Date: _____

Bureau Manager:_____ Date: _____

REVISIONS

Reviser: Wade Strickland **Date of Revision: 2008**
Reviser: Kurt Limesand **Date of Revision: 2005**

ORIGINATOR

Originator: Rick Bean **Date: 1994**

MERCURY CONTAMINATION REMEDIATION AT GAS PIPELINE SITES

1.0 INTRODUCTION

This Scope of Work (SOW) outlines the Kansas Department of Health and Environment (KDHE) requirements for the remediation of mercury-contaminated natural gas pipeline mercury manometer sites. The SOW specifically does not apply to non-mercury type contamination at natural gas metering sites. The objective of the remediation effort is to cleanup any metering station having visible mercury present in or around the natural gas manometer station and/or to reduce the mercury contamination in soil to levels that are deemed to be adequately protective of human health. All mercury impacted soil must be remediated to meet the residential RSK Tier 2 cleanup standard of 2.0 mg/Kg to be eligible for unrestricted site closure. Any residual mercury impacts left in soil above the residential standard will either require active remediation or the implementation of environmental use controls (EUCs) at the site. The requirements of this SOW have been determined by KDHE to be effective for remediation sites with mercury contamination in excess of approved levels in a consistent and cost effective manner. The elements outlined herein must be incorporated into a Remediation Work Plan and submitted to KDHE for review. Final approval of the Remediation Work Plan shall be contingent upon satisfying the elements contained in this SOW. This SOW must be implemented within the framework of the specific Remedial Section program in which the contamination is being addressed (e.g. Voluntary Cleanup Unit, Site Remediation Unit, etc.).

Mercury remediation will include, at a minimum, the following elements: characterization of excavated waste; removal of visible mercury and excavation of contaminated soils; confirmation and verification sampling; backfilling, grading, restoration of excavated area; and disposal of contaminated soils in a manner consistent with applicable regulations. The Remediation Work Plan must contain the following: a summary of characterization (including a list of sites requiring remediation and an implementation schedule), proposed remediation and disposal methodology, a verification sampling plan(s), a site restoration plan, a quality assurance project plan, and a health and safety plan.

Toxicity Characteristic Leaching Procedure (TCLP) analysis must be used to determine the appropriate disposal method of in accordance with the Resource Conservation and Recovery Act (RCRA). The TCLP test is described in 40 Code of Federal Regulations (CFR) Part 261 Appendix II-Method 1311. Critical to TCLP analysis is its representativeness of the potential hazardous waste. RCRA regulation 40 CFR 261.24, Subpart C states:

"(a) A solid waste exhibits the characteristic of toxicity if, using the test methods described in Appendix II or equivalent methods approved by the Administrator under the procedure set forth in §§ 260.20 and 260.21, the extract from a representative sample of the waste contains any of the contaminants listed in Table I at a concentration equal to or greater than the respective value given in that Table."

KDHE interprets "representative sample of the waste" to mean a sample obtained from the excavated waste at each individual site and not from a stock pile of excavated waste from multiple sites.

The Remediation Work Plan should include a discussion of the following activities:

2.0 SUMMARY OF CHARACTERIZATION

The summary should include a brief review of the initial characterization activities. Sites with total mercury in excess of KDHE's established cleanup levels should be listed in an appendix. The list should include:

- station number, name, or other unique identifier
- legal description
- county
- total mercury analysis results
- land use
- status (active/inactive). A proposed schedule for remediation of each site should be included.

3.0 REMEDIATION TECHNOLOGY

The treatment and disposal method selected for mercury-bearing wastes depends on the classification of the wastes according to RCRA guidelines. New and innovative remedial technology designed for pre-treatment and/or treatment of mercury-contaminated soils (non-hazardous) or characteristic hazardous waste will be considered provided they can meet KDHE cleanup criteria and obtain all necessary RCRA and KDHE (Bureaus of Air & Radiation, Waste Management, and/or Water) authorizations or permits, if any. The intent to recycle recovered free/elemental mercury must be stated in the remediation work plan and approved by KDHE. Additionally, the Work Plan should designate the recycling facility. Possible waste classifications include:

3.1 Non-hazardous waste classification:

TCLP analysis results are less than 0.2 mg/l; total mercury analysis results are used to determine if the non-hazardous waste will require remediation. Note: TCLP analysis are not required if the total mercury concentrations are less than 4.0 mg/kg. For the cleanup of non-hazardous mercury-contaminated soils, the approved remediation methodology includes excavation and disposal of contaminated soils at an approved Subtitle D (sanitary) landfill. Appendix A contains a map illustrating the various landfills within Kansas. Natural gas pipeline owner/operator must obtain a solid waste disposal authorization prior to landfilling material of this nature in Kansas. Please direct questions or requests for solid waste disposal authorization to the KDHE’s Solid Waste Section.

The use of mobile treatment units (MTUs) to treat non-hazardous mercury-contaminated soil for remediation will be considered provided the treated soil meets KDHE cleanup levels. Companies contemplating the use of MTUs should contact KDHE Ys Bureau of Air & Radiation, Air Engineering Section, to acquire "special approval" concerning the MTUs air emissions. The MTUs can be operated at individual sites or at a centrally located facility. Treated soils meeting the cleanup levels may be returned to the place of origin with appropriate laboratory verification. Since Kansas cleanup levels are health risk based, federal regulations, directives, and policy would allow for the decontaminated material to be returned to its place of origin.

The recovered component (elemental mercury) would remain subject to regulation as a hazardous waste. A temporary United States Environmental Protection Agency (EPA) identification number will be required in order to transport the recovered mercury to an approved treatment, storage, or disposal facility (TSDF). The temporary EPA identification number is good for thirty days once activated, and can be obtained by contacting KDHE’s Hazardous Waste Section (HWS). Manifests and other shipping requirements for the transportation of recovered mercury intended for recycling should be arranged directly with the recycling facility, with the recycler assuming possession of the mercury at the site.

3.2 Characteristic hazardous waste (low total mercury content)

TCLP analysis results are greater than 0.2 mg/l; total mercury analysis results are less than 260 mg/kg. The approved remediation methodology includes excavation and disposal of hazardous soils at an approved TSDF. Hazardous waste authorizations are not required, a temporary EPA identification number must be obtained.

The use of on-site MTUs to process contaminated soils exhibiting a characteristic hazardous waste classification (low total mercury content) is permissible. 40 CFR 268.7(a)(4) contains provisions for the treatment of a prohibited waste (i.e. D009) in tanks or containers regulated under 40 CFR 262.34 in order to meet applicable Land Disposal Restriction (LDR) treatments standards. The provisions of 40 CFR 262.34 and 268.7(a)(4) exempt the on-site treatment activity only from most hazardous waste permitting requirements. Companies contemplating the use of a MTU should contact KDHE's Hazardous Waste Section regarding the waste analysis plan (required by 40 CFR 268.7(a)(4)(i)) and clarification of permitting issues regarding MTUs. As noted previously, the Bureau of Air & Radiation should also be consulted to determine if "special approval" will be required.

Federal regulations, directives, and policy allow for the decontaminated medium to be placed back into its place of origin because Kansas cleanup levels are health risk based. KDHE will consider the application of "contained-in" remediation for any mercury characteristic waste to allow for the return of decontaminated soil to the place of its origin. Since the hazardous characteristic has been removed from the material the LDR does not apply.

The recovered component (elemental mercury) would remain subject to regulation as a hazardous waste. In order to transport the recovered mercury to an approved TSDF, a temporary EPA identification number will be required. Manifest and shipping requirements, for elemental mercury recovered and intended for recycling, should be arranged directly with the recycling facility with the recycler taking possession of the mercury at the site.

3.3 Characteristic hazardous waste (high total mercury content)

TCLP analysis results are greater than 0.2 mg/l; total mercury analysis results are greater than 260 mg/kg. Under 40 CFR Part 268, the LDR lists the recommended remediation technology for characteristic hazardous waste as the best demonstrated available technology (BDAT). The RCRA specified BDAT treatment is roasting or retorting.

The use of on-site incinerator or retort MTUs, to process contaminated soils exhibiting a characteristic hazardous waste classification with high total mercury content to a hazardous waste classification with low total mercury content, is permissible. 40 CFR 268.7(a)(4) contains provisions for the treatment of a prohibited waste (i.e. D009) in tanks or containers regulated under 40 CFR 262.34 in order to meet applicable LDR treatments standards. The provisions of 40 CFR 262.34 and 268.7(a)(4) exempt the on-site treatment activity only from most hazardous waste permitting requirements. As noted above, the waste analysis plan (required by 40 CFR 268.7(a)(4)(i)) and permit issues must be submitted to the Hazardous Waste Section. The Bureau of Air & Radiation should also be consulted to determine if "special approval" will be required.

The resulting MTU processed soil will be considered hazardous waste and will require disposal at an approved TSDF. A temporary EPA identification number will be required to transport the recovered, processed low mercury content hazardous waste to an approved TSDF.

3.4 D009 (free/elemental mercury)

All recovered free/elemental mercury. Metering houses having visible free mercury on the floors, walls, cracks, or any other location in or around the building shall be cleaned using one or a combination of the following methods: a mercury vacuum equipped with high efficiency particulate air (HEPA) filter or its equivalent, mercury absorbent sponges, and/or similar mercury reclamation equipment. If the

reclamation equipment containing the recovered mercury is not fully saturated, exhausted, or filled, they may be used at other site(s) until they are completely saturated, exhausted, or filled. The recovered component (elemental mercury) would remain subject to regulation as a hazardous waste and a temporary EPA identification number will be needed to transport the recovered mercury to a TSDF. Manifests and other shipping requirements for recovered mercury intended for recycling should be arranged directly with the recycling facility, with the recycler taking possession at the site.

4.0 SOIL REMEDIATION

Procedures for the remediation of contaminated soil outlined herein are for the "ideal" metering station. Variations from the procedures listed may be necessary depending on the physical characteristics of or at each metering station. However, the procedures outlined should be followed as closely as possible with all major deviations documented and noted in the final remediation report. The recommended remediation procedures are:

4.1 Shallow contamination (0 to 6 inches)

The recommended initial vertical cut of soil to be removed is 12 inches, with subsequent cuts at six inches minimum. Confirmation and verification sampling are to be conducted as outlined in the Sampling Plan (Section 4). Verification samples with total mercury concentrations greater than (or exceeding) the cleanup levels will dictate the location(s) (lateral or vertical) for additional cuts of soil. When the confirmation sample results are below cleanup requirements, verification samples will be collected and submitted to an approved analytical laboratory for total mercury analysis. If the results of the total mercury analysis are below established cleanup levels, no further excavation will be required.

4.2 Deep contamination (18 to 24 inches)

The recommended initial cut of soil to be removed is 24 inches, with subsequent cuts at a six inch minimum. Confirmation and verification sampling are to be conducted as outlined by the Sampling Plan (Section 4). Verification samples with mercury above the cleanup levels will dictate the location (lateral or vertical) for future cuts of soil. When the confirmation sample results are below cleanup requirements, verification samples will be collected and submitted to an approved analytical laboratory for total mercury analysis. If the results of the total mercury analysis are below established cleanup levels, no further excavation will be required.

4.3 Area of initial excavation

The recommended size or area of the initial excavation will depend upon the location of the contaminated soil relative to the metering house.

4.3.1 Remediation outside the metering house:

Sites where the metering house has\had a constructed floor (i.e. concrete, metal, or wood), the minimum area of excavation should be:

- for grab sample locations in excess of cleanup levels, an area from the entrance to one foot beyond the grab sample location and not less than two feet wide;
- for composite sample locations in excess of cleanup levels, the area to be excavated should be a radius of not less than two feet from the entrance, out to five feet; or
- if both sample type locations are in excess of cleanup levels, a radius of five feet from the entrance.

Actual area of excavation should be adjusted depending upon the actual location of the original characterization sample(s) or due to the presence of major obstructions. All deviations from the

recommended excavation procedures must be clearly documented in the final report. Surface gravel covering in the excavation area should be removed and the area adjacent to the excavation covered with 6-mil polyethylene sheeting during remediation activities. Cover materials removed may need to be disposed of as special waste if free or visible mercury is present within it.

4.3.2 Remediation inside the metering house:
At sites where the present or former metering house did not have a constructed floor (concrete, metal, or wood), the minimum area of excavation is dependent upon the type of sampling technique used in the characterization investigation (grab, composite, or both sample(s) indicating mercury in the soil in excess of remediation criteria at the site). The recommended minimum area of excavation is:

- at grab sample locations in excess of cleanup levels, a radius of one and a half feet around the former meter or sample location;

- for composite sample locations in excess of cleanup levels, a radius of not less than one and a half feet to four and a half feet; and

- for both sample type locations in excess of cleanup levels, a radius of not less than four and a half feet from the meter or sample location shall be excavated.

The area of excavation maybe adjusted depending on the location of original characterizing sample(s) or due to the presence of major obstructions. All deviations from the recommended excavation procedures must be clearly documented in the final report. Removed cover materials may need to be disposed of as special waste if free or visible mercury is present or there is other evidence suggesting contamination.

4.3.3 Restrictive Conditions:
Conditions may arise limiting the feasibility and extent of remediation. These conditions should be documented, noted in the final report, and reported to KDHE as they occur. Conditions that might limit further excavation include:

- Reaching bedrock,

- Encountering ground water during excavation. If ground water is encountered during the excavation, two representative ground water samples (one filtered and one unfiltered) must be collected and analyzed using method EPA-600/4-82-055. Within 24 hours of encountering ground water and collecting ground water samples, KDHE must be notified. If the analysis indicates the presence of mercury, a work plan must be developed and submitted to KDHE for approval to characterize the nature and extent of ground water contamination.

- Operational considerations (to ensure safety of workers or other individuals or to protect the integrity of pipeline equipment and facilities) may be grounds to suspend further excavation. KDHE must be notified immediately of any operational considerations impacting the excavation activities. KDHE may require an alternative remedial activity to protect human health and the environment at such sites. Operational considerations that impact the remediation work plan must be documented and noted in the field log sheet and in the final report.

4.3.4 Removal of excavated soils:
All contaminated soils excavated before the TCLP analytical results are received, must remain on site until the project manager receives the results. The analytical results are necessary before the project manager can properly classify the waste for appropriate treatment or disposal options. The use of temporary staging areas to store excavated waste prior to receipt of TCLP analytical results will be permitted but a temporary EPA identification number will be required for each staging area. Inquiries

about the requirements and arrangements necessary for obtaining a temporary EPA identification number to establish a temporary staging area should be made to the Hazardous Waste Section.

5.0 SOIL SAMPLING PLANS

All samples should be collected with stainless steel spoons, Shelby tubes, hand trowels, or hand augers and should be collected, handled and packaged in accordance with appropriate EPA guidance. All TCLP analysis for waste characterization shall be performed at a Kansas Certified Laboratory in accordance with Kansas Administrative Regulation 28-31-4(b)(3). The approved methods for total mercury analysis include: 245.5 (Contract Laboratory Program or CLP) and 7471. The TCLP test analysis is described in 40 CFR Part 261 Appendix II - Method 1311. However, verification sampling for total mercury analysis of the non-excavated soil can be conducted at a non-Kansas certified laboratory provided specific KDHE approval is received. The following sampling plans shall be submitted with the Remediation Work Plan and implemented as required:

5.1 Characterization for disposal sampling plan

In accordance with RCRA and Kansas Administrative Regulations, characterization for disposal will be conducted on all excavated material from sample locations exceeding KDHE established cleanup standards. Samples must be collected from the containerized waste (i.e. soil bag, drums, or other such containers) on site. Two composite samples will need to be collected to satisfy requirements for waste characterization. One composite sample will be for TCLP analysis and the second for total mercury. Excavated waste that fails TCLP analyses will require subsequent total mercury analyses to determine if the waste will be classified as high or low total mercury hazardous waste. Composite samples shall be comprised of one aliquot from each container (soil sack, drums, or other holding unit) used/filled at each site (i.e. if five sacks are generated, then a five point aliquot will be used for the composite samples; if three sacks are generated, then a three point aliquot will be used; or if ten drums are filled, a ten point aliquot will be used).

5.2 Confirmation sampling plan

Confirmation sampling is intended as a field screening technique of the non-excavated soil for the purpose of characterizing the presence of residual mercury, if any; and to help insure subsequent verification sampling will validate a site has been successfully remediated below cleanup levels and to alleviate or minimize the necessity to return to the site for remedial excavation. The use of a mercury vapor analyzer (MVA) or similar device in conjunction with a heated headspace analysis is recommended. If mercury is detected during field screening at a level suggesting residual mercury contamination exceeding KDHE's cleanup levels, an additional cut of soil will be required. Confirmation sampling and excavation must continue until the mercury concentration in the soil is below the cleanup levels. Appendix B contains a scenario for confirmation sampling using a MVA.

5.3 Verification sampling

Verification samples will be collected for laboratory analysis when the confirmation samples indicate the mercury concentration in the soil is below the cleanup criteria. Samples will be collected in the same area where the confirmation samples were collected (the final sidewall samples should be collected no closer than six inches from the top of the excavation). A minimum of three composite samples including: 1) two composite sidewall samples (from opposite or adjacent sides), and (2) a composite of the bottom of the excavation (four aliquots from each quarter section of the bottom) will be sent to a laboratory for total mercury analyses. Variation from the number of prescribed samples may be necessary depending upon the final geometry of the site excavation. KDHE will consider alternative sampling scenarios; however all alternate sampling scenarios must be approved by KDHE prior to implementation. If total mercury analyses are below cleanup criteria, no further excavation will be required. If additional cuts of soil are determined necessary, verification samples from walls and/or base area already satisfying KDHE's

cleanup levels are not required. Verification samples are necessary only from the areas of additional excavation.

5.4 Backfill Soil Verification Sampling

One composite sample must be collected from any source of backfill material and analyzed for total mercury before that material is deposited in the excavation. A minimum of one composite sample from each source of backfill material will be required to verify the backfill source is below KDHE cleanup levels. If the backfill material is treated soil from a mobile treatment facility, and the soil is remediated to below the cleanup levels, it can be returned to the site upon verification by a total mercury analysis for every ten cubic yards treated.

6.0 BACKFILLING

Upon receipt of the verification sampling analysis and the backfill soil verification analysis results, the excavated areas can be filled and compacted to original ground levels. Surface covering removed prior to excavation may be placed over filled areas if the material was not present during the use of the mercury manometer or is non-contaminated (i.e. no visible mercury on any of the material). The area should be returned to its original state.

7.0 MERCURY REMEDIATION REPORT

At the conclusion of the remediation phase, a final verification report for the project must be submitted to KDHE. The report should include as a minimum:

- summary of findings;
- regional locator maps for each station, site setting, photographs, copies of field log sheets, scaled site maps (including sampling locations, areas of excavation, sketch of excavation noting dimensions and features), any major deviations from the Work Plan due to physical conditions at the site, and operational considerations documentation;
- summary of excavation quantities and restoration activities, including type of backfill material (i.e. treated or non-treated);
- field screening sample methods and collection data;
- copies of all laboratory analytical reports;
- quality assurance/quality control results;
- final disposition or fate of all treated or landfilled waste, as well as recycled mercury; and
- copies of other relevant site data for the remediation phase.

A natural gas pipeline mercury manometer site owner/operator may formulate a mercury site remediation plan using a sampling and remediation strategy other than outlined above; however, the plan must be approved by KDHE prior to implementation. For additional information or questions concerning this SOW or other aspects of KDHE's natural gas pipeline mercury manometer remediation program, please call or write:

Rick Bean, Remediation Section Chief
Kansas Department of Health and Environment
Bureau of Environmental Remediation
1000 SW Jackson, Suite 410
Topeka, KS 66612
(785) 296-1675

Appendix A

Landfills in Kansas

Attached is a map illustrating the counties with landfills and the type of landfill available. Due to the recent and continued turnover of landfills closing and/or opening, an accurate listing of landfills within Kansas is unavailable. Companies contemplating the use a Subtitle D landfill in their remediation plans can obtain specific information regarding landfills in a specific area from:

- The local County Engineer from the county(s) of interest; and
- The companies local pipeline facility(s) within Kansas (many local pipeline facility(s) are regularly obtaining disposal authorization from KDHE's Solid Waste Section and are aware of the landfills in the area and their specific requirements).

If the landfill contacted has any concerns regarding the material to be disposed of, they should be encouraged to contact KDHE's Solid Waste Section.

Appendix B

Field Screening

The following sampling scheme is presented as a possible technique for field screening based on field work conducted during previous mercury remediation by natural gas pipeline companies. KDHE recognizes other scenarios may be more appropriate at some sites and acknowledges the need to modify the field screening methodology as the remediation project progresses. It should be noted, employment of liberal field screening parameters may result in excessive return visits (increasing the cost and time involved per site) for further remedial activity. If conservative field screening parameters are employed, over excavation at a site may occur. For this reason, adjustments to the field screening should be considered as verification results become available. The scheme presented relies on the use of a MVA. KDHE is not specifically endorsing the MVA, and is aware of its limitations; however KDHE, through past experience, believed the MVA, if used properly, is a cost and time effective field screening instrument. As noted in the SOW, the use of alternate screening instruments is at the discretion of each company.

At the point were the project manager determines excavation activities remediated the site to below cleanup levels or has met the minimum recommended excavation outlined in the SOW, the field screening should commence. For field screening, KDHE recommends a visual inspection and a MVA scan of the excavation followed by a heated head space analysis.

A. Visual Inspection and MVA Scan:

1. A careful inspection for free mercury along the walls and base of the excavation should be conducted. Appropriate personal protection equipment should be considered.

2. Using a MVA, the walls and base of the excavation should be assessed. The project manager can determine the MVA response that constitutes “clean” for field screening. Two possible methods are:

a. Obtain a sample of soil from a laboratory with a known concentration of mercury and calibrate the MVA via a heated head space analysis outlined below; or

b. The MVA units (mg/m^3) can be converted to total mercury (mg/kg) by the following equation following Avogadro's Law:

$\Phi g/m^3 = [(\text{ppm by volume}) \times 1000 \times \text{Molecular Weight}] \div 24.4$

3. If either the visual inspection or MVA scan of the excavation indicate mercury present, additional excavation cuts should be considered. If the visual inspection and MVA scan does not indicate the presence of mercury, the heated headspace analysis should be conducted.

B. Heated Head Space Analysis:

1. Minimum of five grab samples per excavation (one from each excavation wall and one from the base) should be tested using a one-liter glass sample jar fitted with a temperature probe and a sample port.

2. Soil must be mixed to loosen and blend the soil before placing it in the glass jar. The soil and jar should be heated to 85EF for a minimum of 5 minutes.

3. The calibrated MVA probe should then be inserted into the sample port to quantify the concentration of mercury within the jar headspace.

4. If the head space analysis indicates mercury is present above the cleanup level, additional excavation cuts are recommended. Subsequent visual inspection, MVA scanning, and headspace analysis need be conducted only on the additional excavation area. When the heated headspace analysis indicates mercury concentrations are below KDHE's cleanup level, verification sampling should commence (see Section 4(C) in the SOW).