



**PDHonline Course C328 (1 PDH)**

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**Risk-Based Corrective Action (RBCA)  
for UST Sites**

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# Risk-Based Corrective Action (RBCA) for UST Sites

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## COURSE CONTENT

### 1. Background

RBCA (pronounced "Rebecca") is an acronym for "Risk-Based Corrective Action." In 1995 the United States Environmental Protection Agency (USEPA) Office of Solid Waste and Emergency Response (OSWER) issued Directive 9610.17, *Use of Risk-Based Decision-Making in UST Corrective Action Programs*. (listed in "Related Links and References" for this course) In this directive, USEPA OSWER encouraged "the use of risk-based decision-making as an integral part of the corrective action process at sites where leaking underground storage tank (UST) systems have released petroleum products into the environment and thus created risks to human health and the environment." Since the states each have responsibility for development and oversight of their own UST programs, consistent with USEPA policy, the states were encouraged to develop and use risk-based decision-making in their UST corrective action programs. In Directive 9610.17, the ASTM emergency standard entitled *Guide for Risk-Based Corrective Action at Petroleum Release Sites* [ES-38-94], was noted as one example of how risk-based decision-making can be incorporated into UST corrective action programs in a manner consistent with EPA policies and regulations. It was also noted that the ASTM standard may be a good starting point for the development of a risk-based process tailored to applicable state and local laws and regulatory practices. ASTM emergency standard [ES-38-94] was subsequently replaced by the current ASTM Standard [E-1739-95], with the same title. ASTM [E-1739-95] was issued in 1995 and reapproved in 2002. Some states already had RBCA programs in place in 1995, and by now most, if not all, states have developed and implemented RBCA programs for management of petroleum product releases at UST sites. This course will summarize the RBCA process as presented in ASTM [E-1739-95].

### 2. Overview of RBCA Process

The major steps typically included in the RBCA process triggered by the suspicion or confirmation of a petroleum release are:

- a. conduct a site assessment
- b. Classify the site based on the urgency of initial response.

- c. Implement appropriate initial response if called for.
- d. Conduct a Tier 1 evaluation. This consists of comparing measured chemical of concern (COC) concentrations with risk-based screening levels (RBSLs) from a “look-up table” and deciding upon the next step. If COC concentrations do not exceed RBSLs then the site needs no further cleanup.
- e. If COC concentrations exceed Tier 1 RBSLs, then decide whether to implement interim remedial action, initiate remedial action to Tier 1 RBSLs, or conduct a Tier 2 evaluation.
- f. If warranted, conduct a Tier 2 evaluation. This consists of collecting additional site-specific information as necessary and developing site-specific target levels (SSTLs) and point(s) of compliance. Then, concentrations of COCs at determined point(s) of compliance or source area(s) are compared with Tier 2 SSTLs. If COC concentrations do not exceed Tier 2 SSTLs at the point(s) of compliance, then the site needs no further cleanup.
- g. If COC concentrations exceed Tier 2 SSTLs, at the point(s) of compliance, then decide whether to implement interim remedial action, initiate remedial action to Tier 2 SSTLs, or conduct a Tier 3 evaluation.
- h. If warranted conduct a Tier 3 evaluation. This consists of collecting additional site-specific information as necessary and developing site-specific target levels (SSTLs), perhaps using different models or modeling procedures. Then, concentrations of COCs at determined point(s) of compliance or source area(s) are compared with Tier 3 SSTLs. If COC concentrations do not exceed Tier 3 SSTLs at the point(s) of compliance, then the site needs no further cleanup.
- i. If COC concentrations exceed Tier 3 SSTLs, at the point(s) of compliance, then develop a remedial action plan to achieve the Tier 3 SSTLs.

### **3. Conducting the Site Assessment**

The site assessment information required for a Tier 1 evaluation is collected first. The requirements for the site assessment may vary somewhat from state to state in their individual RBCA guidance documents. The required information will typically include the following:

- a. A review of historical records of site activities and past releases,
- b. Identification of chemical(s) of concern,
- c. Location of major sources of the chemical(s) of concern,
- d. Location of maximum concentrations of chemical(s) of concern in soil and groundwater,
- e. Identification of humans and the environmental receptors that could be impacted, referred to as point(s) of exposure,
- f. Identification of potential significant transport and exposure pathways, for example: ground water transport, vapor migration, through soils and utilities, etc,
- g. Determination of current and potential future use of the site and surrounding land, ground water, surface water, and sensitive habitats,
- h. Determination of regional hydrogeologic and geologic characteristics, for example: depth to ground water, aquifer thickness, flow direction, flow gradient, description of confining units, and ground water quality, and
- i. A qualitative evaluation of impacts to environmental receptors.

The site characterization data should be summarized in a clear and concise format.

#### **4. Site Classification**

Typically, the site would now be classified by the urgency of need for initial response action, based on information collected during the site assessment. In ASTM Standard [E 1739-95], a table with a possible classification scheme and appropriate response actions for each is provided. The four possible classifications given in that table are:

- a. Immediate threat to human health, safety, or sensitive environmental receptors,
- b. Short-term (0 to 2 years) threat to human health, safety, or sensitive environmental receptors,
- c. Long-term (> 2 years) threat to human health, safety, or sensitive environmental receptors,
- d. No demonstrable long-term threat to human health, safety, or sensitive environmental receptors,

The appropriate initial response action should then be taken. As more complete information becomes available, or response actions have been implemented, the site may be reclassified. How to handle classification of the site, with respect to need for initial response action, will be provided in each state guidance document, and may be different from the above.

### 5. Tier 1 Evaluation

For a Tier 1 evaluation, representative concentrations of chemical(s) of concern (COCs) are compared with Risk Based Screening Levels (RBSLs) for those COCs. Procedures for calculating representative COC concentrations from measured values are typically specified in the state RBCA guidance document. The RBSLs are typically available in a “look-up table”, available in the state RBCA guidance document. An example of development of RBSLs and a look-up table are given in ASTM standard [E 1739-95], in Appendix X2. Given in the table below are a few lines from that example look-up table:

**Table 1. Example Portion of a Tier 1 Look-up Table**

Exposure Pathway	Receptor Scenario	Target Level	Benzene	Ethylbenzene	Toluene	Xylenes
Vapor inside bldg from ground water (gw conc, mg/L)	residential	cancer risk = 1 E-06	2.38 E-02			
		cancer risk = 1 E-04 chronic HQ = 1	2.38 E+00	7.75E +01	3.28 E+01	> solubility

The full look-up table(s) would include all of the exposure pathways, receptor scenarios, target levels and chemicals of concern to be considered. Typical exposure pathways would include:

- a) ingestion of groundwater;
- b) indoor inhalation of vapors from groundwater, surficial soil, or subsurface soil;
- c) outdoor inhalation of vapors from groundwater, surficial soil, or subsurface soil;
- d) ingestion of soil;
- e) and/or dermal contact with soil or groundwater.

Receptor scenarios could include:

- a) residential,
- b) commercial/industrial,
- c) and construction worker.

The target level is often based primarily on increased risk of cancer. Non-carcinogenic effects may also be considered. There may be many more chemicals of concern than those shown in the example table above.

The Tier 1 risk-based screening levels (RBSLs) are calculated with mathematical models (a series of equations). The inputs for the equations typically include:

- a) Target risk levels,
- b) Chemical-specific toxicological factors for the chemicals of concern,
- c) Physical & chemical properties of the chemicals of concern,
- d) Exposure factors for each type of receptor,
- e) and fate & transport parameters

The target risk levels are typically set by the state regulatory agency establishing the RBCA program. The toxicological factors and physical and chemical properties of the chemicals of concern are known values from scientific literature. Exposure factors will include items such as body weight, exposure duration in years, exposure frequency in days/year, and groundwater ingestion rate in L/day. Fate and transport parameters will include items such as

- a) soil properties such as porosity, depth to contamination source, dry bulk density and others,
- b) ground water parameters such as depth to groundwater, Darcy velocity, hydraulic conductivity and others
- c) ambient air parameters such as average wind speed, fraction of vegetative cover and others,

d) and enclosed space parameters such as air exchange rate, foundation or wall thickness, area fraction of cracks in walls/foundation and others.

For calculation of Tier 1 RBSLs, conservative, default values for exposure factors and fate and transport parameters are typically set by the state agency.

Based on the comparison of measured representative COC concentrations with Tier 1 RBSLs, a decision is made for the next step. If Tier 1 RBSLs are not exceeded the site may be eligible for “no further action” status. If Tier 1 RBSLs are exceeded the decision may be made to i) conduct interim remedial action, ii) make plans for remedial action with Tier1 RBSLs as the target, or iii) conduct a Tier 2 evaluation.

## **6. Tier 2 Evaluation**

For a Tier 2 evaluation, site specific values for selected fate and transport parameters and exposure factors are used, instead of the Tier 1 default values, to calculate Site Specific Target Levels (SSTLs) for those pathways, exposure scenarios and chemicals of concern that had COC concentration exceeding Tier 1 RBSLs. Typically some additional site characterization work is needed to obtain the site specific parameter values. Then the equations specified by the state agency must be used to calculate the SSTLs, usually using some site specific values and some default values for parameters. A set of equations for calculating RBSLs or SSTLs is given in ASTM [E1739-95], Appendices X2 & X3. Also, such equations are typically included in state RBCA guidance documents. The calculation of SSTLs can be done using a spreadsheet with the equations. Also, software for calculating SSTLs is available for purchase from some state agencies and private organizations. If modeling software is used, it is necessary to ensure that it is in compliance with the state RBCA requirements for the state in which the UST site is located.

Based on the comparison of measured representative COC concentrations with Tier 2 SSTLs, a decision is made for the next step. If Tier 2 SSTLs are not exceeded the site may be eligible for “no further action” status. If Tier 2 SSTLs are exceeded the decision may be made to i) conduct interim remedial action, ii) develop and implement a plan for remedial action with Tier 2 SSTLs as the target, or iii) conduct a Tier 3 evaluation.

## **7. Tier 3 Evaluation**

The procedure for a Tier 3 evaluation is typically more open-ended than the Tier 1 and Tier 2 procedures. For the Tier 3 evaluation, different mathematical models may be

used and additional site-specific parameter values may be used to calculate the Tier 3 SSTLs.

If measured representative COC concentrations still exceed Tier 3 SSTLs for some of the pathways, exposure scenarios, and COCs, then a remedial action plan must be developed and implemented to bring representative COC concentration(s) below the Tier 3 SSTL(s). In many cases monitoring is required for a period of time to ensure that conditions are stable.

## **8. Reporting**

After each Tier level evaluation is completed, a report is typically required for submission to the state regulatory agency. Basic requirements for the reports are discussed in ASTM [1739-95], including:

- a) an executive summary,
- b) a site description,
- c) a summary of site ownership and use,
- d) a summary of past releases or potential source areas,
- e) a summary of current and completed site activities,
- f) a description of regional hydrogeologic conditions,
- g) a description of site-specific hydrogeologic conditions,
- h) a summary of beneficial use,
- i) a summary and discussion of the risk assessment (hazard identification, dose response assessment, exposure assessment, and risk characterization), including the methods and assumptions used to calculate the RBSLs or SSTLs, or both,
- j) a summary of the tier evaluation,
- k) a summary of the analytical data and the appropriate RBSL or SSTL used,
- l) A summary of the ecological assessment,
- m) a site map of the location,
- n) an extended site map to include local land use and ground water supply wells,



- o) site plan view showing location of structures, above-ground storage tanks, underground storage tanks, buried utilities and conduits, suspected/confirmed sources, etc.,
- p) site photos, if available,
- q) a ground water elevation map,
- r) geologic cross-section(s), and
- s) dissolved plume map(s) of the chemical(s) of concern.

The actual reporting requirements for each state regulatory agency will be given in the RBCA guidance document(s) for that state. Typically this will include topics to be included in the narrative report, a standardized set of tables to be used to present data and information about the site, and standard formats to be used for various figures.