

RCRA CLOSURE HANDBOOK

**A GUIDANCE DOCUMENT PREPARED FOR HAZARDOUS WASTE
FACILITIES UNDERGOING CLOSURE, BY THE INDUSTRIAL HAZARDOUS
WASTE BRANCH OF THE LAND DIVISION OF THE ALABAMA
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT.**

July 2004

NOTICE

This document has been prepared to assist individuals in understanding the closure requirements of the Alabama Department of Environmental Management hazardous waste regulations. It is not intended as a substitute for the regulations and should not be used as such. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

CLOSURE HANDBOOK

Table of Contents

GENERAL OVERVIEW OF THE CLOSURE PROCESS	1
WHAT IS CLOSURE AND WHY IS A CLOSURE PLAN REQUIRED?	1
WHAT IS A CLOSURE PLAN AND WHAT DOES A CLOSURE PLAN CONTAIN?	1
WHICH STATE OF ALABAMA REGULATIONS ADDRESS CLOSURE?	1
NOW THAT A PLAN HAS BEEN WRITTEN, WHAT DO YOU DO WITH IT?	2
WHAT HAPPENS IF CLEAN CLOSURE CANNOT BE ATTAINED?	2
WHAT ACTIVITIES CAN BE CONDUCTED PRIOR TO PLAN APPROVAL?	3
TIMELINE FOR CLOSURE	4
HOW DOES A FACILITY KNOW WHEN TO SUBMIT A CLOSURE PLAN?	4
WHAT IS INCLUDED IN THE DEPARTMENT'S REVIEW PROCESS?	4
HOW LONG IS THE PUBLIC COMMENT PERIOD?	4
HOW MUCH TIME IS ALLOWED FOR COMPLETION OF CLOSURE ACTIVITIES?	5
WHEN IS A CLOSURE CERTIFICATION SUBMITTED TO THE DEPARTMENT?	5
WHEN IS A FACILITY REQUIRED TO SUBMIT A SURVEY PLAT AND PLACE A NOTICE ON THE PROPERTY DEED?	5
GENERAL FACILITY DESCRIPTION AND HISTORY	7
UNIT DECONTAMINATION	8
NON-POROUS SURFACES	8
POROUS SURFACES.....	8
SOIL.....	8
ORGANIZATION	9
EQUIPMENT DECONTAMINATION	10
DECONTAMINATION PAD.....	10
DECONTAMINATION PROCEDURES	10
VERIFICATION OF DECONTAMINATION.....	11
DECONTAMINATION FLUIDS	11
WASTE SAMPLING AND ANALYSIS FOR CLOSURE	12
WHAT IS A SAMPLING AND ANALYSIS PLAN AND WHY IS IT REQUIRED?	12
WHAT IS THE CLOSURE PERFORMANCE STANDARD?	12
WHAT TYPES OF SAMPLING ARE REQUIRED?	13
<i>Background Sampling</i>	13
<i>Initial Sampling</i>	13
<i>Intermediate Sampling</i>	14
<i>Final Confirmation Sampling</i>	14
HOW IS SAMPLING ACCOMPLISHED FOR VARIOUS MEDIA?	15
<i>Non-Porous Surfaces</i>	15
<i>Porous Surfaces</i>	15
<i>Equipment</i>	16
<i>Decontamination Residues</i>	16
CLOSURE COST ESTIMATE, FINANCIAL ASSURANCE AND SCHEDULE	17
CERTIFICATION OF CLOSURE	18
GLOSSARY	19

GENERAL OVERVIEW OF THE CLOSURE PROCESS

What is closure and why is a closure plan required?

“Closure” of a hazardous waste treatment, storage, or disposal unit refers to the process by which the unit is secured, at the end of its use in hazardous waste management, to prevent or minimize future impacts to human health or the environment. The unit may either be completely decontaminated or treated so that exposure to the remaining contamination is minimized. The closure period is the time period from receipt of the final volume of hazardous waste at the unit to the time when the unit is certified closed. There are two ways to approach the closure of a contaminated site: 1) closure by removal (clean closure) and 2) closure-in-place (dirty closure). Clean closure occurs when all hazardous wastes and any associated contamination at the facility are removed to the extent that laboratory analysis shows the contaminants remaining are either below the action levels that are protective of a residential scenario (see the current version of the Alabama Risk-Based Corrective Action (ARBCA) guidance document) or below background levels (this is only applicable for naturally occurring inorganic constituents). Dirty closure occurs when hazardous wastes or associated contamination remain in place at the site either in the soil or groundwater or both. Protective measures such as engineering controls (ECs) or institutional controls (ICs) or a combination of both should be installed properly at the unit before a dirty closure certification is granted. The ECs or ICs planned to be installed should be provided within the closure plan. A closure plan is used to establish the procedures that will be performed during closure and is required when a contaminated site or a hazardous waste management unit is closed by a facility voluntarily or as a regulatory requirement. Following an approved closure plan helps to assure that the closure of the unit will be protective of human health and the environment.

What is a closure plan and what does a closure plan contain?

A closure plan is a document that: (1) describes the active history of a site and type(s) of contaminants existing there; (2) details in writing and in graphical form depict the procedures that will be followed to achieve contaminant removal and closure; (3) provides a step-by-step sampling and analysis plan including proposed sampling locations, decontamination procedures, and analytical parameters and methods; and (4) identifies the cleanup (for clean closure) or containment (for closure-in-place) standards which must be achieved to obtain acceptance of closure certification.

The five basic components of a closure plan are:

- (1) Facility Description and History;
- (2) Waste Removal and Decontamination Procedures;
- (3) Waste Sampling and Analysis Procedures;
- (4) Closure and Inspection Schedule; and
- (5) Closure Cost Estimate and Financial Assurance Demonstration.

Certification of closure, which is required for all types of closure, and submittal of a new survey plat and recording of a notice on the deed, which are required for closure-in-place closures, are considered part of the closure process but are not part of the plan itself. However, if the submittal of a new survey plat and recording of a notice on the deed are going to be necessary, it should be noted within the plan.

Which State of Alabama regulations address closure?

The regulations governing all hazardous waste activities are contained in Division 14 of the Alabama Department of Environmental Management Administrative Code (ADEM Admin. Code).

The requirements for closure of a permitted hazardous waste treatment, storage or disposal unit or contaminated site are contained in ADEM Admin. Code R. 335-14-5-.07 (NOTE: For interim status units, the requirements are contained in ADEM Admin. Code Rule 335-14-6-.07). Certain situations may be regulated by ADEM Admin. Code R. 335-14-6-.01(1)(b). ADEM will inform the facility of which regulations apply. Depending on the type of unit being closed, Rule 335-14-5-.09 through 335-14-5-.14 may also apply. The process by which closure plans, which are not included in permit applications, are reviewed and approved are described in Rule 335-14-6-.07 (3)(d) and (9)(f). The requirements and procedures for media specific investigational and monitoring activities are contained in ADEM Admin. Code R. 335-14-5-.06. and in the most current version of the *Alabama Environmental Investigation and Remediation Guidance* (AEIRG). These regulations are available on ADEM website.

The Land Division of ADEM regulates hazardous waste activities, including closure activities. The Land Division may be contacted by phone at (334) 271-7700 or by writing to the following address:

Alabama Department of Environmental Management
1400 Coliseum Boulevard (ZIP 36110-2059)
P. O. Box 301463 (ZIP 36130-1463)
(334) 271-7700

Please note that this handbook is intended as guidance only and is not to be used as a substitute to the applicable regulations.

Now that a plan has been written, what do you do with it?

Once a closure plan is written, three copies should be submitted to the Land Division of ADEM where the plan enters the Departmental review process and one copy should be sent to the Chief of the RCRA Programs Branch, Waste Management Division, USEPA Region 4. The Industrial Hazardous Waste Branch of the Land Division will comment on the plan for deficiencies or if any information is missing. The review process continues until the closure plan is determined to contain all information required by the regulations. If the review process is unsuccessful, the closure plan may be revised by ADEM pursuant to ADEM Admin. Code R. 335-14-6-.07(3)(d)4.(v). The revisions will be itemized in the letter which is sent to the facility to inform them that the plan has been modified and, by virtue of ADEM's modifications, determined complete.

When the plan is determined to be complete, it is placed on public notice by the Department for a period of 30 days. During this time, the public and the facility are allowed to review the closure plan and provide comments. Once all public comments have been resolved, the Department will either approve the plan for implementation, or modify and approve the plan pursuant to ADEM Admin. Code R. 335-14-6-.07(3)(d)4.(iv).

What happens if clean closure cannot be attained?

If, once closure according to the approved plan is complete, it is determined that clean closure cannot be achieved, then the site and any contaminated areas are considered to be landfills, and must be closed in accordance with the requirements of ADEM Admin. Code Rules 335-14-5-.07 and 335-14-5-.14. If and when this determination is made, the facility must notify the Department and submit a request to modify their closure plan to close-in-place. The facility must also apply for a post-closure permit to perform post-closure care, monitoring, and possibly corrective action for the site. This post-closure period may be 30 years or greater.

What activities can be conducted prior to plan approval?

Removal of waste inventory can occur at any time. The facility must ensure compliance with all applicable regulations including those pertaining to generation and transportation of hazardous waste, such as waste determinations, manifesting, and land disposal restrictions (ADEM Admin. Code R. 335-14-3, 335-14-4, and 335-14-9). Other activities, such as sampling and soil removal, may be performed at the risk of the facility and will generally have to be verified after plan approval.

TIMELINE FOR CLOSURE

The time required to complete closure of a contaminated site can vary greatly depending on the size of the site, the amount of contamination, the types of waste and the types of media that are contaminated. This section will provide an outline for scheduling closure activities and supply information on how much time a facility can expect to spend in each step of the closure process.

How does a facility know when to submit a closure plan?

Regulations require facilities that wish to or are required to close a hazardous waste management unit to have an approved closure plan before closure is performed. If a plan has not been previously approved for a facility either under interim status, permitting or generator requirements, a plan must be approved before closure can occur. For example, a facility would be required to prepare a closure plan if, during a routine inspection, a small quantity generator is found to have a hazardous waste treatment, storage (other than the less than 90-day generator accumulation area), or disposal unit. The Department usually allows 30 to 60 days for preparation of a closure plan. The length of time is specified by the Department when the facility is notified that a closure plan is required. A closure plan may be required by an administrative order or agreement, a consent decree, or may be requested in a formal letter from the Department. When the Department's Land Division receives the facility's closure plan a fee letter requesting the appropriate fees (see the ADEM Admin. Code R. 335-14-1) is sent to the facility. The facility has 30 days to respond to the fee letter. Upon receipt of the fees, the Departmental review process formally begins.

What is included in the Department's review process?

The Department's review process allows for a closure plan to be reviewed and revised twice. Ideally, the closure plan can be approved at this time. If the plan is not complete, administrative measures may be taken. The time it takes for the Department to review a plan depends upon the initial completeness of the plan and the size and complexity of the unit(s) slated for closure. The review time is also affected by the workload assigned to the reviewing project manager. Each time the plan is reviewed, the project manager prepares a list of comments detailing any deficiencies or missing information discovered during his/her review of the plan. This list of review comments (called a Notice of Deficiency or NOD) is sent to the facility as a guideline detailing what information should be added or removed from the plan so that it will contain complete information. Each NOD is accompanied by a letter providing the length of time allowed for the facility to respond to the comments and submit a revised plan. It is the responsibility of the facility to have the plan revised according to the comments and resubmitted to the Department within the allotted time. Failure or refusal to provide adequate, timely responses to the NOD comments may lead to enforcement action (which may include the imposition of monetary penalties) by the Department. The facility is usually given 30 days to respond to the first NOD and 20 days to respond to the second NOD. If any subsequent NODs are necessary, enforcement action may be taken by the Department. If the extent of the comments is such that the plan cannot be revised within the allotted time, a written request for a time extension may be submitted before the scheduled due date. The facility should also contact the reviewing project manager by telephone to alert him/her of the request.

How long is the public comment period?

After the Department has reviewed the closure plan and has determined that all necessary information has been included, the Department will inform the facility that the latest revision of the closure plan submitted to the Department has been determined complete. Once determined complete by the Department, the closure plan will be made available for review and comment by

the public for 30 days. A legal notice will be placed in the local paper to notify the public of its opportunity to comment. A copy of the closure plan will be placed in a library, town hall, courthouse, or other public repository in the same community as the facility (or the town nearest to the facility if the facility is rural) so that it may be reviewed by interested members of the public. If there is substantial public comment, or if specifically requested, a public hearing may be held. Once the public comment period has expired, the Department will review all public comments received during the public notice period and at the hearing, if one is required. The closure plan may be required to be revised again based upon the comments received. Once the closure plan has been re-examined in light of the public comments and found to either be adequate or modified to reflect the public comments, the plan is ready to be approved. The plan will be approved or disapproved within 30 days of the end of the public comment period. If disapproved, the Department may modify and approve the plan pursuant to ADEM Admin. Code R. 335-14-6-.07(3)(d)4.(iv).

How much time is allowed for completion of closure activities?

If a facility has an approved closure plan in place (such as a permitted facility or an interim status facility with a closure plan approved under the interim status requirements), a notice must be given to the Department at least 60 days prior to the start of closure activities. For all facilities that are under closure as a part of an administrative order or other Department action, the Department will assume that closure will begin as soon as the closure plan is approved unless the start of closure is constrained by a Departmental Order or other Departmental action. If there will be a delay between the approval of the closure plan and the commencement of closure activities, the Department should be notified.

All facilities must complete closure activities within 180 days from the date that the closure plan is approved (or the start of closure activities for facilities with previously approved plans) unless a different schedule is approved in the closure plan. For some facilities, completion within 180 days can be difficult or even impossible. A facility with a large quantity of waste remaining on-site that must be removed and disposed of off-site may need additional time to accomplish the waste removal. The Department will allow time extensions on a case-by-case basis for facilities facing large clean-ups. A time extension can be requested in a letter to the Chief of the Industrial Hazardous Waste Branch of the Land Division and should specify the amount of time required by the facility to complete closure as outlined in the approved plan. The request will be considered and, if the Department determines the request to be reasonable, the time extension will be approved. If a time extension is approved, the facility should submit brief 30 day progress reports to the project manager of the site.

When is a closure certification submitted to the Department?

For a facility with only one hazardous waste management unit undergoing closure activities, the facility should submit certification documents to the Department within 60 days of the completion of closure activities. If concurrent hazardous waste unit closures are occurring on site, each closure should be certified separately and within 60 days of the closure of that particular unit. In addition to the certification of closure for each unit, the closure of the entire site should be certified within 60 days of the closure of the last unit (for multiple-unit facilities).

When is a facility required to submit a survey plat and place a notice on the property deed?

In the event that a facility cannot accomplish clean closure by removing all hazardous waste located on-site (this includes soil, sediment, and groundwater contamination), a survey plat should be prepared which shows the horizontal and vertical extent of any remaining waste(s). This plat should be submitted to the local zoning authority no later than the submittal of the certification of closure. A note should also be placed on the property deed no later than the

closure certification submittal to the Department, stating that hazardous wastes or hazardous waste residues remain on the property. A copy of the survey plat and the notice on the property deed should be submitted to the Department for placement into the Land Division File Room.

GENERAL FACILITY DESCRIPTION AND HISTORY

The purpose of the general facility description is to provide basic understanding of the facility, its location and relation to affected communities, and the activities that are occurring or have occurred at the site. This section should contain information concerning the unit that is to be closed including, but not limited to, wastes managed, maps, process descriptions, locations of spills, *etc.* This information will provide a list of probable waste types that may require removal from the closure site. This information should be included even with closure plans that are contained in a complete Part B permit application since the closure plan is considered to be a "stand alone" document.

The following information should be included in this portion of the closure plan:

- 1) The physical location of the facility including city and/or county. The section, township, range, latitude and longitude of the facility should also be included.
- 2) The physical location of any regulated units at the facility, and information on areas requiring specialized attention such as known spills, leaks, *etc.*
- 3) A topographic map in accordance with the regulations provided in ADEM Admin. Code Rule 335-14-8-.02(5)(b)19. including a wind rose, flood zones, seismic areas, fault zones, bodies of water and water supply wells (including private wells) within 1000 ft. of the facility (unless otherwise specified).
- 4) A brief history of the facility and the unit(s) at the facility to be closed under this closure plan. This history should include any previous property owners and any previous uses of the property.
- 5) A description of the historical and current processes at the facility and a description of the processes that apply to the specific unit(s) being closed.
- 6) The maximum amount of waste that has ever been managed on the intended closure site and the maximum amount of waste currently managed at the unit(s) being closed (for example: the number of 55 gallon drums stored there and/or the in-place volume of the waste pile/landfill/surface impoundment, *etc.*).
- 7) A description of the different types of wastes handled at the facility and at the unit(s) being closed (common name, waste codes, quantities, *etc.*).
- 8) A description of any remediation efforts (including other closures, corrective measures, post-closures, and groundwater monitoring activities) that has been conducted or is in progress at the site.

The eight topics listed above provide only the MINIMUM information required by the Department to describe a facility in the closure plan; therefore, if any additional information is required to fully describe the site, it should also be included in this section.

UNIT DECONTAMINATION

This section of the closure plan should include a complete workplan detailing methods for the decontamination of the hazardous waste management units (tanks, containment areas, concrete pads, *etc.*). Several means of decontamination are available. The method for decontamination obviously depends on the materials of construction and location of the particular unit in question. The plan should contain a sufficient level of detail so that it can be properly interpreted and followed by the facility, contractor, certifying engineer, and ADEM personnel. Methods should be consistent with the current version of the AEIRG document.

Non-Porous Surfaces

Decontamination of non-porous surfaces such as tanks and metal piping may be accomplished by washing. Tanks may require entry procedures for a confined space. A detergent may or may not be employed. Steam cleaning is another option. The efficient removal of hazardous waste residues is the goal. After cleaning, the tank must be sampled for analysis. Sampling requirements are discussed elsewhere in this handbook.

Porous Surfaces

Porous surfaces provide a unique problem for decontamination. If a surface-like concrete (*i.e.*, a container storage pad) has been coated with an impervious coating prior to and during its service as a hazardous waste management unit, steam cleaning or detergent washing may be sufficient for complete decontamination. However, if the coating has been compromised or was added after management operations began, the concrete may have hazardous waste residues in the concrete matrix. If steam or detergent cleaning is insufficient, removal of all or part of the concrete may be necessary. The facility owner or operator should determine which is more economically feasible: complete removal of the concrete or removal of layers of the concrete. Methods are available for removing layers of concrete without demolishing the entire concrete slab. The costs for disposal of the volumes of concrete generated, the costs for labor involved, and analytical costs for proper disposal should be taken into consideration. The main goal of the process is to remove contamination in the most efficient manner possible.

Soil

In order to achieve clean closure, all contaminated soil must be either removed from the site or remediated to levels that are protective of a residential scenario (see the ARBCA document). Surface soil can usually be removed and disposed of. Subsurface soil provides several problems, including accessibility. Methods are available for treating soil *insitu*. However, treatment of soil *in situ* is considered part of the post-closure and corrective action process and would not be part of a closure plan. A means of determining the amount and the areal extent of soil to be removed should be provided in the closure plan. For example, if a volume of soil has been removed and analysis shows that contamination is still present in the soil, the plan should describe how the facility decides how much soil to remove and from what portions of the excavation the soils will be removed.

Organization

The unit clean up portion of the closure plan should be organized such that the ultimate goal of decontamination can be achieved in the most efficient manner. In other words, the closure plan should allow for additional removal of soil or additional cleaning of concrete, *etc.*, without requiring approval from ADEM for the additional steps. In evaluating the closure process, the

Department is concerned that the final results of closure are achieved (*i.e.*, the removal and proper disposal of hazardous wastes and residues, decontamination of the site and equipment, *etc.*), as well as with assuring that the closure takes place in a manner that meets all applicable regulations. The closure plan should provide sufficient detail of the iterative or other removal or decontamination sequence to ensure that applicable regulations are addressed and that the final cleanup standards will be achieved.

EQUIPMENT DECONTAMINATION

One important part of closure is the process of equipment decontamination or cleaning. All equipment and systems used to manage hazardous waste at the site and used in clean-up at the site must be decontaminated. ADEM Admin. Code R. 335-14-6-.07(3)(b)4. states that the closure plan must include a detailed description of the steps needed to decontaminate all hazardous waste residues and contaminated containment system components, equipment, structures, and soils during partial and final closure including, but not limited to, procedures for cleaning equipment and removing contaminated soils, methods for sampling and testing surrounding soils, and criteria for determining the extent of decontamination necessary to satisfy the closure performance standard (see Waste Sampling and Analysis for Closure section regarding closure performance standard). This section will include the steps, at a minimum, that should be performed in the decontamination process. Decontamination should be carried out in such a way as to not contaminate new or previously cleaned areas. Decontamination procedures should be performed in a manner consistent with the AEIRG document.

Decontamination Pad

A decontamination pad is used for containing the wash fluids and debris that are generated during the cleaning of equipment or materials such as that used in the clean up of the site. For instance, the decontamination pad would be used as an area to wash a backhoe or a drilling rig so that any contaminated wash water or soils would be contained and not contaminate a new area. Information presented in the closure plan about the decontamination pad should include, at a minimum, the material that will be used to construct the pad, secondary containment for the pad, the sump(s) used to collect and to remove the decontamination rinsate, all collection systems employed, and the location of the pad at the site. There are two major concerns about the actual construction of the pad. First, the pad must be constructed in an area free of gross surface contamination; and, second, the pad must retain the site contaminants and decontamination fluids for future removal and testing. Once decontamination is completed at the site, the pad and related appurtenances must be disposed of in compliance with all applicable ADEM Administrative Codes. Therefore, the closure plan should also describe the disposal of the decontamination pad components. Some items (e.g., concrete slabs, tanks, etc.) may have to be decontaminated in place. If this is the case, the methods of collection of the decontamination fluids or other residues should be thoroughly discussed with the Department.

Decontamination Procedures

The closure plan should also include a detailed decontamination procedure. This procedure should provide a step-by-step method to be followed to accomplish decontamination of all contaminated equipment and materials. This must include, but is not limited to, the types of detergents, water (e.g., tap/potable, deionized, organic-free), and solvents (e.g. pesticide-grade Isopropanol) to be used. The order in which the different types of water, detergents, and solvents are to be used should be set forth in the decontamination procedure. The procedures outlined in the AEIRG are acceptable for most decontamination requirements.

Since the degree of contamination and size of equipment at the site can vary greatly, the degree of decontamination necessary to meet the performance standards and the procedures to accomplish decontamination will also vary. For example, equipment used to manage or remove waste at the site may require more extensive decontamination than equipment used for soil removal or sampling at the site. If there are criteria to determine the extent or type of decontamination certain equipment will require, these criteria should be included in the closure plan.

The closure plan should also include steps to be taken to decontaminate personnel coming out of the "Hot Zone" into the "Cold Zone." The decontamination station in the "Transition Zone," its location, and substances used for decontamination should all be detailed in this section. The types (level) of personal protective equipment (PPE) to be worn by the personnel performing the decontamination and the disposal of used PPE should be discussed in detail in the closure plan.

Once the closure plan is approved by the Department, the decontamination procedures set forth in the plan should be strictly followed.

Verification of Decontamination

Once a piece of equipment is decontaminated, its cleanliness must be verified. To verify decontamination one must take appropriate quality assurance/quality control samples. The amount and type of these samples will vary with the size, material, and both past and future use of the equipment in question. These samples could be in the form of a visual inspection, wipe samples, chip samples, *etc.* The decontamination procedures should therefore include a detailed sampling and analysis plan that would be applicable for all materials that are to be decontaminated.

Decontamination Fluids

All decontamination fluids generated during the decontamination processes must be contained and sampled before the proper disposal determination(s) can be made. A plan must be developed to determine the number of samples and constituents to be analyzed in order to characterize the decontamination fluids. This characterization will aid in the determination of the disposal method for the fluids. Depending on the test results from the fluid samples and requirements of applicable permits and regulations, the decontamination fluid may be sent to a publicly owned treatment works (POTW), may require disposal as a hazardous waste, or may be disposed of in another manner.

WASTE SAMPLING AND ANALYSIS FOR CLOSURE

What is a sampling and analysis plan and why is it required?

A complete closure plan requires a thorough sampling and analysis plan for both wastes that remain on-site and media affected during operation of the unit. A sampling and analysis plan describes the steps that the facility will take to demonstrate that clean closure has been accomplished. The Sampling and Analysis Plan should include provisions for sampling and analyzing any potentially contaminated materials such as wastes that have been removed, equipment, containment structures, and contaminated media to ensure proper disposal. This plan should include: the number and type of samples that will be collected and their location and depth at the site; a listing of constituents to be analyzed; the testing procedures that will be used; and how clean closure will be verified (*i.e.*, clean closure criteria). This plan should also include an indicator parameters/analytes list, chosen from the list of contaminants historically managed at the site that will be used to determine if the extent of site clean-up is sufficient prior to costly verification sampling. The selected analytical methods should be outlined in the closure plan. The closure plan should also include a laboratory QA/QC plan and should provide a listing of the QA/QC procedures that will be followed during analysis (*i.e.*, matrix spikes, duplicates, *etc.*). This information should be approved by ADEM.

The intent of a sampling and analysis plan is to ensure that complete waste removal is achieved. Initial sampling and analysis of the site may be required to develop a complete list of hazardous wastes and their constituents at the site so that the correct closure action can be chosen and implemented. If an approved closure plan is not in place, all wastes and contaminated media should be sampled initially to formulate the analyte list for final confirmation sampling. Information from the wastes that have been managed, if available, may be used in developing the analyte list. Knowing exactly what these constituents are allows the facility to prove, during final confirmation sampling, that all constituents have been removed from the affected area after closure activities are complete. Sampling of the soils and groundwater left in place following removal of contaminated media allows the facility to certify the site as clean closed (provided that all wastes and residues have been removed); therefore, precluding post-closure care or monitoring. Sampling also serves to delineate the extent of contamination remaining in place in the event of closure-in-place, and is necessary for legal documentation purposes (*i.e.*, notice on property deed, survey plats, *etc.*).

What is the Closure Performance Standard?

The closure performance standard is an analytical target, and is the goal of the clean up effort. Each hazardous constituent that is present in the affected media (soil, groundwater, *etc.*) has a closure performance standard. These levels may be based on naturally-occurring background levels, drinking water standards, or health risk-based levels (see the most current version of the ARBCA document). At a minimum, screening levels should be determined before closure activities begin. If naturally-occurring background levels are used, representative samples of the background conditions should be analyzed (see the most current version of the AEIRG document for more information describing how to determine a representative background concentration). A representative background sample may comprise of more than one sample of each media. Multiple samples can help ensure that abnormalities are averaged out and natural variances are addressed.

The method detection limit (MDL) may be higher than the background level. In this case, the analytical method is not capable of detecting a constituent at the background levels. ADEM would then use the MDL for the closure performance standard. If a drinking water standard has been set, that level may be used for the closure performance standard for groundwater.

Health-based standards have been shown, on a site specific basis, to pose minimal or no threat to human health and the environment. Facilities proposing a health-based standard must demonstrate that the proposed standard for each constituent will pose minimal or no current or future threat to human health or the environment. Guidance on the content of proposals for health risk-based standards may be located in the current version of the ARBCA document

What types of sampling are required?

There are four types of sampling involved with clean closure: (1) background sampling, (2) initial sampling, (3) intermediate sampling, and (4) final confirmation sampling of all affected media.

Background Sampling

Background samples are collected to provide “naturally occurring” levels of any ADEM Admin. Code Rule 335-14-5 (Appendix IX constituents) that existed prior to the management of hazardous wastes on the site. The levels obtained by background sampling provide the baseline standard which clean-up and closure must meet before being certified clean closed. These samples should be collected in locations that are unaffected by hazardous waste management activities. If no background level of a particular constituent exists, then the clean closure performance standard is set at a value determined using the methodology as described earlier in this document.

Initial Sampling

Sampling for the constituents listed in Appendix IX must be addressed during closure. Appendix IX analyses are expensive; therefore, it is to the facilities' advantage to limit the number of full Appendix IX analyses where possible. This can be accomplished by obtaining representative samples of the wastes that were/are managed at the site prior to initiating closure activities and performing complete Appendix IX analysis on them. The final confirmation samples may then be analyzed for the constituents that were/are present in the wastes managed at the site. If sufficient information is supplied, the Appendix IX list may be shortened based on that rationale. It should be noted that ADEM will approve the final list of analytes in the approved closure plan.

Intermediate Sampling

Intermediate sampling may be performed at various times prior to final confirmation sampling and samples may be analyzed for a “short list” of constituents. This “short list” could contain only those contaminants that appeared in the initial samples' Appendix IX analyses and/or an appropriate indicator parameter. Media removal and intermediate samples may be taken until the indicator parameter is no longer present above the closure performance standard.

The indicator parameter is usually chosen to be a constituent (or group of constituents) that is expected to migrate the farthest or be the most pervasive in the affected media. These samples are obtained for cost-effective and quick analysis to determine if an indicator parameter is present using field methods or in a mobile laboratory. Exploratory sampling allows for continued excavation if a dirty sample is found or for the implementation of the confirmation sampling plan if all contamination is removed to the closure performance standard. Many facilities prefer this type of sampling and analysis because it allows the clean-up contractor to remove all necessary media while on-site without having to re-mobilize the crew if more soil or other media should require removal. This also reduces the number of Appendix IX analyses that must be performed.

The primary purpose of intermediate sampling is to provide a cost-effective means to monitor the progress of excavation and removal of wastes and media. It is included primarily for the benefit of the facility. Although the location, sampling method, and analyte list for intermediate samples does not require approval by ADEM, the intermediate sampling plan should still be included in the closure plan for regulatory oversight even though it is not a specific regulatory requirement. This oversight may save the facility from choosing an inappropriate indicator parameter, or from overlooking areas of potential contamination.

Final Confirmation Sampling

After the intermediate samples test at or below the closure performance standard, a series of final confirmation samples should be obtained for complete Appendix IX (or limited Appendix IX, if appropriate) analysis to verify that the clean closure performance standard has been met. A final confirmation sample set is taken in an effort to confirm that all contamination has been removed from the site. The choice of sampling location and analytical parameters are more important for these final confirmation samples than for intermediate samples. Samples should be collected from all sides (three-dimensional) of excavated areas to document complete removal. The location, sampling method, and analysis (including chain of custody requirements) of these samples are closely scrutinized during ADEM's review of the closure plan and closure certification. These sample results, as presented to ADEM in the closure certification, provide the basis for either accepting or rejecting a facility's claim that all contamination has been removed.

Sometimes the confirmation sampling plan must be revised due to unexpected site conditions. For instance, contamination may be more extensive than initially thought. If exploratory sampling was unsuccessful in determining the extent of contamination, then the approved sampling plan may call for confirmation samples to be taken in areas that have been removed. Therefore, the confirmation sampling plan must be revised. In such an instance the facility should contact ADEM with a proposal to amend the approved closure plan to include confirmation samples taken in the additionally excavated area.

Although each closure is different (some require complete removal of various media, others require cleaning and decontamination only), final confirmation sampling is still required for a closure certification to be accepted by ADEM.

How is sampling accomplished for various media?

Sampling of various media is accomplished through a multitude of accepted practices. Soil sampling is a fairly common closure requirement and expertise is common among contractors. However, this may not be true for the sampling of a tank or concrete, or other non-standard media. Standard sampling procedures, such as those published in the most current version of the AEIRG document should be utilized when appropriate and available. Non-standard methods should be thoroughly explained and justified (qualified) in the closure plan.

Non-Porous Surfaces

Sampling of non-porous surfaces, such as metal tanks, poses some inherent problems. For example, what method will allow for analysis of a tank surface to determine if volatile organic compounds (VOCs) have been removed? Obtaining a sample of the rinse solution is generally not accepted by ADEM for use as decontamination verification due to dilution concerns. Use of solvent sampling to obtain a verification sample also carries with it the problem of dilution. If too much solvent is used, the presence of any VOCs could be hidden. Interference with analysis is also a problem. Use of a limited and measured amount of solvent after rinsing may be appropriate if proper restraints are used.

Another possibility is wipe sampling. In obtaining a wipe sample, a wiping cloth is saturated with a solvent and a known area is wiped with the cloth. Care must be taken when choosing a solvent for wipe samples. An analytical laboratory (preferably the lab that performs the analysis) should be contacted for advice in choosing solvents and wiping material. It should be noted that wipe samples are best suited for detecting the presence of a contaminant rather than determining concentration. For tanks, the absence of a contaminant is adequate to determine if decontamination has been accomplished.

Porous Surfaces

For sampling porous surfaces, such as concrete, at least two options are available: (1) core sampling and (2) chip sampling. In a core sample, a concrete core is removed using a coring device. This core is then processed to provide a representative sample. Please note that the

core should properly represent the concrete. If the sample is taken to provide information on the entire slab of concrete, then a full core should be taken. If the sample is meant to represent a certain layer(s) of the concrete, then a partial core may be taken. If a sample is needed to represent only the upper layer(s) of the slab, then a chip sample may be more manageable. A chip of the concrete is obtained by using a chipping hammer or other tool. The chip can then be processed for analysis.

Equipment

For equipment used in decontamination, ADEM generally requires that visible contamination (such as mud or grease) be removed. The facility should decide if decontamination (and the resulting costs of disposal of wash waters and debris, *etc.*) is more economical than disposal as hazardous waste. It may be cheaper to dispose of contaminated shovels with the dirty personal protective equipment (such as used gloves and respirator cartridges) than to clean them and dispose or treat the wash water or other residues.

Decontamination Residues

Decontamination residues (investigation derived wastes (IDW)) such as wash water or removed soil must be sampled and analyzed to ensure proper disposal. The residues must be determined to be hazardous or non-hazardous waste. If a facility decides not to analyze the waste, the wastes should be assumed to be hazardous wastes.

In summary, the purpose of waste analysis and sampling is to ensure and provide a written record that complete decontamination has been achieved. On the other hand, the sampling may serve to delineate the extent of any contamination that remains in place in the event of closure-in-place. This delineation is necessary for legal documentation purposes.

CERTIFICATION OF CLOSURE

Within 60 days after completing closure, the facility owner or operator must submit to the Department, by registered mail, a final report demonstrating that the hazardous waste management unit or facility has been closed in accordance with the approved closure plan. This report should include all daily inspection summary reports, problem identification and corrective measure reports, inspection data sheets, photographic reporting data sheets, acceptance reports, deviations from design and materials specifications (with justifying documentation), and as-built figures. The final report should also include manifests, decontamination, sampling and analysis results if the approved closure plan specifies these actions. The closure activities must be documented by an independent registered (in Alabama) professional engineer and included as part of the Certification of Closure documentation until the Department releases the owner or operator from the financial requirements. Any additional documentation supporting the closure activities or the independent registered professional engineer's certification must be furnished to the Department upon request.

The final documentation should re-emphasize that areas of responsibility and lines of authority were clearly defined, understood, and accepted by all parties involved in the project. Signatures of the facility owner or operator, design engineer, quality control assurance officer, independent registered (in Alabama) professional engineer, and construction contractor should be included as confirmation that each party understood and accepted the areas of responsibility and that they performed their function(s) in accordance with the approved closure plan. All signatures should be accompanied by the necessary statement from ADEM Admin. Code 335-14-8-.02(2)(d).

Final documentation submitted to the Department as part of the Certification of Closure does not sanction the certification as a guarantee of facility construction and performance. Rather, the primary purpose of the final documentation is to improve confidence in the closure through written evidence that the approved Closure Plan was implemented as approved and that the construction proceeded in accordance with design criteria, plans, and specifications.

It is important that applicants understand the requirements of Rules 335-14-5-.07(6) and 335-14-6-.07(6) "Certification of Closure." In order for an independent registered (in Alabama) professional engineer to give the required Certification of Closure, he or she must have followed the closure process from beginning to end including several visits to the site during the closure. If the closure takes an extended time to complete, the certifying engineer need not be on-site every single day. The engineer may use field personnel to verify some activities, but should be present for "milestone" activities. The certification should be based on the professional engineer's own observation and knowledge of the closure activities.

GLOSSARY

AFFECTED MEDIA: Groundwater, soil, surface water, air, *etc.* that have been impacted by management of hazardous waste.

APPENDIX IX CONSTITUENTS: Constituents found in Appendix IX in ADEM Admin. Code R. 335-14-5, entitled "Groundwater Monitoring List." This list of chemicals may also be used for soil sampling.

BACKGROUND: Analytical levels of constituents that are naturally occurring.

CERTIFICATION OF CLOSURE: Statement and supporting documentation by a qualified independent registered (in Alabama) professional engineer that a facility or unit has been closed according to the closure plan.

CHAIN OF CUSTODY: Steps taken to ensure that the integrity of samples is not compromised.

CLOSURE BY REMOVAL: Closure process in which all hazardous waste contamination is removed from a unit. The facility is released from financial responsibility for closure of the unit(s) and no post-closure requirements will be imposed. Also called "clean closure."

CLOSURE IN PLACE: Closure process in which all contamination cannot be removed. Post-closure requirements are imposed. The unit(s) must be closed as a hazardous waste landfill. Also called "dirty closure."

CLOSURE PERFORMANCE STANDARD: The analytical level of a constituent that is allowed to remain in a media.

CLOSURE PLAN: A plan which, when completed, results in a decontaminated (in the case of a closure by removal) or a secured (in the case of closure in place) site. In both cases, hazards to human health and the environment have been reduced as much as possible.

COLD ZONE: Uncontaminated area in which no personal protective equipment is needed.

CONSTITUENTS: Chemicals present in a waste. "Appendix IX" constituents are found in Appendix IX in ADEM Admin. Code R. 335-14-5.

CORRECTIVE ACTION: Activities undertaken to decontaminate a facility or unit.

DECONTAMINATION: Removal of all hazardous waste constituents.

FINAL CLOSURE: Closure of all or the last unit at a facility. After final closure, no more regulated hazardous waste management units are in operation.

FINANCIAL ASSURANCE: Financial mechanisms, defined in ADEM Admin. Code R. 335-14-5-.08 and 335-14-6-.08, used to ensure that funds exist to perform clean up of a facility should the facility be abandoned.

GENERATOR: Any person, by individual generation site, whose act or process produces hazardous waste identified or listed in Chapter 335-14-2 or whose act first causes a hazardous waste to become subject to regulation.

GROUNDWATER PROTECTION STANDARD: Analytical level of a constituent which has been determined to be protective of human health and the environment. The groundwater protection standard is the level of contaminants in groundwater which defines the point at which corrective action must begin.

HAZARDOUS WASTE MANAGEMENT UNIT: A contiguous area of land on or in which hazardous waste is placed, or the largest area in which there is significant likelihood of mixing hazardous waste constituents in the same area. Examples of hazardous waste management units include surface impoundments, waste piles, land treatment areas, landfill cells, tanks and associated ancillary piping and containment, incinerators, and

container storage areas. A container alone does not constitute a unit; the unit includes containers and the land or pad upon which they are placed.

HAZARDOUS WASTE: A waste that either exhibits a characteristic of a hazardous waste (ADEM Admin. Code R. 335-14-2-.03) or a waste that is "listed" (ADEM Admin. Code R. 335-14-2-.04).

HOT ZONE: Contaminated area of a facility that requires use of personal protective equipment and decontamination of personnel and equipment before exit from the area.

HYDRAULICALLY INTERCONNECTED AQUIFERS: Water-bearing geologic formations that have been shown to be connected with the uppermost water-bearing zone through hydrogeologic investigation.

IN SITU: Latin phrase meaning "in place." Wastes treated "in situ" are treated without removing them. For instance, in situ treatment of soils would be a method by which contamination of the soil was reduced without digging up the soil to place in a treatment unit.

INDEPENDENT REGISTERED PROFESSIONAL ENGINEER: A person which is not an employee of a company or organization which has a direct interest in the completion of the activity (*e.g.*, the facility, construction contractor, *etc.*) which is to be certified and is registered as a professional engineer with the State of Alabama Board of Registration for Professional Engineers and Land Surveyors and practicing under the Rules of Professional Conduct.

INTERIM STATUS: A facility is said to be in "interim status" when it is required to comply with ADEM Admin. Code R. 335-14-6.

LAND DIVISION: Division of ADEM that regulates hazardous waste. Most communication concerning the closure plan will be with the Land Division. The Land Division can be contacted by calling (334) 271-7700 and asking for the Industrial Hazardous Waste Branch of the Land Division.

METHOD DETECTION LIMIT (MDL): The lowest concentration of a chemical which can be detected by a particular analytical method. This level may vary depending on matrix interference. An analytical laboratory can provide more information on this topic.

NOTICE OF DEFICIENCY: Also called "NOD." This is a list of comments prepared by ADEM and sent to the facility. The comments are generated by reviewing a document such as a closure or post-closure plan. The comments raise questions, request additional information, *etc.*, in an effort to obtain a complete document.

OFFICE OF GENERAL COUNSEL: Division of ADEM where copies of regulations may be obtained. This division can be reached at (334) 271-7855. This office also handles legal matters for the Department. Certain regulations are also available on the ADEM website located at: <http://www.adem.state.al.us/>.

OWNER/OPERATOR: The person who owns in fee simple the property on which a facility or part of a facility is sited or the person responsible for the overall operation of the facility.

PART B POST-CLOSURE PERMIT APPLICATION: A site-specific document that is prepared and submitted to ADEM to obtain a post-closure permit. This application is called a "Part B" to distinguish it from a "Part A" application, which is a fill-in-the-blank form for initial notification of hazardous waste activities.

PARTIAL CLOSURE: Closure of one or more units, but leaving one or more units in operation.

POINT OF COMPLIANCE (POC): Set of groundwater wells that define the point of the facility where the groundwater protection standard is applied. ADEM Admin. Code R. 335-14-5-.06(6) defines the point of compliance.

PUBLIC NOTICE PERIOD: The period of time (30 days) during which a closure plan that has been determined to be complete by ADEM is placed in a location for the public to review.

The public and the facility may review the closure plan and make comments to ADEM concerning the closure plan

PUBLICLY OWNED TREATMENT WORKS (POTW): Any device or system used in the treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature which is owned by the State or municipality [as defined by 33 U.S.C. § 1362(4)]. This definition includes sewers, pipes, or other conveyances only if they convey wastewater to a POTW providing treatment.

QA/QC: Quality Assurance/Quality Control. QA/QC consists of the steps that samplers and analytical laboratories take to ensure the quality of the data developed from site sampling and analysis. The QA/QC includes chain of custody documentation as well as the internal procedures the laboratory follows to ensure reproducibility of the analytical data.

REGULATED UNIT: A unit that is regulated by ADEM Admin. Code R. 335-14-2, 335-14-5, 335-14-6, or 335-14-8.

SAMPLING PLAN: A plan that includes, but is not limited to: all instructions for choosing media to be sampled, location of samples, and sample preservation techniques.

SW-846: EPA Document entitled "Test Methods for Evaluating Solid Wastes/Chemical/Physical Methods." EPA's document number is "SW-846."

TRANSITION ZONE: Area between the hot zone and the cold zone where decontamination procedures take place.

TSD FACILITY (or TSD): A facility that treats, stores, or disposes of hazardous waste. The terms "treatment," "storage," and "disposal" are defined in ADEM Admin. Code R. 335-14-1-.02.

UPPERMOST AQUIFER: The geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary.

VOLATILE ORGANIC COMPOUNDS (VOCs): Organic compounds having a boiling point above 200°C. These compounds are listed in Method 8260B of EPA SW-846.

WASTE ANALYSIS PLAN: Also called a "WAP." This plan includes all analytical parameters. The types of media to be analyzed, the locations (or criteria for choosing parameters), the analytical methods to be employed, and constituents for analysis are included, among other things.

WASTE CODE: A code, defined by EPA, that classifies hazardous wastes. The waste codes are listed in ADEM Admin. Code R. 335-14-2-.03 and .04.