BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

PEOPLE OF THE STATE OF ILLINOIS,	)	
	)	
Complainant,	)	
	)	
v.	)	**PCB NO. 13-41**
	)	**(Enforcement – Land)**
AMERENENERGY RESOURCES	)	
GENERATING CO., an Illinois corporation,	)	
And AMERENENERY MEDINA VALLEY	)	
COGEN, LLC, an Illinois limited liability co.,	)	
	)	
Respondents.	)	

NOTICE OF FILING

To: Renee Cipriano, @ *aantoniolli@schiffhardin.com*
Francis Lyons, @ flyons@schiffhardin.com

PLEASE TAKE NOTICE that I have today filed with the Office of the Clerk of the Pollution Control Board the Stipulation and Proposal for Settlement, and Agreed Motion to Join Medina Valley as Respondent, a copy of which is herewith served upon you.

s/Raymond Callery
RAYMOND CALLERY, Assistant Attorney General

Dated: July 15, 2016

Raymond Callery
Assistant Attorney General
Environmental Bureau
500 South Second Street
Springfield, Illinois 62706
(217) 782-9031

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Complainant,	)	
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v.	)	**PCB 13-41**
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	)	
Respondents.	)	

STIPULATION AND PROPOSAL FOR SETTLEMENT

Complainant, PEOPLE OF THE STATE OF ILLINOIS, by LISA MADIGAN, Attorney General of the State of Illinois, the Illinois Environmental Protection Agency ("Illinois EPA"), and AmerenEnergy Resources Generating Company, Inc. ("AERG") and AmerenEnergy Medina Valley Cogen, LLC ("Medina Valley") ("Respondents"), (collectively, "Parties to the Stipulation"), have agreed to the making of this Stipulation and Proposal for Settlement ("Stipulation") and submit it to the Illinois Pollution Control Board ("Board") for approval. This stipulation of facts is made and agreed upon for purposes of settlement only and as a factual basis for the Board's approval of this Stipulation and issuance of relief. None of the facts stipulated herein shall be introduced into evidence in any other proceeding regarding the violations of the Illinois Environmental Protection Act ("Act"), 415 ILCS 5/1 *et seq.* (2014), and the Board's Regulations, alleged in the Complaint except as otherwise provided herein. It is the intent of the Parties to the Stipulation that it be a final adjudication of this matter.

I. STATEMENT OF FACTS

A. Parties

1. On February 4, 2013, a Complaint was filed on behalf of the People of the State of Illinois by Lisa Madigan, Attorney General of the State of Illinois, on her own motion and upon the request of the Illinois EPA, pursuant to Section 31 of the Act, 415 ILCS 5/31 (2014), against Respondent AERG. Concurrently with this Stipulation, the Parties to the Stipulation filed an Agreed Motion for Joinder, to add Medina Valley as a Respondent pursuant to Section 101.403(a) of the Board's Regulations, 35 Ill. Adm. Code 101.403(a).

2. The Illinois EPA is an administrative agency of the State of Illinois, created pursuant to Section 4 of the Act, 415 ILCS 5/4 (2014).

3. Complainant alleges that at all times relevant to the construction of the "Rail and Road Project" described below, Respondent AERG, owned and operated the Duck Creek Power Generating Station located at 17751 North Cilco Road, Canton, Fulton County, Illinois (the "Site").

4. By letter dated July 29, 2004, Respondent AERG informed Illinois EPA that it intended to use beneficially coal combustion by-product ("CCB") as structural fill material to construct a railroad embankment and a haul road at the Site ("Rail and Road Project"), and that Respondent AERG intended to begin construction on September 1, 2004.

5. On dates best known to Respondents, approximately 180,000 tons of coal ash were transported to the Site from Respondent AERG's E.D. Edwards Power Generating Station located in Bartonville, Illinois, where it was generated.

6. CCB as defined by Section 3.135 of the Act, 415 ILCS 5/3.135 (2014), excludes structural fill material that does not meet the Class I Groundwater Standards for metals found at 35 Ill. Adm. Code 620.410, unless a Beneficial Use Determination ("BUD") is obtained from

Illinois EPA.

7. The analytical data submitted by Respondent AERG with the July 29, 2004 letter established that the coal ash fill material exceeded the Class I Groundwater Standards for antimony, boron, and chromium when tested using test method ASTM D3987-85.

8. Prior to AERG ownership and the construction of the Rail and Road Project, the Site was previously used in connection with mining activities.

9. On August 8, 2006, Illinois EPA conducted an inspection of the Site. All construction work for the Rail and Road Project was completed in 2005.

10. Based, in part, on the August 8, 2006 inspection, Illinois EPA issued a Violation Notice ("VN") to Respondent AERG on September 1, 2006. Respondent AERG responded to the VN on September 22, 2006, and a meeting between Illinois EPA and Respondent AERG was held on October 10, 2006.

11. On November 2, 2006, Respondent AERG submitted a Compliance Commitment Agreement ("CCA") to Illinois EPA, wherein Respondent AERG agreed to submit a Beneficial Use Determination ("BUD") application to the Illinois EPA for the project already completed.

12. On November 27, 2006, the Illinois EPA rejected the CCA.

13. On August 7, 2013, Respondent AERG submitted a Beneficial Use Determination ("BUD") to Illinois EPA for the Rail and Road Project, pursuant to Section 3.135(b) of the Act. The Agency did not act upon the BUD application submittal.

14. Pursuant to Section 3.135(b) of the Act, the Agency's failure to act is deemed a denial of the BUD application. Respondent AERG appealed Illinois EPA's denial of the BUD application to the Illinois Pollution Control Board and that appeal is pending. *See* PCB 2014-041. The entry of this Stipulation is a final adjudication of the instant matter, but shall not be

construed as Illinois EPA's approval of a BUD for the Rail and Road Project.

15. As previously presented to the Board, on December 2, 2013, Ameren Corporation completed a transaction which, among other things, resulted in the divestiture of its merchant generation business including the Duck Creek Energy Center (the "Transaction"). As part of the divestiture, a narrow set of liabilities including all claims by the State of Illinois relating to the use of coal combustion material as sub-base within a rail line at Duck Creek, were retained. In accordance with the terms governing the Transaction, Respondent Medina Valley assumed any liabilities arising from the Complaint as well as the authority to resolve the matter at issue.

B. Allegations of Non-Compliance

Complainant contends that the Respondents have violated the following provisions of the Act and Board regulations:

Count I: Caused or Allow Open Dumping of Coal Combustion Waste: violation of Section 21(a) of the Act, 415 ILCS 5/21(a) (2014);

Count II: Conducting Waste Storage and Waste Disposal Without a Permit: violation of Section 21(e) of the Act, 415 ILCS 5/21(e) (2014);

Count III: Operating a Coal Combustion Waste Disposal Site Without a Permit: violation of Section 21(r) of the Act, 415 ILCS 5/21(r) (2014).

C. Non-Admission of Violations

The Respondents represent that they have entered into this Stipulation for the purpose of settling and compromising disputed claims without having to incur the expense of contested litigation. By entering into this Stipulation and complying with its terms, the Respondents do not affirmatively admit the allegations of violation within the Complaint and referenced within Section I.B herein, and this Stipulation shall not be interpreted as including such admission.

II. APPLICABILITY

This Stipulation shall apply to and be binding upon the Parties to the Stipulation. The Respondents shall not raise as a defense to any enforcement action taken pursuant to this Stipulation the failure of any of their officers, directors, agents, employees or successors or assigns to take such action as shall be required to comply with the provisions of this Stipulation. This Stipulation may be used against the Respondents in any subsequent enforcement action or permit proceeding as proof of a past adjudication of violation of the Act and the Board Regulations for all violations alleged in the Complaint in this matter, for purposes of Section 39 and 42 of the Act, 415 ILCS 5/39 and 42 (2014).

III. IMPACT ON THE PUBLIC RESULTING FROM ALLEGED NON-COMPLIANCE

Section 33(c) of the Act, 415 ILCS 5/33(c) (2014), provides as follows:

> In making its orders and determinations, the Board shall take into consideration all the facts and circumstances bearing upon the reasonableness of the emissions, discharges, or deposits involved including, but not limited to:
>
> 1. the character and degree of injury to, or interference with the protection of the health, general welfare and physical property of the people;
>
> 2. the social and economic value of the pollution source;
>
> 3. the suitability or unsuitability of the pollution source to the area in which it is located, including the question of priority of location in the area involved;
>
> 4. the technical practicability and economic reasonableness of reducing or eliminating the emissions, discharges or deposits resulting from such pollution source; and
>
> 5. any subsequent compliance.

In response to these factors, the Parties to the Stipulation Complainant state as follows:

1. The Rail and Road Project is not known to threaten human health or the environment at this time.

2. The Rail and Road Project adds social and economic value to the surrounding community and the State of Illinois, if operated in a manner such that it does not threaten human health or the environment.

3. The Respondents' operation of the Site is suitable to the area where it is located, if the Site is operated and maintained in a manner such that it does not threaten human health or the environment.

4. Applying for a BUD prior to construction of the Rail and Road Project was both technically practicable and economically reasonable.

5. After receiving the VN in 2006, Respondent AERG sought to reach an agreement with Illinois EPA regarding the Rail and Road Project.

IV. CONSIDERATION OF SECTION 42(h) FACTORS

Section 42(h) of the Act, 415 ILCS 5/42(h) (2014), provides as follows:

> In determining the appropriate civil penalty to be imposed under ... this Section, the Board is authorized to consider any matters of record in mitigation or aggravation of penalty, including but not limited to the following factors:
>
> 1. the duration and gravity of the violation;
>
> 2. the presence or absence of due diligence on the part of the respondent in attempting to comply with requirements of this Act and regulations thereunder or to secure relief therefrom as provided by this Act;
>
> 3. any economic benefits accrued by the respondent because of delay in compliance with requirements, in which case the economic benefits shall be determined by the lowest cost alternative for achieving compliance;
>
> 4. the amount of monetary penalty which will serve to deter further violations by the respondent and to otherwise aid in enhancing voluntary compliance with this Act by the respondent and other persons similarly subject to the Act;
>
> 5. the number, proximity in time, and gravity of previously adjudicated violations of this Act by the respondent;

6. whether the respondent voluntarily self-disclosed, in accordance with subsection i of this Section, the non-compliance to the Agency;

7. whether the respondent has agreed to undertake a "supplemental environmental project," which means an environmentally beneficial project that a respondent agrees to undertake in settlement of an enforcement action brought under this Act, but which the respondent is not otherwise legally required to perform; and;

8. whether the respondent has successfully completed a Compliance Commitment Agreement under subsection (a) of Section 31 of this Act to remedy the violations that are the subject of the complaint.

In response to these factors, Complainant states as follows:

1. The beneficial reuse of CCB is encouraged and authorized by the Act, so long as it is reused in a manner that is protective of human health and the environment.

2. Respondent AERG did not seek a BUD prior to its construction of the Rail and Road Project, After Illinois EPA issued a VN to Respondent AERG on September 1, 2006, Respondent AERG did submit a proposed Compliance Commitment Agreement on November 2, 2006, and subsequently submitted a BUD application on August 7, 2013.

3. Any economic benefit Respondent AERG gained as a result of the violations alleged in the Complaint is less than the proposed civil penalty, in light of the cost to construct the engineered barrier at the Site required by this Stipulation.

4. Complainant has determined, based upon the specific facts of this matter, that a penalty of Sixty Thousand Dollars ($60,000.00) will serve to deter further violations and aid in future voluntary compliance with the Act and Board regulations.

5. Respondents have no previously adjudicated violations of the Act.

6. Self-disclosure is not at issue in this matter.

7. The settlement of this matter does not include a supplemental environmental project.

8. The settlement of this matter does not include performance of a Compliance Commitment Agreement.

V. TERMS OF SETTLEMENT

A. Penalty Payment

1. The Respondents shall pay a civil penalty in the sum of Sixty Thousand Dollars ($60,000.00) within thirty (30) calendar days from the date the Board adopts and accepts this Stipulation.

B. Stipulated Penalties, Interest and Default

1. If the Respondents fail to construct the barrier wall as described in Section V Subpart D: Future Compliance, Paragraph 1 (a-e), or fail to collect and submit groundwater level data as required by Subpart D - Paragraph 2 by the dates specified herein, Respondents shall provide notice to the Complainant of each failure to comply with this Stipulation and shall pay stipulated penalties in the amount of $100.00 per day for the first 30 days, $300 per day for the next 30 days and $500 per day after 60 days, for each violation, until such time that compliance with this Stipulation is achieved. The Complainant may make a demand for the stipulated penalties upon the Respondents for their noncompliance with this Stipulation. However, failure by the Complainant to make this demand shall not relieve the Respondents of the obligation to pay stipulated penalties. All stipulated penalties shall be payable within thirty (30) calendar days of the date the Respondents know or should have known of their noncompliance with any provisions of this Stipulation.

2. If the Respondents fail to make any payment required by this Stipulation on or before the date upon which the payment is due, the Respondents shall be in default and the remaining unpaid balance of the penalty, plus any accrued interest, shall be due and owing

immediately. In the event of default, the Complainant shall be entitled to reasonable costs of collection, including reasonable attorney's fees.

3. Pursuant to Section 42(g) of the Act, interest shall accrue on any penalty amount owed by the Respondents not paid within the time prescribed herein. Interest on unpaid penalties shall begin to accrue from the date such are due and continue to accrue to the date full payment is received. Where partial payment is made on any penalty amount that is due, such partial payment shall be first applied to any interest on unpaid penalties then owing.

4. The stipulated penalties shall be enforceable by the Complainant and shall be in addition to, and shall not preclude the use of, any other remedies or sanctions arising from the failure to comply with this Stipulation.

C. Payment Procedures

All payments required by this Stipulation shall be made by certified check or money order payable to the Illinois EPA for deposit into the Environmental Protection Trust Fund ("EPTF"). Payments shall be sent by first class mail and delivered to:

Illinois Environmental Protection Agency
Fiscal Services
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

The name, case number and the Respondents' federal tax identification number shall appear on the face of the certified check or money order. A copy of the certified check or money order and any transmittal letter shall be sent to:

Raymond J. Callery
Assistant Attorney General
Environmental Bureau
Illinois Attorney General's Office
500 South Second Street
Springfield, Illinois 62706

D. Future Compliance

1. The Respondents shall construct a fifty (50) to sixty (60) foot deep low permeability barrier wall between the road and the rail line at the Site, designed to minimize groundwater migration through the coal combustion material fill area. The barrier wall will be designed and constructed according to the following parameters:

(a) Sufficiently low permeability (hydraulic conductivity) such that the groundwater flow is reduced, gradient is minimal, and groundwater elevation is lowered in the fill area;

(b) When completed, have a minimum thickness of 24 inches and a hydraulic conductivity of 1 x 10-7 cm/sec. or less;

(c) Extend from 75 ft. south to 125 ft. north of the limits of where the coal combustion fill material is estimated to be in contact with groundwater;

(d) Keyed to a low-permeability layer (underclay/weathered shale) advanced to a minimum of five feet below the fill (mine spoil)/silty clay interface to eliminate underflow; and

(e) The standards used to design and construct the barrier wall shall be as contained in the bid specification document provided previously to Illinois EPA and appended hereto as Exhibit "A", consistent with the Duck Creek Slurry Wall Guide Specification dated 7-17-15 appended hereto as Exhibit "B".

2. The Respondents shall provide the Illinois EPA a copy of the barrier wall final design plan at least sixty (60) days prior to commencement of construction of the barrier wall and no later than ninety (90) days after the acceptance of this Stipulation by the Board. Construction work shall be conditioned on Illinois EPA approval of the final design plan

which shall not be unreasonably withheld or delayed. The final design plan submitted to Illinois EPA for approval shall not deviate materially from Exhibit "A". If the design plan is not accepted, a modified design plan must be submitted within ninety (90) days. If Illinois EPA does not respond to the design plan by either accepting it or seeking modification within sixty (60) days of submittal then the completion of construction deadline set forth at paragraph 3 below shall be extended by time equal to the length of the delay in responding beyond sixty (60) days and stipulated penalties shall not accrue during such extension of time. Resubmittals must include incorporation of comments until such time as a final design is approved and must include a schedule for submission of any portion of the design not submitted within the ninety day time frame.

3. The Respondents shall notify the Illinois EPA two (2) weeks prior to beginning construction. Completion of the construction of the barrier wall shall occur within twenty-four (24) months of the acceptance of this Stipulation by the Board. Upon completion of the construction, the Respondents shall submit a final report demonstrating compliance with the CONSTRUCTION QUALITY ASSURANCE PLAN FOR LOW PERMEABILITY BARRIER WALL appended hereto as Exhibit "C" and certified by a licensed engineer for approval by the Illinois EPA.

4. Only fresh water, free of excessive amounts of deleterious substances that would adversely affect the properties of the slurry, shall be used to manufacture the bentonite slurry. The material for the barrier wall shall be composed of slurry, excavated soils, dry bentonite, and other admixtures as approved by the Engineer of Record and the Illinois EPA.

5. Following completion of the barrier wall, the Respondents will perform post construction quarterly monitoring of groundwater elevation to confirm the location of the

groundwater relative to the constructed wall. This monitoring will continue for a period of thirty-six (36) months following completion of construction of the barrier wall. The Respondents will provide the Illinois EPA with the locations of the sampling wells sixty (60) days prior to installation of the wells. The Respondents shall submit a revised elevation sampling work plan within thirty (30) days of any sampling work plan being rejected.

6. The groundwater monitoring wells shall be designated as follows:

Facility Piezometer	Illinois EPA Designation
PZ-01	P101
PZ-02	P102
PZ-03	P103

7. The Respondents shall make the results of the groundwater sampling available to the Illinois EPA on a quarterly basis, as follows:

Samples to be Collected During the Months of	Results Submitted to the Illinois EPA by the Following	Parameters
Jan – Feb	April 15	Groundwater Elevation
April – May	July 15	Groundwater Elevation
July – August	October 15	Groundwater Elevation
October – November	January 15	Groundwater Elevation

8. Commencing with the second quarter following the construction of the barrier wall described above, if the groundwater as reported exceeds 597 feet mean sea level ("MSL") at any point, the Respondents shall commence monthly monitoring. 597 feet MSL is the estimated low point of the coal combustion material fill area. In determining whether 597 MSL is exceeded, and recognizing that groundwater elevation levels slope, the Respondents may average samples in order to derive values that are representative of actual groundwater

elevation conditions. All sampling data shall be reported to the Illinois EPA. If groundwater elevations exceed 597 MSL at any point, then the Respondents shall submit an assessment report to the Illinois EPA within ninety (90) days for approval. The assessment report shall provide the following:

(a) An evaluation of the extent and frequency by which the groundwater level exceeded 597 MSL;

(b) An evaluation of the reasons the groundwater level exceeded 597 MSL;

(c) An evaluation of the potential for impact to human health and the environment as a result of the groundwater level exceeding 597 MSL;

(d) Based upon an assessment of items (a) through (c), an evaluation of whether there are additional measures or actions that are both technically feasible and economically reasonable to address adverse impacts, if any, associated with groundwater levels rising to 597 MSL at the site; and

(e) Proposed action(s), which may include additional monitoring, groundwater use restrictions, or other actions which address the potential for impact to human health and the environment, and/or actions relative to reduction of the groundwater elevation to 597 feet MSL or below. These proposed actions(s) may include, at the Illinois EPA's discretion, an additional monitoring period to determine the efficacy of the proposed actions in addressing groundwater migration through the coal combustion material fill area, and the submission of additional assessment reports and action plans should the proposed actions prove ineffective in addressing groundwater migration through the coal combustion fill area.

9. The Respondents shall complete all work required under the assessment report(s) and action plan(s) in accordance with any schedules contained within the assessment report(s) and action(s) approved by the Illinois EPA. The Respondents shall submit a revised assessment report and action plan within thirty (30) days of any assessment report and action plan being rejected.

10. In addition to any other authorities, the Illinois EPA, its employees and representatives, and the Attorney General, her employees and representatives, shall have the right of entry into and upon the Site which is the subject of this Stipulation, at all reasonable times for the purposes of conducting inspections and evaluating compliance status. In conducting such inspections, the Illinois EPA, its employees and representatives, and the Attorney General, her employees and representatives, may take photographs, samples, and collect information, as they deem necessary.

11. This Stipulation in no way affects the responsibilities of the Respondents to comply with any other federal, state or local laws or regulations, including but not limited to the Act and the Board Regulations.

12. The Respondents shall cease and desist from future violations of the Act and Board Regulations that were the subject matter of the Complaint.

E. Release from Liability

In consideration of the Respondents' payment of the $60,000 penalty, their commitment to cease and desist as contained in Section V.D. above, and upon the Board's approval of this Stipulation, the Complainant releases, waives and discharges the Respondents from any further liability or penalties for the violations of the Act and Board Regulations that were the subject matter of the Complaint herein. The Complainant reserves and this Stipulation is without

prejudice to, all rights of the State of Illinois against the Respondents with respect to all other matters, including but not limited to, the following:

(a) criminal liability;

(b) liability for future violation of state, federal, local, and common laws and/or regulations;

(c) liability for natural resources damage arising out of the alleged violations; and

(d) liability or claims based on the Respondents' failure to satisfy the requirements of this Stipulation.

Nothing in this Stipulation is intended as a waiver, discharge, release, or covenant not to sue for any claim or cause of action, administrative or judicial, civil or criminal, past or future, in law or in equity, which the State of Illinois may have against any person, as defined by Section 3.315 of the Act, 415 ILCS 5/3.315 (2014), or entity other than the Respondents.

F. Enforcement and Modification of Stipulation

Upon the entry of the Board's Order approving and accepting this Stipulation that Order is a binding and enforceable order of the Board and may be enforced as such through any and all available means.

G. Execution of Stipulation

The undersigned representatives for the Parties to the Stipulation certify that they are fully authorized by the party whom they represent to enter into the terms and conditions of this Stipulation and to legally bind them to it.

WHEREFORE, the Parties to the Stipulation request that the Board adopt and accept the foregoing Stipulation and Proposal for Settlement as written.

AGREED:

FOR THE COMPLAINANT:

PEOPLE OF THE STATE OF ILLINOIS
ex rel. LISA MADIGAN
Attorney General of the
State of Illinois

MATTHEW J. DUNN, Chief
Environmental Enforcement/
Asbestos Litigation Division

BY: _____
ANDREW B. ARMSTRONG, Chief
Environmental Bureau
Assistant Attorney General

DATE: 07/13/2016

ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY

Alec Messina Acting
~~LISA BONNETT~~, Director
Illinois Environmental Protection Agency

BY: _____
JOHN J. KIM
Chief Legal Counsel

DATE: 7/12/16

FOR THE RESPONDENTS:

AMERENENERGY RESOURCES
GENERATING COMPANY, INC. and
AMERENENERGY MEDINA VALLEY
COGEN, LLC

BY: _____
~~GREGORY~~ L. NELSON
Senior Vice President,
General Counsel & Secretary
Medina Valley Cogen, LLC

DATE: 6/24/2016

CONSTRUCTION SPECIFICATION POS - 000159

FOR

LOW PERMEABILITY BARRIER WALL

AT

MEDINA VALLEY COGEN, LLC
DUCK CREEK GENERATING STATION

Prepared by Dam Safety

for

Ameren MISSOURI

Rev	Date	Revisions	Originator	Reviewer	Approver
	1-28-2015	Draft for Review	DG (CEC)	MJW	
0	(type date)	Issued for Bid	---	---	---
1	(type date)	Conformed to Contract	---	---	---

EXHIBIT
tabbies
A

INDEX

SECTION 1A - SUPPLEMENTAL GENERAL CONDITIONS

FOR AMEREN MISSOURI POWER OPERATIONS

1.0 GENERAL

1.1 This section of the specification clarifies and supplements the Ameren General Conditions of Contract (GCC) and other Contract documents. Specific duties set forth herein do not constitute an exclusive list of requirements, but complement the Ameren GCC. In the event of a conflict between this specification and the Ameren GCC, this specification shall be controlling.

1.2 Contractor shall assure that all tiers of Subcontractors comply with all requirements of Contract documents.

1.3 For any work performed for Ameren Missouri Power Operations, Contractor agrees to comply with Ameren's Supplemental Terms and Conditions, commonly referred to as Section 1A-Supplemental General Conditions for Ameren Missouri Power Operations.

2.0 DEFINITIONS

2.1 Accident/Incident An incident is defined as a near miss, vehicle accident, or property damage to Company-owned/leased equipment or facilities. Refer to OSHA 29CFR1904 for definitions of reportable incidents and injuries.

2.2 Asbestos Containing Material (ACM) Material that contains asbestos in concentration greater than 1% and must be handled according to Ameren procedures and Federal and State regulations.

2.3 Barricade A physical obstruction such as barricade tape, chains, cones, concrete barriers, fencing, or "A" frame type wood and/or metal structures intended to warn and limit access to a work area. Barricade tape alone cannot be used to protect certain hazards such as unattended floor openings or fall hazards.

2.4 Competent Person An individual, who is trained and certified in applicable standards, is capable of identifying workplace hazards relating to specific operations, performs inspections of industrial and construction jobsite equipment, and has authority to take corrective actions when needed.

2.5 Computer Based Training (CBT) Computer Based Training is used for safety and job work rules orientation of new employees before they are permitted unescorted access to Company property.

2.6 Confined Space An enclosed area that is not normally designed or intended for human occupancy, has a restricted entrance or exit by way of location or size, and can represent a risk for the health and safety of anyone who enters, due to atmospheric, engulfment, entrapment, mechanical, electrical, or any other recognized hazard. See OSHA 29CFR1910.146 and Power Operations Administrative Procedure AUE-ADM-2415.

2.7 Hot Work Work that will generate sparks, such as; cutting, grinding, welding, and brazing. A permit may be required for hot work that is hazardous due to location or other factors.

2.8 Corporate Safety Department Ameren's Corporate Safety Department sets standards for safety and health issues and monitors compliance with Ameren policies, as well as with Federal, State and Local regulations.

2.9 Extra Work is defined in Article 1 of the GCCs.

2.10 Extra Work Order (EWO) is defined in Article 1 of the GCCs.

2.11 Job Working Rules Rules of conduct for Contractors working at Ameren facilities that include various types of prohibited behavior: off-limit areas, driving and parking instructions, and safety information that may be specific for the plant, such as fire alarms and evacuation procedures.

2.12 Single Point of Contact (SPOC) is defined in Article 1 of the GCCs.

2.13 Specifications are defined in Article 1 of the GCCs.

2.14 Work is defined in Article 1 of the GCCs.

2.15 Worker's Protection Assurance (WPA) or Hold Card Procedure Ameren's equipment lock-out procedure that ensures equipment and systems are in a safe state prior to service or testing. Employees must have WPA training and adhere to WPA procedures. Contractor supervisors must have plant-specific training prior to starting jobs requiring WPA protection.

3.0 INTENT OF SPECIFICATIONS AND DRAWINGS

3.1 The Contract Documents shall be interpreted as being complementary, requiring a complete Project. Any requirement occurring in any one of the Contract Documents is as binding as though occurring in all Contract Documents. Generally, Specifications address quality, types of materials and Contract conditions, while Plans show placement, sizes, and fabrication details of materials. Reference Article 2.01 of the GCCs.

4.0 BENCH MARKS

4.1 Company will furnish one site bench mark with its assigned elevation. Contractor shall furnish field layouts and shall be responsible for the use of field dimensions and elevations. All such Work shall be subject to approval at the discretion of the SPOC.

5.0 DRAWINGS, DETAILS & INSTRUCTIONS PROVIDED BY CONTRACTOR

5.1 Contractor shall submit to the Company copies of shop drawings, equipment details, installation, operating, and maintenance instructions, wiring diagrams, parts lists, cable termination sign-off sheets, etc. Reference Article 3.02 of the GCCs.

5.1.1 These submittals shall cause no delay in the performance of work. The minimum turn-around time for design changes shall be incorporated on drawings and shall not delay the performance of work. As-built drawings shall be submitted in accordance with Company's schedule.

5.1.2 Contractor shall submit five (5) copies of the above information, four (4) of which Company will retain. One (1) copy will be returned.

5.1.3 In addition to the copies listed above, Contractor shall submit drawings electronically in an approved CAD format. Ameren typically uses Bentley Microstation V7 or V8 (.dgn files).

5.1.4 Company will review submittals for general design features. Contractor is responsible for dimensions, quantities, accuracy, fit, adequacy of details, and coordination with other trades. Contractor must request deviations from contract documents in writing and receive written approval from Company.

5.1.5 Contractor must request field changes in writing and receive written approval from Company. Contractor shall promptly submit as-built drawings to Company.

5.2 Professional Engineering (PE) License Seals

5.2.1 All design documentation meant for fabrication, permitting, erection, or construction such as design drawings, specifications, and calculations shall have a Professional Engineering (PE) seal applied, signed and dated by Contractor's registered professional engineer(s).

5.2.1.1 The license shall be current, valid, and in good standing for the appropriate state where the work is taking place.

5.2.2 Documents where seals are not required include review items (not to be constructed), sketches, samples, design control documents, operations manuals, vendor material design documents, engineered product drawings (not related to permitting) and other documents agreed upon in writing between Ameren and Contractor.

5.2.2.1 Contractor shall be responsible to contact the main Ameren contact up-front to clarify the requirements to seal any project specific documentation.

6.0 LABOR CONDITIONS

6.1 Contractor's Work shall be performed under the National Maintenance Agreement (NMA), unless an exception is agreed upon in writing by the Construction Project Lead or his management, Contractor must furnish a copy of the site extension approval(s) granted by the International Union(s). Site extension requests for the NMA may be filed online at www.nmapc.org.

6.2 There shall be no limit on the work output of any employee, and no restrictions on what tools or equipment may safely be used to increase productivity. There shall be no minimum, other than what may be required by safety regulations, on the number of employees assigned to any crew or to any service.

6.3 Featherbedding practices of any kind will not be tolerated.

6.4 Actual work hours will be agreed upon during pre-job conferences; lunch breaks will be an unpaid one-half hour. No additional organized breaks are allowed. There shall be no non-working stewards. If a steward is included in the labor force, the steward must be a qualified worker and shall exercise no supervisory functions.

6.5 Contractors must conform to Construction Users Round Table (CURT) Tripartite Initiative report, dated June 2004, with respect to absenteeism, excessive overtime and work disruptions.

6.6 Contractor employees must be rested and fit for duty when they report to the Company's site. Contractor employees must not work in excess of 16 consecutive hours without prior approval of Contractor's Superintendent and Company, and then only when additional steps have been taken to ensure worker safety.

6.7 Contractor shall provide break/lunch facilities at a location in close proximity to the majority of the Work such locations to be approved by the SPOC or other Ameren Management personnel.

6.8 There shall be no slowdowns, illegal strikes, or unauthorized work stoppages of any kind. Contractor understands that its work must be completed in a timely fashion notwithstanding the presence of a labor strike or any pickets at or around the job site.

6.9 In the event that Company's employees, another contractor's or subcontractor's employees or Contractor's employees engage in a strike or established pickets, Contractor is expected to continue to meet its obligations under the terms of the contract and/or obligations with Company. Any such picketing activity is not an excuse for non-performance or delay in completing the project

6.10 Medical services provided by Ameren: On specified projects, contractors are not to include costs within bids associated with the following medical services:

- Random and for-cause substance abuse (SA) testing,
- First-aid expenses that can be addressed by an onsite nurse, if an onsite nurse is provided.

7.0 CONTRACTOR MANAGEMENT REQUIREMENTS

7.1 Prior to mobilization, Contractor shall submit an organizational chart and resumes for the entire management team that will utilize, on or offsite, for the project.

7.2 Contractor should adhere to the Job Working Rules (Appendix B).

7.3 Contractor will be responsible to comply with the training and implementation requirements of the FERC Affiliate Restrictions procedure, AUE-ADM-5476.

7.4 Contractor supervisory employees who will be responsible for requesting and signing the WPA must receive site-specific training before working onsite. The SPOC will arrange for the required WPA supervisor training to be located at the Ameren POS Training Center training facility.

7.5 Contractor supervisor shall comply with the specific plant's WPA procedure which is included as Appendix A, Section 2 of this specification. WPA procedure provides details of program and outlines responsibilities for supervisors.

CAUTION: The presence of WPA process does not relieve workers of the responsibility to verify that equipment is actually de-energized or in the designated state. Instruct employees to walk down the job, check energy sources and isolation points such as: voltages, temperatures, pressures, etc. to confirm status.

7.6 Contractor Site Representative should read, understand, and sign the Contractor Agreement of Understanding Form (Appendix A, Attachment A18), prior to beginning work onsite.

7.7 Contractor supervisors shall instruct employees to observe WPA rules and comply with WPA tags at all times.

7.8 Contractor shall participate in individual Construction Progress meetings. The meetings are typically held weekly, but the SPOC may specify another frequency during the course of the Contract.

7.8.1 A Contractor representative with sufficient authority to make binding work and schedule commitments shall attend these meetings.

7.8.2 The individual progress meeting will typically concentrate on safety and housekeeping, schedule and work progress, job related problems, and site coordination.

7.8.3 Contractor should come to the progress meeting with an updated schedule showing actual progress and the critical path of the work. See Contractor Schedule Requirements (Appendix D) for additional schedule requirements.

7.8.4 Contractor shall take and distribute meeting minutes within 2 working days of the meeting.

7.9 A Contractor representative with sufficient authority to make binding commitments may also be required to attend a weekly Outage Coordination Meeting.

7.10 Contractor personnel, Business agents, Vendor/Sales representatives, etc., should use the entrance designated for their Contractor, park in the Construction parking lot, and be escorted onsite unless they have a Contractor badge. Construction badge holders may use Contractor entrance or Ameren employee entrance, and park in the Construction parking lot or main parking lot depending on purpose of visit.

8.0 DELIVERY AND STORAGE

8.1 Contractor shall be responsible for receiving, unloading, inspecting and hauling materials unless otherwise stated in the Contract documents.

8.2 Contractor and the project must be indicated on materials delivered to the site.

8.3 Contractor shall provide facilities to store materials and equipment on the jobsite. The SPOC will designate storage locations that will not interfere with Company's personnel or operations.

8.4 Payment for material or equipment stored onsite will not be made to Contractor until the material or equipment is installed. Contractor may apply for early payment only if early delivery and storage of the material or equipment will benefit Ameren.

8.5 A carrier that is compliant with the Depart of Transportation's (DOT) Hazardous Materials Security Plan must be used for deliveries of hazardous materials to Ameren. For a list of approved carriers visit http://vics.keyship.net/Ameren. Fill out the required fields & check the HazMat option. A list of qualified carriers will populate. Any vehicle carrying hazardous materials onto Company facilities will be refused entry until proof of compliance is provided.

8.6 If materials are provided by Ameren, they will be stored by Ameren until Contractor is onsite. Contractor will be responsible for loss or damage after acceptance of equipment or material provided by Company. Contractor shall inventory and haul excess material retained by Company to designated Company storage location(s) after completion of Work.

8.7 Contractor shall restore construction storage areas to a reasonable condition that satisfies the SPOC.

8.8 Material Receipt

8.8.1 Contractor must resolve all issues with contractor-procured material.

8.8.2 Contractor must identify, inspect, test and store material to purchase order requirements.

8.8.3 Contractor must ensure all receiving quality documentation is supplied to Ameren's SPOC upon receipt.

8.8.4 Contractor must have a program in place to ensure receipted critical plant material and equipment is not relocated or improperly stored without proper authorization from Ameren's SPOC.

8.8.5 Contractor will be provided a list of critical materials and equipment during pre-construction meetings.

8.8.6 Contractor must handle, store, and identify Critical Material in accordance with the paragraph below:

Ameren MISSOURI

MATERIAL HANDLING, STORAGE & IDENTIFICATION INSTRUCTIONS FOR CONTRACTORS

AUE-ADM-4203, Receiving Storage & Handling of Critical Materials

All Ameren purchased critical material received by a contractor or sub-contractor has specific requirements that must be met to comply with Ameren's Quality Management Program in accordance with AUE-ADM-4203. Contractor requirements contained in AUE-ADM-4203 are provided below. Contractors will be evaluated on their quality control and material management. A list of critical materials shall be provided to the contractor during Pre-Construction Meetings.

1) Notify Responsible Engineer (RE) of Ameren material received and the PO number. Ensure receiving documentation remains with the material until clear direction is provided by RE.

   NOTE: Steps 2-5 shall be directed by Responsible Engineer (RE)

2) Receiving documentation, number of containers, and intended storage location shall be taken to Storeroom personnel.

3) Storeroom shall create a Receipt Order (RO) number for traceability and provide identification labels for attachment to each container. Information will always include the RO tracking# and may include PO #, Job #, RE, PM, Storage Level, and intended location.

4) The RO number shall be clearly marked on all boxes, containers, equipment, and packing slip(s).

5) An Ameren Material Receipt Inspection Report (MRIR) shall be printed with the inspection requirements and shall be used to document inspection results. Contractors may perform additional inspections as directed by RE.

6) After successful acceptance, MRIR Inspector(s) shall sign the MRIR and each traceable barcode label; and shall attach labels to containers.

7) Hold tags shall be attached to any materials not accepted.

WARNING: Contact Responsible Engineer or Ameren Designee immediately if unidentified material is discovered, labels become unreadable, material needs to be relocated, or if material location or storage level differs from label.

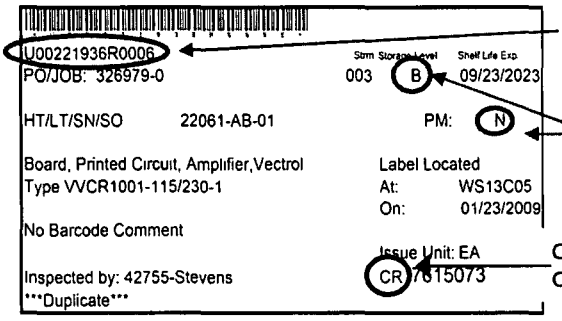
If during staging, prep work, etc., the material is repackaged or removed from labeled containers and the potential for identification or material loss exists, transfer the RO or barcode number, at a minimum, to the materials.

Storage Level B – Indoor storage. Temperatures controlled between 40°F and 140°F. This level includes the storeroom, turbine floor, or any other location inside the plant.

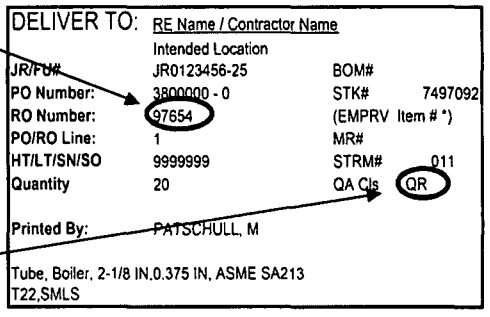
Storage Level C – Covered storage. Temperature control not required. These locations include secondary storerooms, covered parking areas, etc.

Storage Level D – Outside storage. Store in well drained areas in a manner allowing air circulation to minimize trapped water. Provide adequate protection from forces due to rain, wind and storms

CRITICAL MATERIAL BARCODE



DELIVERY MATERIAL TAG



9.0 REMOVALS AND PREPARATORY WORK

9.1 Contractor shall cooperate with the SPOC in scheduling removal work so there is no disruption to Company's personnel or operations.

9.2 Contractor shall provide protective enclosures, covers, water stops, etc. to prevent water or other weather-related damage to facilities during construction.

9.3 Before mobilizing tools, material and equipment, Contractor will install appropriate trash cans, cigarette butt receptacles, and dumpsters in designated areas.

9.4 Materials authorized to be removed become the property of Contractor, unless otherwise specified in the Contract documents, and shall be promptly removed from the worksite. An inventory of materials being removed must be submitted to the SPOC. If materials are retained, the SPOC will designate where materials shall be stored. Retained materials shall be neatly stored and protected from the elements.

9.5 Before mobilizing tools, material and equipment, Contractor shall install protection on both sides of all walkways in work area from top rail to toe board. This protection may include, but not limited to, orange fencing, plywood and sheet metal. However, openings in fencing shall be no larger than one inch square. Contractor shall install decking on open floor work areas, seal decking along edges and install toe boards, and install debris nets to further contain fallings objects. All wood subject to ignition sources shall have fire retardant cloth or tarps installed over the wood. Cloth shall be secured to avoid tripping hazards. All safety barriers shall be removed after the completion of the project.

9.6 For additional safety requirements to be performed prior to working on elevated platforms, walkways and scaffolds above 6 feet, refer to Safety Requirements for Working on Elevated Platforms (Appendix Y).

10.0 CUTTING & PATCHING AND TEMPORARY BUILDINGS, ETC.

10.1 Contractor shall do all cutting, fitting, or patching that may be necessary to make the several parts come together properly and fit to receive the Work of other Contractors and Subcontractors.

10.2 All temporary buildings/structures such as tool rooms, break rooms, lunch rooms, etc., shall be constructed with non-combustible materials.

11.0 TEMPORARY HEAT

11.1 Contractor shall provide temporary heat to protect Work materials against damage from dampness and cold to the satisfaction of the SPOC.

12.0 QUALITY REQUIREMENTS

12.1 The Quality Management System Manual, AUE-MAN-QMS-1001, provides the basis for the Ameren Missouri Power Operations Quality Management System (QMS) and provides the assurance that processes are in place to achieve our business objectives. The QMS performance standards and performance criteria provide requirements to achieve a controlled and systematic approach to quality management activities and promote continuous improvement. Contractors and Sub Contractors can obtain a copy of the QMS from the Ameren Missouri Project Manager.

12.2 The Contractor's quality management program and supportive procedures are subject to Ameren review and audit. Should a gap exist between the QMS, and the Contractor's quality management program and supportive procedures, the Contractor will be required to comply with the QMS.

12.3 Contractors and Sub Contractors agree to comply with the applicable QMS requirements for the work scope included in this Ameren Missouri contract. The Contractor shall provide a copy of the Contractor's quality management program and supportive procedures with the bid submittal, if the Contractor is not on the Ameren Missouri 'Generation Approved Supplier List – Critical (GASLC)'.

12.4 The QMS Application Aid (QMS-AA) per Appendix Q contains the applicable QMS requirements in this Ameren Missouri contract. The Contractor shall complete and return the QMS-AA with the bid submittal, if the Contractor is not on the Ameren Missouri GASLC.

12.5 The Contractor shall upon award develop and provide to Ameren a 'Project-specific Quality Management Plan' which is compliant with the QMS-AA.

12.6 The Contractor's awarded work scope, including that of its Sub Contractors, shall be performed to the requirements of the QMS-AA.

12.7 Ameren will be allowed to make quality inspections at Contractor's and Sub Contractor's facilities at no cost to Ameren. Ameren will be allowed to view applicable Contractor's and Sub Contractor's quality procedures and procedure generated records and documents.

12.8 Design Documents and Calculations:

12.8.1 Contractors and Sub Contractors shall meet the technical requirements included in Section 1D of this specification and the QMS-AA.

13.0 OWNER APPROVAL OF PROCEDURE

13.1 Ameren must consent to deviations from the procedures, methods and materials agreed to in the Contract. Reference Articles 2.01 and 4.01 of the GCCs.

13.2 Ameren reserves the right of approval over all procedures, methods, and materials to be employed by Contractor or its Subcontractors for this Work. Reference Articles 2.01 and 4.01 of the GCCs.

14.0 CONFIDENTIALITY

14.1 Contractor shall hold Ameren's Confidential Information confidential and shall not use or disclose to others during or subsequent to the performance of the Work (except as is necessary to perform the Work). Reference Article 9.02 of the GCCs.

14.2 Publication or advertising of information directly derived from Project or Work or data obtained in connection with services rendered under the Contract must first be approved in writing by Ameren (Ameren personnel need approval from Ameren Corporate Communications). Contractor shall not release any information for publication or advertising purposes relative to the material, equipment and/or services furnished under the Contract Documents without the prior written consent of Ameren. Ameren reserves the right to release all advertising or publicity concerning the Project or Work. Except as to signs required by building department regulations or any other governmental requirements, Contractor shall not display or permit any signs or advertisements to be displayed about the Project site nor publicize in any manner its performance of the Work without the express written permission of Ameren. Reference Article 9.02 of the GCC.

14.3 Contractor shall restrict the knowledge of all confidential information regarding the Work to as few as possible of its employees who are directly connected with performance of the Work and have a definite need for such knowledge. Upon request by Ameren's Representative, Contractor shall cause such persons or groups of persons involved in the Work on Contractor's behalf as Ameren may designate to sign individual secrecy agreements in a form satisfactory to Ameren. Reference Article 9.02 of the GCCs.

15.0 ACCOUNTING / INVOICING REQUIREMENTS / ACIP

15.1 Contractor shall furnish complete accounting information and cooperate with Ameren's accounting practices.

15.2 For Time and Material contracts prior to commencing work, Contractor shall furnish Company with a written estimate for Company approval. Once approved, Contractor shall promptly notify Company of any facts and circumstances that may adversely impact the estimate. Further, Contractor shall not exceed ninety percent (90%) of the time and materials estimate without Company approval. All overtime for Time and Material contracts shall be approved by Company in advance of working. Reference Articles 6 and 8 of the GCCs.

15.3 Company reserves the right not to honor charges associated with timesheets that are not provided daily.

15.4 Material invoices must be submitted as Work progresses. Total cost updates will be provided on a weekly basis.

15.5 If Work indicated or specified in Contract Documents is increased, Company may have Contractor perform Extra Work.

15.5.1 Contractor must obtain written approval from the SPOC prior to performing any Extra Work. Each Extra Work Order (EWO) shall be invoiced separately and shall reference the EWO number and Purchase Order (PO) number.

15.5.2 If work is performed on a time and material basis, then work shall be charged at the rates indicated on the Labor Rate Sheets in the Contract.

15.5.3 Ameren will pay Contractor the cost of extra work as follows:

NOTE:	Subcontractor labor and material charges shall be subject to the provisions of Items 15.5.3.1, 15.5.3.2 and 15.5.3.3 below.

15.5.3.1 Labor:

- Direct cost of payroll labor, including first line foreman, excluding job Superintendent and General Foreman
- Fringe benefits including welfare and pension
- Insurance
- Taxes including FICA, Federal, State and Local tax
- Overhead, including costs for home office, field office, consumables, and small tools with an original value under $1,200, as agreed by Company and Contractor at the award of Contract
- Profit, as agreed by Company and Contractor at the award of Contract

15.5.3.2 Material and third party rental equipment:

- Direct cost of material or rental equipment

Subcontractors:

- Direct cost of Subcontractor

Contractor-Owned Rental Equipment (excluding third party rental equipment):

- Contractor shall submit for approval an equipment rental rate schedule including all equipment, tools, and supplies required to perform the Work specified. These equipment rental rates will be used for extra work.

15.5.3.3 Ameren Coordinated Insurance Program (ACIP)

- If the project is part of the Ameren Coordinated Insurance Program (ACIP) all contractors of all tiers will be required to provide completed enrollment and monthly reporting forms for duration of their work on project. All prime contractors will be responsible for their subcontractors of all tiers with respect to compliance of enrollment and reporting requirements.
- If the project is part of the ACIP, contractors of all tiers must be enrolled and have a copy of ACIP certificate of insurance prior to mobilization onsite. Ameren will not allow non-enrolled contractors to access site prior to enrollment in ACIP.

END OF SECTION 1A

SECTION 1B
SUMMARY OF WORK

1.0 INTRODUCTION

The intent of this Specification is to describe the technical requirements for services to be provided by a contractor for installation of a soil-bentonite slurry wall.

1.1 Definitions

1.1.1 The term "Company" means the entity identified in the Company's Purchase Order, its agents, employees, representatives, successors, and assigns. The terms "Purchaser," "Owner," and "Buyer," if used in the Contract Documents, are considered synonymous and refer to the Company.

1.1.2 The term "Engineer" means the Engineer duly appointed to represent the Company as specified from time to time by the Company who may be employed by the Company or who may be employed by others.

1.1.3 The term "Contractor" means the entity identified in the Company's Purchase Order, and its agents, employees and authorized representatives undertaking the performance of the Work as defined in this Specification. The terms "vendor," "supplier," "manufacturer," or "fabricator" if used in the Contract Documents, are considered synonymous and refer to Contractor.

1.1.4 The term "Sub Contractor" means any individual, partnership, firm, corporation or business entity, other than an employee of Contractor, who contracts or agrees with Contractor (or another Sub Contractor or any tier thereof) to furnish any services, labor, materials or equipment for, or in connection with, the performance of the Work.

1.1.5 The term "Construction Project Lead" means the Company's representative as specified from time to time and located at the job site.

1.2 Location

1.2.1 The site is located approximately two miles north of Dynegy's Duck Creek Generating Station and approximately five miles southeast of Canton, Illinois. The mailing address for the Duck Creek Generating Station is 17751 N. Cilco Road, Canton, IL 61520.

1.3 General

1.3.1 The project site lies between the access road to the Duck Creek plant and the active rail spur serving the plant. The center point of the planned slurry wall is approximately 80 feet west of rail station 20+40. The slurry wall is intended to divert groundwater flow and lower the groundwater elevation around a section of the rail line where coal combustion ash was used as fill material..

1.4 Contacts

1.4.1 All commercial matters should be directed to the Ameren purchasing agent designated on the Request for Proposal or listed on the purchase order.

1.4.2 All technical questions regarding this specification shall be directed to:

Michael J. Wagstaff, PE
Ameren Missouri
3700 S. Lindbergh Blvd
Sunset Hills, MO 63127
Ph. 314-957-3202
mwagstaff@ameren.com

2.0 SUMMARY OF WORK

2.1 Project Objectives

The objective of the project is to divert groundwater flow around the section of the rail line where ash was used as fill and to lower the groundwater level on the down-gradient side of the slurry wall to minimize groundwater contact with the ash..

2.2 General Requirements and Design Basis

2.2.1 Contractor shall be responsible for furnishing all material (except those items of material specifically stated to be furnished by the Company), tools, equipment, labor, supervision and any other incidental items or services required to perform all of the work described herein.

2.2.2 Contractor shall be responsible for any and all engineering, drafting, field sketches, and field layout required for temporary supports, rigging, removals, and installation of all material.

2.2.3 Contractor shall be responsible for receiving, storage and security of all materials supplied by Contractor and material provided by Company. Contractor will be required to unload material in laydown areas as designated by the Construction Project Lead.

2.2.4 Contractor will be responsible for proper disposal of all material.

2.2.5 Contractor supervision shall obtain necessary plant-specific training for the work they will perform, including Foreign Material Exclusion (FME).

2.2.6 Contractor employees shall observe Ameren's practices and procedures for Foreign Material Exclusion (FME). Severe damage can result from non-compliance when working on critical systems, including but not limited to; feedwater, condensate, steam, or lubrication. The Company may seek to recover costs for contractor non-compliance.

2.2.7 Explosives may only be used with written permission from the Company.

2.2.8 Contractor Design shall use the Design for Safety Checklist (Appendix A, Section 4.0).

2.3 Description of Work

2.3.1 This specification outlines the services of a Contractor and items of material necessary to design, construct, and properly install a soil-bentonite slurry cutoff wall through what is believed to be mine spoil and keyed into clay soils at the depths shown on the accompanying drawings. The slurry trench is anticipated to be 1,132 linear feet with depths ranging from 38 to 58 feet and will be placed between the road and the rail line. The slurry wall, when completed, shall have a minimum thickness of 24 inches and a hydraulic conductivity of 1×10^{-7} cm/sec or less.

The area the slurry trench will be installed in is a grassed ditch between the road and the rail line. At approximately station 9+30 of the trench, a drainage swale area between two culverts is crossed and the Contractor shall be responsible for diverting or collecting runoff water so as not to interfere with construction but maintain integrity and use of the road and rail line. The culverts and swale shall be restored to their original condition after slurry wall installation. Additionally, a soil cap shall be placed by the Contractor over the length of the slurry wall after initial settlement of the backfill.

3.0 SCHEDULE MILESTONES

3.1 The contract award date is XXXXXX. The contractor shall complete Slurry Mix and Soil-Bentonite Backfill Mix design and testing and submit results to the Engineer by XXXXX. The contractor should mobilize and start construction no later than XXXXXX. The required finish date for this contract is XXXXXXX.

4.0 COMPANY AND MANUFACTURER'S DRAWINGS

4.1 The following information and drawings are intended to indicate the scope of the work to be done and details necessary for the items of work set forth in this specification, and are part of this specification. The drawings

in general are to scale, but figures shall always be followed and drawings are not to be scaled. Contractor shall make any requests for additional drawings in writing to the Engineer.

4.1.1 Site Investigation Report, Duck Creek Rail Spur Site (Civil & Environmental Consultants, September 2014). **(See Appendix AA for report)**

4.1.2 Drawing X-X-1 "Cover Sheet"

4.1.3 Drawing X-X-2 "Plan and Profile of Low Permeability Barrier Wall"

4.1.3 Drawing X-X-3 "Cross Section of Low Permeability Barrier Wall"

5.0 WORK, MATERIALS AND EQUIPMENT SUPPLIED BY COMPANY

5.1 The Company will have an on-site Construction Supervisor that will follow the Work and will be the Contractor's primary contact during this project. Additional resources listed below may be available to the Contractor during the project.

4.1.1 On-site water within the adjacent unnamed ponds.

4.1.2 Disposal areas for excess or undesirable excavation materials. All disposal areas should be coordinated with Ameren.

5.1.4 A staging area is available to the north of the project site.

6.0 WORK, MATERIALS AND EQUIPMENT FURNISHED BY CONTRACTOR

6.1 All supervision, labor, materials, equipment, tools, and any incidental items necessary to completely install each portion or component of the work shall be furnished by Contractor. These items shall include, but not necessarily limited to the following:

6.1.1 Labor, equipment, and materials required to install the slurry wall

(All materials should be reviewed and approved by Ameren)

7.0 UTILITIES AND FACILITIES

7.1 Contractor shall supply sanitary facilities, drinking water and shower facilities (if needed) equipped with water heaters.

7.2 Temporary lighting, wiring, plumbing, globes, guard lights, barricades or any other items required for protection, facility of work, local regulation, or by law for public protection shall be provided by Contractor.

7.3 Power and plant service air are **not** available at the project site.

7.4 Lay down areas for equipment and material will be designated as close to work site as possible. Areas for tool, office, and change house trailers will be designated as close to work site as possible. Contractor's lay down area will be as determined by the Construction Project Lead.

8.0 RECORDING OF HISTORICAL DATA

8.1 Contractor shall make provisions to record the man-hours expended by each craft on each activity during the course of the work.

8.2 Within three (3) weeks after completing the work, a report shall be submitted by Contractor summarizing the activities completed together with the man-days expended on each activity each week during the project all segregated according to craft.

9.0 CONTRACTOR'S FIELD SAFETY PROGRAM

9.1 Contractor shall comply with the Safety and Housekeeping procedures stated in Section 1A.

9.2 The Company has computerized the WPA request process. All organizations working on plant site shall be required to use the WPA computers to request WPA tags to be hung. The Company will provide training to one or two individuals per organization.

10.0 CONTRACTOR'S COST TRACKING PROGRAM

10.1 In addition to daily timesheets, Contractor shall furnish percent complete information to the Construction Project Lead for all work on a weekly basis. Percent complete information is to be submitted on Contractor-supplied forms.

11.0 GENERAL INFORMATION

11.1 Contractor shall develop and be responsible for all details, which may be required to complete the work, but which are not included in this document. The Company retains the right of approval of all such details.

11.2 Upon completion, all work defined in this document shall be of a uniformly neat and workmanlike appearance. All costs of repair to meet this condition shall be to Contractor's account.

11.3 Contractor shall follow the manufacturer's or fabricator's guidelines and requirements for installation of all materials and equipment, except as modified by this Specification.

11.4 Contractor shall not have any materials, tools, equipment, etc., fall from elevated work areas. Contractor shall be responsible for designing his own means to prevent objects from falling.

11.5 Only Contractor's vehicles permanently marked with Contractor's name and displaying an Ameren Contractor Mirror Tag, shall be permitted on job site. Mirror tags are available from the Construction Project Lead only after verification of auto insurance and other criteria has been met. No personal vehicles will be permitted on job site.

11.6 Upon admittance into the Plant, Contractor (including each and every employee or sub-contractor's employees) shall be subjected to a computer based training (CBT) program that describes the Plant Construction Job Work Rules. These work rules are similar to those listed in Section 1A, Appendix B. The training lasts approximately ¾ hour for the average worker. Employees cannot begin work until the training is completed.

11.7 Job Working Rules

Contractor must enforce the Ameren Job Working Rules, included in this specification as Appendix B, as well as the Contractor's own work rules. If the rules conflict, the more restrictive rule applies. The Ameren Safe Work Rules Handbook may provide guidance on the most common hazards in the work place and outlines the rules that Ameren employees must follow. It can be found on Scholar, the Ameren intranet (Scholar, Safety/Environmental, Look under letter "S", and Safe Work Rules Handbook) or a hard copy can be requested from the SPOC.

12.0 EXTRA WORK ORDERS

12.1 Extra work will be authorized by an approved Extra Work Order (EWO). Contractor shall not start any additional work without written approval from the Company.

12.2 Extra work may be authorized on a lump sum firm price, unit rate, time and materials (T&M), or a T&M-not-to-exceed basis. The Company will select the terms of the EWO.

12.2.1 Pricing for lump sum firm price and T&M-not-to-exceed work shall be based on the Engineering Inspection Report supplied by the Construction Project Lead.

12.2.2 The Company may accept or reject Contractor's proposal for any EWO. If an EWO proposal is rejected the Company may try to negotiate the price, reduce or cancel the work scope, or obtain pricing from another contractor.

12.2.3 If Contractor's submitted EWO proposal is acceptable to the Company an approved EWO will be issued authorizing the work.

12.3 Invoices for all approved Extra Work Orders shall reference the purchase order number of the original contract, the EWO Number, and have a copy of the approved EWO attached.

END OF SECTION 1B

SECTION 1C – INFORMATION REQUIRED FROM BIDDERS

1.0 INFORMATION REQUIRED WITH BID PROPOSAL

1.1 Pricing

1.1.1 Describe pricing for the project.

1.1.1.1 **INSTALL SOIL-BENTONITE SLURRY WALL** Provide a lump sum price to supply material and labor to install a soil-bentonite slurry wall as described in this specification and shown on the drawings. The square footage of the wall as depicted in this specification is estimated at 57,000 SF. If contractor feels that this area is in error, please indicate so in the bid. Also include the cost of constructing a permanent soil cap.

Item 1 (use words) $_____

Item 1 (use numbers) $_____

1.1.1.2 UNIT RATE FOR OVER/UNDER QUANTITIES (UNITS OF SQUARE FOOT OF WALL) [Provide a unit rate in SF if the slurry wall should extend deeper than planned (add) or extends to a shallower depth (subtract).]

Item 1 (use words) $_____

Item 1 (use numbers) $_____

1.1.1.3 **IMPORTED FILL MATERIAL** [Provide a unit cost for imported fill material to be used in the event the excavated soils are not suitable for soil bentonite slurry backfill. Please provide a unit cost based on cubic yards.]

Item 2 (use words) $_____

Item 2 (use numbers) $_____

Note to Bidders: Please respond to this bid as it is written. If, however, the Bidder has an alternative approach that in the opinion of the Bidder would provide a cost and/or time savings to Ameren, then please provide an explanation of this alternative and how it would function at least as effectively as the slurry wall specified herein.

1.1.2 Contractor shall submit with bid proposal a schedule of time and material (T&M) rates as well as T&M rates for all planned subcontractors. The submitted schedules of T&M rates will be used for any additional work the Company may request or approve during the course of the specified work.

1.1.2 Break out cost for safety personnel per Section 4.2 of Appendix A – Safety and Contractor Requirements.

1.2 Project Execution Plan

1.2.1 Contractor shall submit with bid proposal a preliminary work plan describing how each individual project will be executed. Included in the work plan shall be items/details such as:

1.2.1.1 Planned access

1.2.1.2 Lifting and rigging, including identification of Critical Lifts (see Appendix A)

1.2.1.3 Quality control plan

1.2.1.4 Organization chart with resumes

1.2.1.5 List of subcontractor

1.2.1.7 Plan for Elevated Platform Safety Requirements (Appendix Y)

1.3 Exceptions

1.3.1 Any contract award resulting from this Specification will incorporate all provisions specified herein. It is understood that Contractor agrees to all provisions of Specification unless exceptions are specifically listed in bid proposal.

1.4 Environmental, Safety and Health

1.4.1 Contractor shall submit with bid proposal a completed Contractor Environmental, Safety & Health Data Form as found in Appendix A, Attachment A10.

2.0 INFORMATION REQUIRED AFTER CONTRACT AWARD

2.1 Schedule

2.1.1 Contractor shall submit a construction schedule as described in Appendix D - Contractor Schedule Requirements. Failure to provide a schedule may result in rejection of the bid.

2.1.2 Contractor shall provide continuous (daily) updates of his project work schedule beginning after he mobilized at jobsite and continuing through completion of work. Failure to provide a schedule may result in charges to Contractor.

2.2 Revised Project Execution Plan

2.2.1 Contractor shall submit after award of contract a detailed work plan describing how project will be executed. Included in the work plan shall be items/details such as:

2.2.1.1 Planned access

2.2.1.2 Lifting and rigging, including Critical Lift Plan (see Appendix A)

2.2.1.3 Quality control plan

2.2.1.4 Organization chart with resumes

2.2.1.5 List of subcontractors

2.2.1.6 Site-specific safety plan

2.2.1.7 Site-specific demolition plan (may be incorporated into the Safety Plan)

2.3 Contractor Project Management

2.3.1 Contractor shall provide an organizational chart depicting names and roles of individuals involved with project from Project Manager to Foreman level.

2.3.2 Contractor shall provide necessary resources to provide scheduling information and updates as defined in Appendix D Contractor Schedule Requirements.

2.3.3 Contractor shall provide a full time Project Manager onsite unless an exemption is provided in writing by the Managing Supervisor of Construction.

2.4 After contract award the Contractor may be responsible for utilizing the Ameren Contractor Cost Tracking Module (CCTM) for all lump sum and T&M work. Ameren Purchasing or Strategic Sourcing will decide whether to require CCTM or Ameren's API invoicing system. If CCTM is utilized, the Contractor's representative(s) will be trained by

Ameren on the use of the CCTM program in Ameren's EMPRV computer program. The Contractor shall use the CCTM module frequently to estimate/re-estimate the job scope and record actual billing costs.

2.5 Contractor and subcontractors shall provide FME plan in accordance with Appendix X prior to start of work.

2.6 Contractor and subcontractors shall submit a Quality Plan which is in compliance with the Quality Requirement in Section1A – Supplemental General Conditions, Section 12, prior to start of work.

END OF SECTION 1C

SECTION 1D – GENERAL TECHNICAL REQUIREMENTS

1.0 TECHNICAL REQUIREMENTS

1.1 This specification technical section together with attached appendices, covers the requirements for installation of a soil-bentonite slurry wall as described in this specification and shown on the drawings..

1.2 Codes, Standards, and Regulations

1.2.1 The Contractor shall, as a minimum, perform the necessary work to meet the requirements of the codes, standards and regulations set forth in this specification. In the exercise of his experience and knowledge of the equipment, materials and work covered by this Contract, the Contractor shall perform all work and provide materials and equipment in accordance with other codes, standards and regulations consistent with providing a safe and reliable product.

1.2.2 Any deviations from this specification shall be documented by the submittal of an alternate proposal. Alternate proposal shall list exception by specification section in numerical order on the first page of the alternate proposal. Alternate proposal shall list breaker data sheets from specification after exception sheet. Manufacturing schedule, delivery date, and price shall follow the proposal data sheets. Individual manufacturer specification technical selling points shall be listed at the end of the proposal along with the terms and conditions.

1.2.3 Contractor shall plan on having one design review meeting conference call with the customer. Contractor shall send five (5) sets of drawings and documents for approval for this meeting. See submittal requirements in Information Required By Bidders (Section 1C), Item 2.0. Contractor is responsible for setting up meeting and coordinating conference call.

1.3 Equipment and materials shall be complete in all respects within the limits herein outlined. Errors or omissions required to be corrected in the field shall be done by the manufacturer or its duly authorized representative at the Vendor's expense.

1.3.1 The latest revisions or addenda to codes, standards and regulations set forth as the date of the Contract shall apply.

1.4 The following codes, standards and regulations, with the issue dates noted, shall be complied with except as modified by this Specification. Materials not specified shall be in accordance with references within the codes and standards listed, or if not listed, with the latest applicable industry standard wherever possible. Conflicts between either the codes, standards, or this Specification shall be brought to the attention of the Engineer for resolution.

a) American Society for Testing and Materials (ASTM)
b) The Basic Building Code of the Building Officials of Code Administrations International, Inc. (BOCA)
c) America Institute of Steel Construction (AISC)
d) American National Standards Institute (ANSI)
e) American Society of Mechanical Engineers (ASME)
f) Environmental Protection Agency (EPA)
g) National Fire Protection Association (NFPA)
h) Occupational Safety and Health Administration (OSHA)
i) American Welding Society (AWS)
j) American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
k) Underwriters Laboratories, (UL)
l) Institute of Electrical and Electronic Engineers (IEEE)
m) Department of Transportation (DOT)

2.0 DESIGN AND MATERIAL

2.1 Design change, material change/substitution or information requests require the Contractor to submit request to the Responsible Engineer for approval prior to project changes. Written approval is required from the Responsible Engineer or construction supervisor.

2.1.1 If the Responsible Engineer approves the request, he will issue an FCN (Field Change Notice) per Ameren Design Control process.

2.2 When supplying a skid of pre-assembled equipment containing valves, gauges, and other general instrumentation in addition to the main component (pump, blower, etc.) as part of the Supplier's scope of supply, the Supplier shall label all skid devices for clear identification in the field.

3.0 TECHNICAL SERVICES

3.1 The Vendor shall quote, as a separate price, the services of one or more manufacturer's technical service representative on a per diem basis. Pricing for travel and per diem rates for service time shall be provided in the Bid Forms. The service representatives shall be technically competent; factory trained; experienced in the installation and operation of the equipment; and authorized by the manufacturer to perform any work stipulated.

3.2 The manufacturer's technical service representatives shall furnish written certification to the Owner that the equipment has been field inspected and adjusted by them or under their direction and that it is ready for service, all of which shall be done before initial operation of equipment.

a. Providing technical advice to assist the installation contractor in installing the equipment.

b. Inspecting and testing the equipment after installation and directing any changes or adjustments required to assure proper operation.

c. Providing technical direction during start-up and initial operation of the equipment.

d. Directing the correction of any design or manufacturing errors.

e. Instructing/training the plant personnel in the operation and maintenance of the equipment.

f. Providing services required as a condition to providing the warranties and guarantees specified.

3.3 When, in the judgment of the Owner, a field service representative's time is required under Section 1D, Item 3.1 above, solely and expressly for the purpose of correcting design or manufacturing errors covered under warranty, no payment will be made, nor will the time spent at the site while correcting such errors apply toward the days of service or round trips specified for Section 1D, Item 3.2 (a), (b), (c), (e) and (f) above.

3.4 The per diem rates shall include all costs associated with the service representative's work at the site, including local travel, local travel time wages, and living expenses. The round trip rate shall include all expenses for the travel to and from the manufacturer's facilities and the site, including any salary costs for travel time. The Owner will not reimburse Vendor for air fare costs exceeding tourist class air fare unless unusual circumstances exist. The Vendor shall notify the Owner in advance of such circumstances.

3.5 A day of service (per diem) is defined as 10 man-hours at the site. The total number of days of service shall be defined as the total regular time man-hours at the site divided by eight.

3.6 Contractor shall provide 2 days of training for Fossil Plant personnel and 2 days of training for Callaway Plant personnel at the plant sites.

4.0 TESTING

4.1 (insert testing requirements)

4.2 The Owner reserves the right to observe the above tests being performed.

4.3 The Vendor shall notify the Owner of all tests not less than 14 days prior to the date of test to allow the Owner to observe testing of the equipment if so desired.

4.4 Certified copies of inspection and test reports shall be provided by the Vendor for all test and inspections conducted on the specified equipment. One (1) copy of each report shall be submitted to the Owner within one (1) week after completion of each test or inspection as specified in Item 3.2 above.

4.5 A site acceptance test will be performed to verify voltage, current, and wattage requirements. A performance test will be performed to verify the rating after temperature compensation.

5.0 PRE-SHIPMENT INSPECTION

5.1 The Owner reserves the right to inspect the equipment prior to shipment.

5.2 The Vendor shall notify the Owner of all Shipments not less than 14 days prior to the date of shipment to allow the Owner to inspect the equipment if so desired.

6.0 SHIPPING

6.1 Shipments to the plant site shall be consigned to the shipping address as defined in Summary of Work (Section 1B), Item 1.2.1.

6.2 The vendor shall include costs of shipping all materials and associated equipment together in the price quote.

6.3 The vendor shall be responsible for delivery to the Owner's site F.O.B. This shall include special work required to support delivery of heavy and/or oversized items such as, but not limited to, road repairs, road upgrades or extensions, power line disconnections and reconnections, bridge reinforcements, grade alterations, and the like. The Vendor shall provide and coordinate all special services required to complete all deliveries based on the existing conditions surrounding the site on the Contract Date.

6.4 The Vendor shall discuss with the Owner the routing of shipments and shall reroute the same as indicated by the Owner provided the freight rates and overall costs are no greater than by other routes.

6.5 Truck shipments will be accepted weekdays only between the hours of 8:30 A.M. and 2:30 P.M. (Central time). After-hour deliveries not provided for by contract may be refused until the next regular workday. Cost incurred by the Owner for offloading prior to or after normal working hours shall be back-charged to the Vendor unless prior authorization has been approved by the Owner.

6.6 Packages shall be clearly marked with the Contract Number and Purchase Order Number where applicable. Packing lists shall identify Contract Number, Purchase Order Number and item numbers and quantities, bills of lading shall identify the Contract number and Purchase Order Number.

6.7 Equipment shall be shipped completely factory assembled. Preparation for Shipment shall be in accordance with Manufacturer's standards unless otherwise noted in this specification. The Manufacturer shall be solely responsible for the adequacy of the preparation for shipment to ensure materials are received at their destination in EX-Works (EXW) conditions when handled by commercial carriers.

6.8 Equipment shall be boxed, crated, or otherwise suitably protected during shipment, handling, and storage. Components with moving parts which might be damaged in shipment, shall have all such moving parts securely blocked and braced. All items blocked and braced for shipment must be clearly identified and tagged accordingly. Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures.

6.9 Materials required for protection during shipping and storage shall be treated for fire resistance. Wood protection shall be Class A, fire retardant, pressure treated type.

6.10 Coated surfaces shall be protected against impact, abrasion discoloration, and other damages. Surfaces which are damaged shall be repaired.

6.11 Electrical equipment, controls, and insulations shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings, and like items shall be thoroughly cleaned, coated with rust-preventive compound, and protected with suitable wood, metal, or other substantial type covering to ensure their full protection. Exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. Damages due to insufficient protection shall be repaired by the Vendor.

6.12 Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Vendor's expense.

6.13 A weatherproofed itemized list of the contents shall also be attached to the outside of each box.

6.14 Spare parts shall be shipped separate in heavily constructed wooden boxes. The boxes shall be designed as permanent storage enclosures. Separate boxes shall be used for the spare parts for each major piece of equipment. Where applicable, boxes shall be designed and constructed for return shipment of damaged or worn components for repair.

6.15 Spare parts shall be protected from damage due to moisture and dirt accumulation during an extended storage period by use of special coatings, airtight membranes, bags of desiccant, or other means acceptable to the Owner.

6.16 All separately packaged accessory items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip, indicating what is in that container only, shall be attached to the outside of each container used for packing. A similar list shall be inside of each container. A master packing slip, covering all accessory items for a given piece of equipment which are shipped in separate containers, shall be attached to one container.

6.17 Vendor shall provide dimensions (H" x W' x D") and weight for each shipping container with approval drawings.

6.18 If materials require special fixtures or lifting rigs for offloading, such rigs or fixtures shall be provided at no additional cost with shipment.

7.0 RECEIPT INSPECTION

7.1 Materials or equipment purchased under this contract may be inspected at the specified receiving points and there accepted or rejected. Inspection will include the necessary testing for determining compliance with the specifications. All expense of initial acceptance tests will be borne by the Owner. The expense of subsequent test due to failure of materials or equipment first offered will be charged against the Vendor. The Owner may reject damaged materials or equipment at any point along the line of shipment with the return and shipment costs to the Vendor's account.

8.0 WARRANTY

8.1 The Warranty shall be warranted by the contractor against defects in materials, performance, and workmanship for a period of 2 years from the date of acceptance by Ameren. The length of the warranty supersedes the length specified in the GCC's (General Conditions of Contract). Contractor shall include parts, contractor service engineer, and labor to remove and install the necessary parts and equipment.

Note: As used herein "Seller" means Vendor and "Buyer" means Customer.

Seller warrants that its services, including without limitation, its design, inspection, and installation services, and the equipment and materials to be supplied by Seller under this contract, shall be free of defects and shall conform to the requirements of the contract.

9.0 LIQUIDATED DAMAGES

Liquidated damages shall be assessed at $_____ (insert amount) per day. The liquidated damages shall have a cap of 5% of the contract.

In the event the cap on liquidated damages is reached, and Contractor fails to meet the Schedule within an additional 7 Days, Owner may, in addition to the liquidated damages provided for in this Section and in its sole discretion, terminate this Contract for Contractor default under Article 7.02 of the General Conditions of Contract and, subject to the limitation of liability set forth in Article 10 of the General Conditions of Contract, seek additional damages Owner may incur as a result.

END OF SECTION 1D

DIVISION 2 – SITE WORK

SECTION 02200
SOIL-BENTONITE SLURRY TRENCH WALL

PART 1 GENERAL

1.01 WORK INCLUDED

A. This Section includes the requirements for the installation of a Soil-Bentonite slurry trench wall approximately 1,132 feet in length between the access road and rail spur to the Duck Creek Generating Station. The mid-point of the wall is approximately opposite station 20+40 of the rail spur, offset to the west approximately 80 feet. The construction area is located approximately two miles north of the Generating Station and approximately five miles southeast of Canton, Illinois. The Work consists of furnishing all plant, labor, equipment and materials, and performing all operations required to design and construct the slurry cut-off wall.

B. An impervious (hydraulic conductivity ≤ $1X10^{-7}$ cm/sec) Soil-Bentonite slurry trench cutoff wall shall be constructed to the lines, grades and cross-section as indicated on the contract drawings. The wall shall have a length of approximately 1,132 feet, depths as indicated on the contract drawings and a minimum trench width of 24 inches. The area of the wall is estimated to be 57,000 square feet. The approximate start and ending points of the wall will be staked in the field by the Owner and additional stakes will be placed along the suggested alignment at 100-foot intervals. The depth of the wall may be increased or decreased based on field observation of excavated material. The intent of the construction is to "key" the base of the wall a minimum of five (5) feet into the underclay, or native residual clay soils underlying the mine spoil. The depth of the wall shown on the profile is based on widely spaced soil borings; actual field conditions may vary from that shown on the contract drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. D422 – Particle Size Analysis of Soils
2. D1140 – Materials Finer Than #200 Sieve by Washing
3. D2216 – Moisture Content Determination
4. D4318 – Liquid Limit, Plastic Limit and Plasticity Index
5. D4380 – Density of Bentonite Slurries
6. D5084 – Hydraulic Conductivity Using Flexible Wall Permeameter
7. D5890 – Swell Index of Clay Mineral Component
8. C143 – Slump of Hydraulic Cement Concrete

B. American Petroleum Institute (API):
1. 13A – Specification for Drilling-Fluid Materials
2. 13B-1 – Standard Procedure for Field Testing Water-Based Drilling Fluids

1.03 SUBMITTALS

A. Qualifications of Key Personnel. The Contractor shall submit the qualifications of key personnel who shall be assigned to this Work. Key personnel shall include: Field Superintendent, Field QA/QC Engineer, Excavator Operator, and Project Manager. The qualifications shall show that each key personnel have the experience and training to successfully construct the Soil-Bentonite slurry trench wall. Key personnel shall be approved by the Company.

B. Slurry Mix Design. The Contractor shall submit a slurry mix design that meets the material specifications herein using the water available on site. The submittal shall include the results of swell tests (ASTM D5890) and filter cake permeability tests using the Soil-Bentonite to be used for this Work and the water from the site.

C. Soil-Bentonite Slurry Backfill. The Contractor shall submit a mix design for the Soil-Bentonite slurry backfill that meets the material specifications herein. The backfill design shall utilize an economical mix as required of excavated materials, dry Bentonite, Bentonite slurry and other materials to produce the required permeability. The submittal shall include the results of permeability (ASTM D5084), particle size (ASTM D422) and slump (C143) tests with varying amounts of dry Bentonite and any supplemental material added and using site water to determine the most economical mix.

D. Cap Design. The Contractor shall submit the design of the soil cap of the slurry wall. The soil cap shall be installed by Contractor once initial settlement of the wall trench is completed. The wall design settlement shall be no more than 3 feet. The cap shall be mounded to an approximate elevation 18 inches above the adjacent ground and tapered over an approximate width of five feet to either side of the slurry wall trench. See Contract Drawings for additional details.

E. Work Plan. The Contractor shall submit a work plan to Ameren for approval. The work plan shall include, but not be limited to: the method for preparing the slurry and the backfill, site set-up, required working areas, equipment, sources of materials, means of conveying the slurry and backfill to the trench, field QA/QC procedures, procedures to temporarily suspend work, disposal of materials, and cleanup.

F. Schedule. The Contractor shall submit a schedule for completing the Work in accordance with the contract requirements and within the Time for Completion.

G. QA/QC Documentation. The results of all tests performed in accordance with these specifications will be recorded on forms acceptable to Ameren and signed by the Field QA/QC Engineer. These forms shall be available to Ameren at all times. Copies of all forms will be submitted daily to Ameren for reference.

1.04 QUALITY CONTROL

A. The Contractor shall maintain his own quality control for the Work under the direction of the approved Field QA/QC Engineer and in accordance with the approved Work Plan.

B. Trench Continuity and Depth. The Contractor shall be responsible for demonstrating to the satisfaction of Ameren that the slurry wall is continuous and to the minimum specified depth. Trench continuity shall be assured by the action of movement of the trench excavation equipment such that digging tools can be passed vertically from top to bottom of the trench as well as moved horizontally along the axis of the trench without encountering unexcavated material. Adequate depth of the trench shall be demonstrated by direct measurement of the depth to the satisfaction of Ameren.

C. Materials.

1. Bentonite: A certificate of compliance with these specifications from the manufacturer shall be submitted to Ameren.

2. Slurry: A complete series of tests shall be conducted from the mixer or pond containing slurry ready for introduction into the trench at least twice per shift or each time a batch is prepared. The series of tests shall include: unit weight of slurry, filtrate loss, viscosity, and pH of the slurry. Samples shall be obtained from near the bottom of the trench near the point of trenching.

3. Backfill: Mixed backfill material shall be tested prior to placement in the trench by conducting tests to determine the unit weight, slump and gradation (visual) and other means to determine the mix is homogeneous and in accordance with the design as submitted.

PART 2 PRODUCTS

2.01 SLURRY

Slurry shall consist of a stable colloidal suspension of bentonite and soil in water and shall be controlled in accordance with API Standard 13B-1 "Standard Procedure Testing Drilling Fluids", and the following requirements:

A. At the time of introduction of the slurry into the trench, the slurry shall be a mixture of not less than 18 pounds per barrel (42 gallons) of bentonite and water. Additional bentonite may be required depending upon the hardness and temperature of the water and the quality of the bentonite. The slurry shall have a minimum apparent viscosity of 15 centipoises or 40 seconds reading through a Marsh Funnel Viscosimeter, and a maximum filtrate loss of 25 ml in 30 minutes at 100 psi, and a minimum unit weight of 64 pcf.

B. The slurry mixture in the trench shall have a unit weight not less than 64 pcf, not greater than 85 pcf, or as approved by the Engineer.

2.03 WATER

Fresh water, free of excessive amounts of deleterious substances that adversely affect the properties of the slurry shall be used to manufacture the bentonite slurry. The adjacent pond water is available for use, but should be tested for suitability in the slurry prior to its use. It is the responsibility of the Contractor that the slurry resulting from the water shall always meet the standards of this Specification.

2.04 BENTONITE

Bentonite used for the slurry and the backfill shall be pulverized (powder or granular) premium grade sodium cation montmorillonite and shall meet the requirements of API 13A.

2.05 SOIL-BENTONITE SLURRY BACKFILL

The material for the trench backfill shall be composed of slurry, excavated soils, dry Bentonite, and possibly additional materials to achieve a satisfactory mix. The backfill shall be thoroughly mixed and well-graded with a minimum of 15 percent passing the U.S. #200 sieve, shall remain sufficiently plastic to fill voids or seal cracks that may develop, shall support the existing site embankment, and shall have a permanent hydraulic conductivity of $1x10^{-7}$ cm/sec or less.

PART 3 EXECUTION

3.01 SITE PREPARATION

A. Explosives:

1. Blasting will not be permitted.

B. Waste Materials:

1. Remove unsuitable and excess subsoil materials from work area as excavated.

2. Deposit such materials in locations and within areas indicated or designated by the Engineer. The disposal areas will be adjacent to the work site.

3. Grade disposal areas and leave free draining with an orderly, neat appearance.

C. Protection:

1. Protect areas adjacent to the trench from slurry and trench waste. The Contractor shall control the slurry mixing operation to prevent the slurry and/or trench waste from leaving the Plant's property or contaminating excess areas of the site. The Contractor shall perform this work in an efficient and clean manner to control slurry and minimize waste contamination of the site and all areas adjacent to the work site.

2. Protect areas from actions of the elements. Limit surface erosion. Contractor should be aware of a drainage swale in the work area opposite rail spur stations 23+50 to 24+00. An 18-inch pipe conveys water from the western pond under the road to the open ditch area where construction will take place. The ditch area then drains through a 66-inch pipe under the rail spur embankment to the eastern pond. Contractor shall in his submittal describe a contingency plan which in the event of a significant rain event would prevent runoff into the construction working area. Possible mitigation efforts could be a pump-around of the work area, temporary plugging, or other diversions. Silt fences and/or straw bales are to be utilized as best management practices (BMPs) in the Contractor's plan. Installation shall follow the examples given on the Construction Drawings.

3. Settled or eroded areas shall be filled and repaired and grades reestablished by the Contractor to the required elevations and slopes.

D. Using the Company's survey stakes, the Contractor shall layout the alignment of the trench and establish adequate control points and benchmarks for control of the Work.

E. The Contractor shall prepare and maintain the work areas, mixing areas, and haul roads in accordance with the approved Work Plan.

F. The Contractor shall construct all required berms and embankments to prevent contamination of the site from slurry and trench wastes.

3.02 TRENCH EXCAVATION

A. Excavation of the slurry trench shall be accomplished by use of suitable trenching equipment such as a backhoe or clamshell so that the required width of the trench can be carried to its final depth of cut continuously along the trench alignment. Special tools shall be used as necessary to remove obstructions to accomplish the required excavation limits. The width of the excavating tool shall be equal to or greater than the required minimum width of the trench.

B. The Contractor shall provide all the necessary equipment to adequately supply properly prepared slurry to the trench. Storage ponds/tanks may be used to store initially-mixed slurry to allow hydration and to store prepared slurry in case of an emergency, such as a large loss of slurry in the trench. Slurry in the tanks shall be agitated or re-circulated as required to maintain a homogeneous mix. No slurry shall be prepared in the trench. Mixing of water, bentonite, and other materials shall continue until the particles are fully hydrated and the resulting slurry appears homogeneous.

C. Slurry shall be introduced into the trench at the same time trenching is begun and shall be maintained in the trench during excavation and until backfilled. The Contractor shall maintain the stability of the excavated trench at all times for its full depth. The level of the slurry shall be maintained at least 2 feet above the ground water level and shall not be permitted to drop more than 3 feet below the ground surface adjacent to the trench. The Contractor shall have personnel, equipment and materials ready to raise the slurry level at any time.

D. The bottom of the slurry trench shall be to the minimum specified depth in the underlying soil stratum. Changes in the depth of penetration shall be approved by Ameren. The final depth and penetration of the trench shall be measured by the Contractor and approved by Ameren immediately following excavation.

E. Undesirable cuttings or sediments in the trench shall be removed. At the beginning of each shift or if soundings indicate a buildup the trench bottom shall be scraped clean by adequate repeated passes of the bucket of the excavator horizontally along the trench. Additional equipment, such as air lift pumps or slurry desanders shall be used if required to clean the trench bottom and the slurry in accordance with these specifications. The accumulation of sediments in the trench shall be minimized by proper construction techniques. The length of the trench supported only by slurry shall be minimized. The toe of the backfill slope shall be kept as close to the face of the excavation as practical. Soundings will be taken at regular intervals to determine if sediments are present. Sediments accumulated on the trench bottom or on the backfill slope shall be removed.

3.03 BACKFILL

A. Backfill material shall be mixed and blended in mechanical blenders, by windrowing, disk harrowing, blading or other means approved by Ameren. Mixing or blending shall be performed so as to produce a homogeneous mixture with the required gradation. The backfill material shall be free of large lumps, pockets of fines, sand or gravel. Occasional lumps up to 6 inches in the largest dimension may be permitted. Just prior to placement of the backfill material, the slump shall be 3 to 6 inches. The materials shall be sluiced with slurry during blending; sluicing with water will not be permitted.

B. The backfill shall be placed continuously from the beginning of the trench, in the direction of the excavation, to the end of the trench. The distance from the toe of the advancing cut slope to the toe of the backfill slope shall not be less than 50 feet or as required to permit proper cleaning of the trench bottom and to permit inspection and soundings. The surface of the backfill below the slurry shall follow a constant slope such that pockets of slurry shall not be trapped during backfilling. Backfill materials shall not be allowed to free-fall through the slurry. Initial placement of the backfill shall be by excavator bucket or clamshell starting at the bottom of the trench until the surface of the backfill rises above the surface of the slurry. Subsequently, the backfill may be placed by sliding down the forward slope of the previously placed backfill. The backfill material shall not be transported, dropped or deposited in any manner that may cause segregation.

3.04 CAP OF SLURRY TRENCH WALL

A. The approved cap shall be placed on the slurry trench wall by the contractor upon testing and acceptance of the completed backfill and before the backfill material can dry below its liquid limit. The Contractor shall maintain the trench and repair ruts or settlement that may occur during construction of the Work.

3.05 CLEAN UP

A. After completion of the backfill, the Contractor shall spread and level all remaining excavated material adjacent to the trench and clean the work site. Any slurry shall be removed by the Contractor in a manner approved by Ameren, and the surface and the site area shall be cleaned and leveled. No slurry shall be left in ponds, and mixing and handling ponds shall be pumped dry and shall be backfilled and appropriately cleaned.

END OF SECTION 02200

Ameren MISSOURI

APPENDIX AA
CEC Site Investigation Report September 2014

Collection of References Cited For Specification

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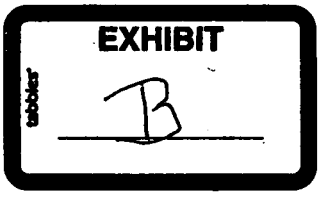


A) HAYWARD BAKER – SAMPLE SPECIFICATIONS FOR CUTOFF WALLS

Sample specifications should always be tailored to site specific conditions and design intent. Verification testing of work should be focused on quality aspects most important to satisfying the design. Hayward Baker Inc. makes no representation or warranty as to the applicability of this specification to a particular design or use and shall not be liable for the use of this draft specification, whether in whole or in part.

SAMPLE SPECIFICATIONS FOR VIBRO CONCRETE COLUMNS

PART 1 GENERAL

1.01 INTRODUCTION

A. Vibro Concrete Columns (VCCs) are constructed in the ground with a bottom feed vibroflot. Backfilling with concrete via tremie pipe during the vibro compaction process creates a concrete column while densifying the surrounding soils. The bottom of the column is bulbous to enhance bearing capacity.

B. Applicable soil types: VCCs are ideal for weak alluvial soils such as peats and soft clays overlying competent founding stratum such as sands and gravels, soft rocks etc.

C. Applications: Reduction of foundation settlement, improvement of bearing capacity, slope stabilization, economical piling alternative.

1.02 INTENT

The intent of the VCCs specified herein is to provide ..... within the limits indicated on the project drawings to achieve the degree of improvement required to meet the performance criteria in Section 1.08of these specifications.

1.03 STANDARDS AND REFERENCES

A. The most recent version of the following testing method(s) may be employed:

1. Full-scale Load Testing (individual column, or column groups) D1194 modified for size.
2.

B. Reference documents as provided to the VCC Contractor shall include:

1. This specification.

2. Project drawings:

a. Engineer's foundation plan, drawing no.....

b. Engineer's existing underground utilities plan in the work area.

3. Project geotechnical report.

4. Contract documents.

C. **British Standards and Other Codes of Practice**: All materials and workmanship shall be in accordance with the appropriate British Standards, codes of practice and other approved standards current at the date of tender except where the requirements of these standards or codes of practice are in conflict with this Specification in which case the requirements of this Specification shall take precedence.

1.04 DEFINITIONS

A. ***Field Quality Control Representative*** **(FQCR):** The individual given specific inspection tasks identified in this specification.

B. ***Bottom Feed Method:*** This method maintains hole stability by utilizing a depth vibroflot that has a tremie pipe attachment. Concrete is placed in the hole as the surrounding soil is densified in 6 to 12-inch lifts.

1.05 SCOPE OF WORK

A. The work shall consist of installation, monitoring and testing of the VCCs within the limits indicated on (.....) drawing no.....to meet the acceptance criteria presented in Section 3.02 of these specifications.

B. In connection with the VCC program, as shown on the drawings, the VCC Contractor shall provide all labor, materials, and equipment to accomplish the following items of work:

1. Predrilling of holes as necessary, and disposal/stockpiling of all spoil.
2. Construction of the VCCs to the lines and grades on the construction drawing.
3. All quality control inspections and tests, including load tests.

C. It shall be the VCC Contractor's responsibility to determine and implement the systems and criteria to ensure that the specified performance is achieved.

1.06 SUBMITTALS

A. The following shall be submitted to the Owner's representative by the VCC Contractor *with the bid documents:*

1. A list of at least five previously completed projects of similar scope and purpose for approval by the Owner's representative. The list shall include a description of the project, relative size, and contact person with phone number.

B. The following shall be submitted to the Owner's representative by the VCC Contractor three weeks *prior to the start of the work:*

1. Resumes of the management, supervisory, and key personnel, for approval by the Owner's representative.
2. A ground improvement design that demonstrates specified tolerances are achieved, if the design is the VCC Contractor's responsibility.
3. A ground improvement QC plan, as detailed in section 3.03 of these specifications.
4. Work procedures and control criteria.
5. A shop drawing for review, indicating the spacing, location, and depth of the VCCs to achieve the criteria outlined in this specification.
6. Load test detail and setup that represents actual loading conditions. This should include a load test footing having the dimensions and loading of the project's typical footing.
7. A schedule of work tasks and time for completion.

C. The following shall be submitted to the Owner's representative by the VCC Contractor *during the work:*

1. Accurate daily records that include VCC number, start/finish time of the VCC, depth of treatment, backfill quantities, and imparted densification energy.

2. Any change in the predetermined VCC program necessitated by a change in the subsurface conditions.

D. The following shall be submitted to the Owner's representative by the VCC Contractor *after the work:*

1. A report documenting the observations and results of the tests. This report will certify that the bearing pressure has been achieved within settlement tolerances.

1.07 QUALIFIED CONTRACTORS

A. The VCC Contractor shall be pre-qualified before bidding on this work. Pre-qualified contractors are:

1. Hayward Baker Inc.

2.

1.08 PERFORMANCE CRITERIA

1. Construct appropriate VCCs beneath all column foundations and load-bearing wall foundations to provide the following criteria upon successful completion of each:

   a. An allowable soil bearing capacity of _____ pounds per square foot (psf) with a maximum total settlement of _____ inches.

2. The VCCs should be constructed to a depth sufficient to satisfy the settlement criteria above, as confirmed by full-scale load testing of a loaded area (_' x _' in plan dimensions).

1.09 QUALITY ASSURANCE

A. The VCC program shall be performed by a specialist VCC Contractor with at least five continuous years of documented experience in VCCs.

B. The VCC Contractor shall provide experienced management, supervisory and key personnel as required to implement the VCC program, as follows:

1. The Project Manager shall have at least five years of continuous experience in VCCs, with at least the last two years in the full-time employment of the VCC Contractor.

2. The superintendent shall have at least two years of experience in VCCs.

3. As detailed in Section 1.06 of these specifications, the VCC Contractor shall provide:

   a. Evidence of previous VCC project experience.

   b. Evidence of management, supervisory and key personnel experience.

C. The Owner's representative will ensure that procedures and documentation conform to these specifications.

PART 2 EQUIPMENT AND MATERIALS

2.01 EQUIPMENT

A. Vibrocat

1. The purpose-built Vibrocat rig is stabilized by hydraulic outriggers and the guide leaders positioned for verticality/tremie system is connected to a powerful mobile concrete pump.

B. Vibroflot

1. A vibroflot is a vibro probe producing horizontal vibrations from an energy source located near the tip of the probe. The VCC Contractor shall use an electric vibroflot capable of providing at least ___ HP of rated energy and a centrifugal force of ___ tons. An appropriate metering device should be provided at such a location that inspection of amperage increase may be verified during the operation of the equipment. The metering device may be an ammeter directly indicating the performance of the vibroflot tip of the eccentric. Complete equipment specifications should be submitted to the Engineer prior to commencement of the fieldwork.

2.02 MATERIALS and MATERIAL PREPARATIONS

The VCC Contractor shall produce evidence that backfill material to be used meets or exceeds the design requirements.

A. **Cement:** Cement shall be ordinary Portland, sulphate-resisting Portland, Portland blast furnace cement or rapid-hardening Portland cement unless otherwise specified or approved. High alumina cement shall not be used.

B. **Cement Replacement Materials**: The use of cement replacement materials will be permitted subject to the approval of the Engineer and provided that they can be shown to have beneficial effects on concrete impermeability, heat generation during setting and general durability. The mix proportions of use shall be approved.

1. **Storage of Cement and Cement Replacement Materials:** All cement and cement replacement materials shall be stored in separate containers according to type in waterproof stores or silos.

C. **Aggregates:** Aggregates shall consist of approved naturally occurring material unless otherwise specified or ordered. The Contractor shall inform the Engineer of the source of supply of the aggregates before the commencement of work and, at the request of the Engineer, provide evidence regarding their properties and consistency.

1. The total equivalent anhydrous sodium chloride content of the mix used in steel reinforced concrete, whether arising from aggregates, water, admixtures or any other source, shall not exceed 0.5% of the mass of cement used (inclusive of any cement replacement material) where the cement is in accordance with BS 12, BS 146, BS 1370 or BS 4246 (0.3% chloride ion content is equivalent). Where sulphate-resisting Portland cement to BS 4027 is used, the permitted chloride content shall be reduced to half the amount stated above.

2. **Storage of Aggregates**: All aggregates brought to the site shall be kept free from deleterious matter. Aggregate of different types and sizes shall be stored separately in different hoppers or different stockpiles.

D. **Water:** If water for the Works is not available from a public supply, approval shall be obtained regarding the source of water.

1. **Tests:** When required by the Engineer, the Contractor shall arrange for tests of the water for the work to be carried out in accordance with BS 3148 before and during the progress of the work.

E. **Admixtures:** Admixtures complying with BS 5075 may be used if approved and shall be used as and when required. No admixtures will be permitted which contain more than the equivalent of 0.02% of anhydrous calcium chloride by weight of the cement in the final mix.

F. **Concrete Mixtures**

1. Concrete mixtures shall be in accordance with Paragraph 2.02A1 (Designed Mix) or Paragraph 2.02A2 (Prescribed Mix) and or Grades 20, 25 or 30 of BS 5328 or other grades approved appropriate to the work. Grades of concrete shall be denoted by the characteristic 28 day test cube strength in new tons per square millimeter. The free alkali content of the concrete mix shall be calculated from the Formula A = Ca/100, where A is the alkali content of Portland cement content (%). The latter percentage is to be the declared monthly mean alkali content +0.1%. Where low alkali sulphate-resisting cement to BS 4027 is specified, the alkali content (equivalent sodium oxide) of the cement shall not exceed 0.6% by weight. The VCC Contractor shall submit the slump factor before work commences. Neither trial mixes nor strength tests are required to prescribed mixes. The concrete shall have sufficient workability to enable it to be placed and compacted by the methods used in forming the columns.

2. **Designed Mix**: When a designed mix is specified, the VCC Contractor shall be responsible for selecting the mix proportions to achieve the required strength and workability, but the Engineer will be responsible for specifying the minimum cement content and any other properties required to ensure durability. Designed mixes shall be in accordance with Grades 20, 25 or 30 of BS 5328. Other grades may be approved if appropriate to the work. Complete information on the mix and sources of aggregate for each grade of concrete and the water/cement ratio and the proposed degree of workability shall be approved before work commences.

3. **Prescribed Mix**: When a prescribed mix is specified, the Engineer will specify the mix proportions and the Contractor shall undertake to provide a properly mixed concrete containing the constituents in the specified proportions.

4. **Durability**: For columns exposed to potentially aggressive ground or groundwater, approved measures shall be taken to ensure durability. Reference should be made to Building Research Establishment Digest 363 relating to sulphate attack.

5. **Minimum Cement Content**: The cement content in any mix shall be not less than 300 kg/m^3. Where concrete is to be placed underwater the cement content shall be not less than 340 kg/m^3, or where the column will be exposed to seawater 400 kg/m^3.

6. **Target Slump**: The concrete mix shall have a target slump of 60mm unless otherwise approved.

G. **Trial Mixes**

1. **General**: When designed mixes are specified, trial mixes shall be prepared for each grade of concrete in accordance with BS 1881, unless there are existing data acceptable to the Engineer showing that the proposed mix proportions and manufacture will produce a concrete of the strength and quality required, having adequate workability for compaction by the method to be used in placing.

2. **Preliminary Trial Mixes**: When required in accordance with Clause 2.02G1, the Contractor shall, before the commencement of the concreting, preferably under full-scale production conditions or, if this is not possible, in an approved laboratory, use a sufficient number of samples to be representative of the aggregates and cement to be used. Unless otherwise approved, for each grade of concrete a set of eight cubes shall be made from two batches. From each set of eight cubes, four shall be tested at an age of 7 days and four at 28 days. When accelerated testing is proposed for works cubes, an additional four cubes from each batch shall be made, cured and tested in accordance with the accelerated regime.

3. **Trial Mixes During the Work**: Where a trial mix is required after commencement of the Work, the procedure in Clause 2.02G2 shall be adopted for full-scale production conditions as approved. The strength requirement shall be as in Clause 2.02F2.

4. **Workability**: The workability of each batch of the trial mixes shall be determined by the slump test as described in BS 1881 or by an alternative approved method.

5. **Standard of Acceptance**: Unless other acceptance criteria are specified or approved, the trial mix proportions will be regarded as satisfactory if the compliance requirements of BS 5328 are met in relation to characteristic strength.

6. **Variations in Approved Mix**: When a mix has been approved, no variations shall be made in the proportions, the original source of the cement and aggregates, or their type, size or grading zone without the consent of the Engineer. Further tests may be required before any such variations are approved.

H. Batching Concrete

1. **General**: Facilities shall be provided for the Engineer to inspect the concrete mixing plant or plants when requested. Unless otherwise specified the requirements in Clauses 2.02H2, 2.02H3 and 2.02H4 shall be met.

2. **Accuracy of Weighing and Measuring Equipment**: The weighing and water-dispensing mechanisms shall be maintained at all times to within the limits of accuracy described in BS 1305.

3. **Tolerance in Weights**: The weights of the quantities of each size of aggregate and of cement shall be within 2% of the respective weights per batch after due allowance has been made for the presence of free water in the aggregates, which shall be determined by the VCC Contractor by an approved method.

4. **Moisture Content of Aggregates**: The moisture content of aggregates shall be measured immediately before mixing and as frequently thereafter as is necessary to maintain consistency of mix.

I. Mixing Concrete

1. **Type of Mixer**: The mixer shall be of the batch type, unless otherwise approved, and shall have been manufactured in accordance with BS 1305 or as shown by tests in accordance with BS 3963 to have mixing performance within the limits of Table 6 of BS 1305.

2. **Tolerance of Mixer Blades**: The mixing blades of pan mixers shall be maintained within the tolerances specified by the manufacturers of the mixers, and the blades shall be replaced when it is no longer possible to maintain the tolerances by adjustment.

3. **Cleaning of Mixers**: Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before another batch of concrete is mixed. Unless otherwise stated by the Engineer, the first batch of concrete through a mixer shall contain the normal batch quantity of cement and sand, but only two thirds of the normal quantity of coarse aggregate. Mixing plant shall be cleaned thoroughly between the mixing of different types of cement.

4. **Minimum Temperature**: The temperature of fresh concrete shall not be allowed to fall below ____F. No frozen material or materials containing ice shall be used. In cold weather when the ambient air temperature is less than ____F, the heads of newly cast columns are to be covered to protect them against freezing unless the final cut off level is at least ___ inches below the final head level as cast. Where a column is cast in frozen ground appropriate precautions shall be taken to protect any section of the column in contact with the frozen soil where this occurs below the cut off level.

J. Transporting Concrete

1. **Method of Transporting**: Concrete shall be transported in uncontaminated watertight containers in such a manner that loss of material and segregation are prevented.

K. Ready-mix Concrete

1. **Conditions of Use**: Subject to approval the VCC Contractor may use ready-mixed concrete in accordance with BS 5328. Approval shall be obtained for each proposed use of ready-mixed concrete in different sections of the Works and for each different mix, which shall comply with this Specification.

2. **Mixing Plant**: Unless otherwise agreed by the Engineer, truck mixer units and their mixing and discharge performance shall comply with the requirements of BS 4251.

PART 3 EXECUTION

3.01 SITE INSPECTION

A. If an adjacent building is within ___ ft of the VCC work area, a relevant building examination shall be performed prior to initiating work. The building must also be monitored during any work within ___ ft of the structure. The work shall be stopped and the engineer notified if any building settlement is observed.

3.02 VIBRO CONCRETE COLUMN INSTALLATION

A. VCC installation process shall be performed as such:

1. The tremie pipe shall be charged with concrete prior to penetration, sealing it against ingress of water and soil until concrete placing begins. Care shall be taken to ensure that the vibroflot is lifted only sufficiently to initiate the flow of concrete, and water inflow and soil movement at the base of the vibroflot are minimized. The technique and equipment used to initiate and maintain the concrete flow shall be such that a column of the full specified cross-section is obtained from the maximum depth to the final cut off level.

2. The vibroflot then penetrates the soil until design depth is reached. If the founding layer is granular, it is further compacted by the vibroflot. The founding layer, if granular, is further compacted by the vibroflot. Concrete is pumped out from the base of the vibroflot at positive pressure. After raising the vibroflot ___ feet, it is then lowered back into the concrete shaft. The shaft is displaced into a bulbous form until a predetermined resistance is achieved.

3. The vibroflot is then withdrawn at a controlled rate whilst concrete continues to be pumped out at positive pressure.

   a. The concrete shall be supplied to the column at a sufficient rate during vibroflot withdrawal to ensure that a continuous monolithic shaft of the full specified cross-section is formed, free from debris or any segregated concrete.

   b. The rate of withdrawal of the vibroflot and pressures of concrete shall be measured and recorded throughout the phase of vibroflot withdrawal for each column. The VCC Contractor shall submit proposals for his method of monitoring construction for approval prior to the commencement of the work.

4. After complete installation, the columns are trimmed and reinforcement is placed as necessary to fulfill design requirements. When cutting off and trimming columns to the specified cut off level, the VCC Contractor shall take care to avoid shattering or otherwise

damaging the rest of the column. Any latent, contaminated, cracked or defective concrete shall be cut away and the column made good in an approved manner to provide a full and sound section up to the cut off level.

5. An enlarged head is formed by reintroducing the vibroflot into the top of the finished column while maintaining a concrete flow.

B. Penetration

1. **Penetration Near Recently Cast Columns**: Columns shall not be advanced so close to other columns which have recently been cast and which contain workable or unset concrete that a flow of concrete could be induced from or damage caused to any of the columns.

2. **Removal of Vibroflots from the Ground**: Vibroflots shall not be extracted from the ground during the penetration or construction of a column in such a way that an open unsupported void or inflow of water into the column section would result.

3. **Depth of Columns**: Any failure of a column to reach the required depth, as given in the Particular Specification or shown on the Drawings, shall be reported to the Engineer without delay and a full statement of the reasons given.

3.03 FIELD QUALITY CONTROL

A. Inspections

1. All VCC operations shall be performed under the inspection of the FQCR.

2. Monitoring and logging of VCC operations for both test areas and production work shall be done by the FQCR.

3. The FQCR will provide site inspection to insure performance of the VCC work. This inspection may include the following: observance of the VCC Contractor's procedures, recording of backfill quantities, and recording of compaction energy information.

4. A sample of the concrete backfill material shall be submitted to the Engineer for analysis to establish the suitability, the cost of which will be borne by the owner.

5. The Owner/General Contractor shall ensure that the footing base is compacted and firm prior to the construction of the footing.

B. Load Testing

The effectiveness of the VCCs will be verified as follows:

1. Testing to determine specification compliance will be provided by the VCC Contractor, and will consist of a Static Load Test.

2. The load test shall be performed at an actual foundation location or a sacrificial location chosen by the Engineer. The test foundation to be tested should be similar in size to the specific project foundation size. The load test foundation shall measure ____ ft by ____ ft in plan dimension.

3. The load test shall be erected and performed by the VCC Contractor at the _____'s expense. The Owner shall pay for all costs associated with monitoring of the test by the Engineer.

4. The load test shall be performed in general accordance with ASTM D-1194 procedures as modified herein. The test foundation shall be loaded to ____ psf, which is 150 percent of the design load. Settlements of the test foundation shall be measured midway between the center

of the footing and each of the four corners. The average of the four readings shall be used to confirm that the required settlement criteria has been satisfied. The VCC Contractor shall submit load test detail and setup.

C. **Production Concrete Testing**

1. **Sampling**: Concrete for the columns shall be sampled in accordance with BS 1881.

2. **Workability**: The workability of concrete shall be determined by the slump test as described in BS 1881 or by an alternative approved method.

3. **Works Cube Tests**: For each grade of concrete four cubes shall be made from a single batch when required for 50 m^3 of concrete or part thereof in each day's work. The cubes shall be made, cured and tested in accordance with BS 1881 or as otherwise approved. Testing shall be carried out by an independent and approved laboratory. One cube shall be tested at an age of 7 days, two at 28 days, and one cube shall be held in reserve for further testing, if required. Alternatively, cubes may be tested in accordance with an approved accelerated testing regime. The VCC Contractor shall submit certified copies of the results of all tests to the Engineer.

4. **Standard of Acceptance**: The standard of acceptance of sample cubes shall be in accordance with BS 5328 or as otherwise approved. Where the Contract is a small one and of short duration (less than 28 days) the VCC Contractor shall submit for approval an alternate standard of acceptance before the commencement of work.

5. **Record of Tests**: The Contractor shall keep a detailed record of the results of all tests on concrete and concrete materials. Each test shall be clearly identified with the columns to which it relates.

3.05 RESTRICTIONS

A. VCC construction is typically performed under the site permit. The Owner *or* General Contractor shall be responsible for obtaining any state and local permits (if required) and conforming to all state and local regulations.

B. The Owner will be responsible for the precise delineation of all above and below ground utilities and obstructions.

C. The following shall also be listed within this section when applicable:

1. Environmental restrictions.

2. Work boundaries.

3. Hours for construction.

3.06 FOOTING SUBGRADE PREPARATION (by others)

A. The footing base shall be free of all water and compacted prior to placement of any reinforcement. Compaction can be by any heavy tamping type compaction equipment designed for compaction in small spaces. Reinforcement and concrete placement shall be placed in a timely manner so that no degradation of the bearing surface occurs.

PART 4 PAYMENT

4.01 METHOD OF PAYMENT

A. Mobilization and demobilization shall be a separate lump sum item.

B. Design and construction of the VCCs shall be a separate lump sum.

C. Load testing may be priced as a lump sum or unit price based on the VCCs specified.

B) IDEM – ENGINEERING CONTROL: SLURRY WALLS

TECHNICAL GUIDANCE DOCUMENT

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

ENGINEERING CONTROL: SLURRY WALLS

Office of Land Quality

(317) 232-8941 • (800) 451-6027 www.idem.IN.gov 100 N Senate Ave., Indianapolis, IN 46204

Guidance Created: October 12, 2010
Guidance Updated: April 1, 2013

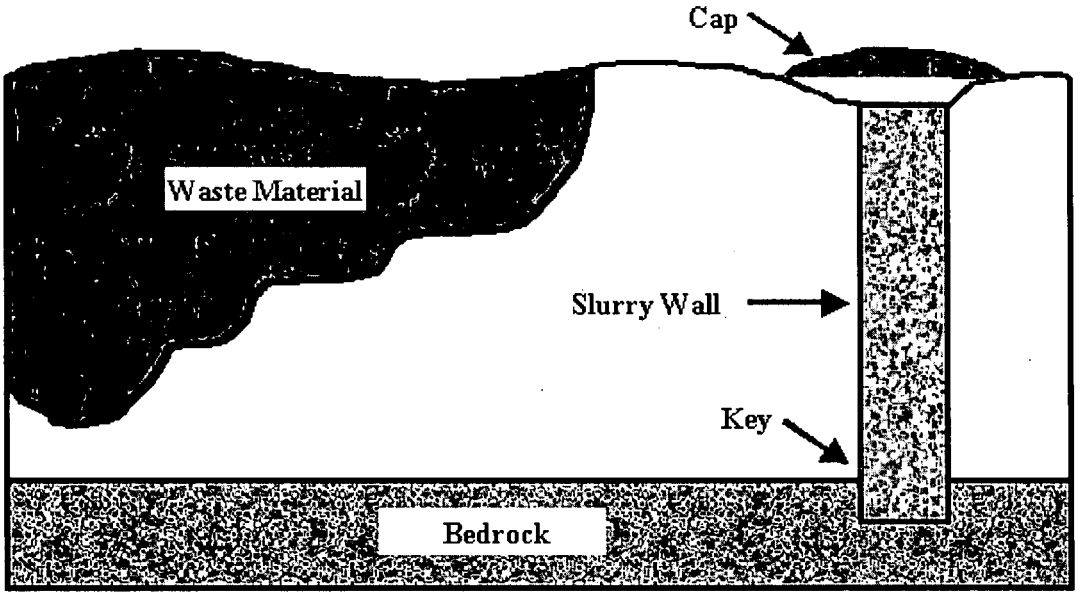
1.0 Purpose, Scope and Applicability:

This guidance provides basic design specification, operation and maintenance guidelines for containment slurry walls. Slurry walls are used as an engineering control to prevent groundwater and non-aqueous phase liquids (NAPL) migration and/or maintain separation between contaminated and uncontaminated groundwater regimes. This guidance does not intend to provide comprehensive instruction or direction on remedy selection, site-wide feasibility assessment, exposure, or risk assessment.

2.0 Table of Contents

3.0 Introduction:

Slurry walls have been used to contain contaminated groundwater for decades. They can be a cost effective remedial measure in appropriate circumstances. Containment slurry walls operate by creating an impermeable barrier between contaminated and uncontaminated groundwater with groundwater gradient control inside the slurry wall. Slurry walls are implemented in conjunction with a groundwater pumping system to collect contaminated groundwater and also with an low permeability cap on top of the slurry wall to eliminate infiltration into the wall. The following sections provide an overview of the types and methods of slurry wall construction, applicable performance specifications, and operation and maintenance requirements.



Picture from http://www.frtr.gov/matrix2/section4/D01-4-53.html . The slurry wall key must be either into bedrock or a layer of appropriately low permeability.

4.0 Design and Installation:

Slurry wall designs should be submitted by a Professional Engineer. Basic slurry wall installation consists of excavating a vertical walled trench which is subsequently backfilled with a low permeability material. The success of slurry walls as a remedial measure depends on selecting appropriate location, excavation and installation methods, slurry type and backfill specifications, key into an impermeable layer and accompanying measures such as impermeable covers and groundwater management plans. The decision to choose a slurry wall as a remedial measure should consider the continuing obligation to replace or propose a new remedy at the end of the slurry wall design life.

Location:

A low permeability slurry barrier may be upgradient of, downgradient of or completely encircle (circumferential slurry wall) contamination. Circumferential walls with a cap over the entire contaminated area are the most expensive but offer the most complete containment and result in greatly reduced leachate generation over the lifetime of the wall. Upgradient walls are somewhat uncommon and serve to divert water around contamination; they are most common in sites with steep groundwater gradients where collection would be prohibitively expensive. Downgradient slurry walls provide a means to capture contamination for treatment. Safety considerations such as trench stability, existing utilities and the need to avoid undermining nearby structure foundations must be considered when choosing a location also.

Excavation methods:

Drilling Mud:

The most popular method of installing slurry walls is to dig a trench which is immediately filled with bentonite slurry (drilling mud) to support the excavation; the slurry is subsequently displaced with backfill which is more dense than the slurry. The bentonite in the slurry mix forms a thin layer commonly called the filter cake on the trench walls due to its thixotropic properties. The filtercake has three primary functions:

1. The filtercake inhibits slurry loss from seeping through the trench walls and groundwater from entering the trench due to the low hydraulic conductivity of the filtercake;
2. The filtercake forms a vertical plane for the slurry to exert hydraulic force on the trench walls thereby keeping the trench open until backfill can be placed;
3. The filtercake stabilizes soil particles on the trench sidewall keeping them in place.

The trenches are usually dug with a hydraulic excavator. Clamshell diggers are necessary for deeper (greater than approximately 80 ft) installations. Typically, trenches built using this method are 3 ft wide.

Vibrating beam:

A second method of excavation is via a vibrated steel beam attached to a pile driver. The beam is vibrated along the slurry wall line forming a trench which is the width of the beam, typically 10 inches wide. The trench is filled with slurry as the beam is pulled out. Vibrating beams can only be installed when depth and geology allow the vibrating beam to operate without being structurally damaged.

Backfill materials:

The composition of the completed slurry wall is determined by the backfill. Backfill is usually a mixture of excavated soil, dry bentonite and bentonite slurry which forms an impervious barrier. Backfill material is generally mixed on site adjacent to the trench with earthmoving equipment until homogeneous.

In general, the soil fines content and bentonite content are the most important factors in determining the final performance of the slurry wall. Soil Bentonite (SB) backfill generally needs at least 15-20% soil fines content. A slump test is strongly recommended (ASTM D143) as a performance standardization measure. Total bentonite content by weight will determine the final permeability of the wall. Total bentonite content is from the bentonite in the original slurry, bentonite in the backfill and dry bentonite added directly. Typically, slurry bentonite concentrations are 5-7%, dry bentonite added is 0-3% and backfill bentonite contents is largely dependent on the accompanying soil specifications and whether any amendments such as cement are added. Hydraulic conductivity ASTM 5084 is usually used to assess the hydraulic conductivity of the placed backfill.

Keying:

At slurry wall base:

A primary determining aspect of any slurry wall is the 'key' into an impermeable (hydraulic conductivity $<10^{-7}$ cm/s) layer. Generally the key extends 2-3 ft into the impermeable layer. A 'hanging wall' is not keyed in but is completed several feet into the lowest water table level and can be used to control floating contaminants.

Circumferential:

If a slurry wall is to completely encircle contamination, the final section will have to be keyed into a previously backfilled section to close the loop. The standard method is to dig through the previously placed backfill creating an overlap which should be at least 5 ft long. The thixotropic nature of bentonite allows it to be agitated and then reset without degrading the performance of the completed wall.

Amendments:

If structural strength is required, backfill amendments such as Portland cement may be necessary to obtain the required compressive strength. Soil Bentonite walls (SB) have a lower hydraulic conductivity and generally cost less than cement bentonite (CB) walls. Structural strength is generally specified using a 7 day unconfined strength test. Cement mixtures are generally used as the slurry and then allowed to harden eliminating the backfilling step. CB walls require more carefully timed construction methods from SB walls. Cement begins to harden after 2-3 hours; continued agitation after 24 hours inhibits the cement from setting. CB walls are sometimes constructed as a series of panels in which alternate panels are constructed under slurry and allowed to partially set before the remaining panels are trenched using the same method. The caveat to this construction method is the possibility of hydraulic leaking at the point where the panels are joined.

Chemical compatibility

Certain chemicals may degrade the wall over time such that even if it meets specifications originally, over time its integrity may erode. In particular, pure xylene and methanol have been reported to increase slurry wall conductivity two to three orders of magnitude. Chemical compatibility must be investigated before a slurry wall is chosen as a containment method. This is also an added reason that long term monitoring is necessary even if the original wall meets conductivity specifications.

CAP

The slurry wall design must include a CAP covering the surface of the slurry wall at a minimum to prevent surface infiltration. Usually the top 1 to 3 ft of slurry wall is removed and an impermeable cover placed over it. A CAP covering all waste material may be required. See OLQ Engineering Control: Covers technical guidance document.

Groundwater Management:

A groundwater management plan should be submitted with any slurry wall corrective action plan. Even in the case of circumferential slurry walls, over time, groundwater can build up and need to be addressed. An appropriate groundwater monitoring well network

is required to show that the groundwater management plan is working. A one foot differential measured across the slurry wall is required to indicate an inward gradient is achieved.

5.0 Performance Specifications:

Most test methods for slurry construction were originated from the oil well drilling industry and specified by the American Petroleum Institute in their Standard Procedure for Field Testing Drilling Fluids (API RP 13B). ASTM has also developed corresponding specs for most of these methods.

Since the primary purpose of a slurry wall is to impede groundwater, the primary performance criteria should center on assuring impermeability of the completed wall by demonstrating both a low conductivity and a lack of leaks. However, interim specifications during construction of the slurry, backfill mixture and site conditions are usually required to help insure that the completed wall will be impermeable.

Interim Slurry/ Backfill & Construction Specifications:

Marsh Funnel Viscosity (API Code RP13B) test is used to determine the viscosity of the slurry. The typical specification is greater than 40 seconds. The viscosity of the mixture depends on the bentonite content, type of bentonite, the degree of hydration and water quality.

Density or Mud balance is generally at least 15lb/ft3 less than the density of the backfill. (API Code RP13B)

Filter Press is a test which measures water loss of a slurry under a pressure (usually 690kPa) and the thickness of the resulting filter cake. It is not particularly useful as an environmental specification as it does not give an indication of the performance of the completed wall. It is more an economic specification since a lower filtrate value would result in less loss through the trench walls of slurry wall construction materials resulting in a less expensive wall.

Visual Confirmation of the Key should be required every 100 feet to insure that the wall is properly keyed at least two feet into an impermeable layer. For vibrating beam installation, a boring must be taken in advance of installation and the appropriate depth of installation maintained. For traditional trench slurry walls, inspection of the excavation spoil from the trench bottom is required.

Completed Wall Monitoring and Performance Specifications.

Performance specifications for slurry walls involve assuring that the completed wall is of adequately low hydraulic conductivity and that the wall is keyed to an impermeable layer such that leakage does not occur. Hydraulic conductivity is generally determined by sampling the backfill using ASTM D5084. In situ testing of the completed wall is difficult. The only reliable method to assess the conductivity without degrading the structure of the wall is to create a substantial test cell and do a pump test. A pump test is both expensive and time consuming but may be appropriate at some sites.

Key integrity and hydraulic conductivity should both be assured over the lifetime of the wall with an appropriate monitoring well network. A monitoring well network is required as it is the only way to continually verify long term integrity of the wall. A series of appropriately screened wells approved by Geological Services must be sampled over the

lifetime of the wall. Wells screened at the key interval may be necessary depending on site conditions. An additional performance measure is gradient monitoring on both sides of the wall. An adequate performance specification is that a one foot inward gradient differential across the wall be maintained.

Both a long term groundwater monitoring program and the long term details of the O&M for the groundwater pumping system/ hydraulic head obligations (if required) should be planned and approved before this remedy is allowed. These plans should be documented within an enforceable mechanism such as an Environmentally Restrictive Covenant, Agreed Order or Permit.

Performance Specification				
Material	**Test Function**	**Test**	**Specification**	**Frequency**
Interim Construction Specifications				
Slurry in trench or fresh	Unit weight or mud balance	API Std 13b	1.03 -1.36gm/cm or specify amt less than backfill.	Twice per shift
Slurry in trench and fresh	Viscosity	API Code RP13B Marsh Funnel	>40 s @68F	Twice per shift
Final Specifications				
Backfill at Trench	Slump	**ASTM C143**	3-6 inches	Twice per shift
Backfill	Unit weight or mud balance	API Std 13b	15 pfc greater than slurry	Twice per shift
Backfill	Permeability	ASTM D 5084	$1x10^{-7}$ cm/sec. Different conductivity may be appropriate at some sites.	One sample per 400cy or other appropriate volume
Backfill (typically only for CB)	Compressive Strength	ASTMD 5102 7 day unconfined strength test.	70 psi for structural or per design specification	One sample per 400cy or other appropriate volume
Key into impermeable layer	Visual Confirmation of boring.	On site borehole confirmation that impermeable layer is being keyed into.	At least 2 ft tie in.	Every one hundred foot during installation.
Monitoring Well/ Piezometer Network	Biweekly sampling until compliance attained then quarterly moving to annually.		1 ft head differential across the wall. Lower differential may be appropriate at some sites.	MW installed every 400 ft.

6.0 Operation and Maintenance (O/M):

6.1 Maintenance Plan Submittal:

A plan for operation, maintenance, and monitoring should be submitted for review and approval for all sites proposing engineering controls, including slurry walls. The plan may be submitted as part of a work plan (i.e., corrective action plan, remediation work plan) or as a stand-alone document. This plan or portions of this plan can be referenced in a statutory enforcement document to serve as a primary mechanism for long term management of the slurry wall. An example O/M plan is included as Attachment 1.

Inspection and Maintenance Guidelines:

Materials	Design Life(Typical)	Inspection Frequency	Inspection Criteria	Maintenance Actions
Slurry Wall CAP	CAP Lifetime	As Scheduled (spring)	Pooling/ Puddles/ Discoloration	Fill depression/ Resurface / Regrade
			Erosion: Swales/ Gullies / Ripples	Fill depression/ Resurface / Regrade
Pumping System	System lifetime	Monthly inspection.		
Slurry Wall	Wall Lifetime	Annual	Insure wall is protected from breach by root penetration, degradation from traffic loading and cracking from desiccation.	Remove vegetation and eliminate traffic.
Monitoring Well/ Piezometer Network	Biweekly sampling until compliance attained then quarterly moving to annually.		1 ft head differential across the wall. Lower differential may be appropriate at some sites.	MW installed every 400 ft.

7.0 References:

American Petroleum Institute; 2003; API Recommended Practice for Field Testing Water-based Drilling Fluids 13B-1 Third Edition, December 2003 ANSI/API 13B-1/ISO 10414-1

EPA; 1984; Slurry Trench Construction for Pollution Migration Control EPA-540-84-001 available by searching at the EPA web site: http://www.epa.gov/nscep/

Indiana Department of Environmental Management, "Remediation Closure Guide", Non Rule Policy Document #0046-R1, http://www.in.gov/idem/6683.htm, March 22, 2012.

Ryan, C. and Spaulding, C; 2007; Vertical Groundwater Barriers for Contaminated site reclamation. Presented at the, "Proceedings of the 10th Australia New Zealand Conference on Geo-Mechanics, "Common Ground", Brisbane, Australia; Available at: http://www.geo-solutions.com/tech-papers/pdf/Brisbane-Conf-Vert-Barriers-10-07-Final-1.pdf

Ryan, C, PE; Day, S.; Soil Bentonite Slurry Wall Specifications. Geo Solutions White Paper available at: http://www.geo-solutions.com/tech-papers/pdf/TP-PANAM-SBSpecs03.pdf

Appendix 1:

EXAMPLE SLURRY WALL OPERATION AND MAINTENANCE PLAN

[DATE]

Property Located at:

[ACTIVITY ADDRESS]

[City, County]

[IDEM Program Area and Program ID]

Introduction

Instructions: This document is an example 'Operation and Maintenance Plan' for a slurry wall at the above-referenced property. Edit the template appropriately in the bracketed areas.

This Operation and Maintenance Plan has been prepared by [*insert name of preparer*] for the slurry wall remedy installed at the above-referenced site. It outlines the policies and procedures for the long-term maintenance and monitoring of the slurry wall on-site. The onsite contaminated [soil] [and/or] [groundwater plume] is impacted by [enter list of contaminant(s)]. The location of the slurry wall and accompanying pumping system and monitoring well network to be maintained in accordance with this plan, as well as the impacted [soil] [and] [groundwater plume] are identified in the attached map.

Cover Purpose

The slurry wall serves as a barrier to capture, contain, or divert groundwater contamination. Based on the current and future use of the property, the slurry wall should serve these functions unless disturbed or deteriorated.

Inspection/Monitoring Activities

The slurry wall as depicted in the map may be inspected [*insert proposed time frame* (annually, semi-annually, quarterly, etc.)] [in the months of [April or May] [insert other timeframe]]. The inspections may be performed to ensure that the slurry wall remains intact, settling is not occurring and that the wall is protected from breach by root penetration, degradation from traffic loading and cracking from desiccation. Any accompanying groundwater capture system may be inspected [*insert proposed time frame* (annually, semi-annually, quarterly, etc.)] [in the months of [April or May] [insert other timeframe]] to ensure that the system is functioning properly and that well vaults and pumps are operational. The monitoring well network may be inspected [*insert proposed time frame* (annually, semi-annually, quarterly, etc.)] [in the months of [April or May] [insert other timeframe]] to ensure that the monitoring well network is maintained; this inspection should be coordinated with the agreed upon sampling periods necessary to ensure that the agreed upon head differential is maintained across the wall. A log of the inspections and any repairs should be maintained by the property owner. The log may include recommendations for necessary repairs. Once repairs are completed, they may be

documented in the inspection log. The inspection log should be kept on site and made immediately available for review by the IDEM Office of Land Quality (OLQ), its successor, and/or other appropriate state agency.

Maintenance Activities

If problems are noted during the annual inspections or at any other time during the year, repairs may be scheduled as soon as practical. In the event that necessary maintenance activities expose underlying contaminated soil or groundwater, the owner should inform maintenance workers of the exposure hazard and provide them with appropriate personal protection equipment ("PPE"). The owner should also sample any soil or groundwater that is removed from the site prior to disposal to ascertain if contamination remains. The soil or groundwater should be treated, stored and disposed of by the owner in accordance with applicable local, state and federal law.

The property owner, in order to maintain the integrity of the slurry wall system, may maintain a copy of this Maintenance Plan on-site and make it available to all interested parties (i.e. on-site employees, contractors, future property owners, etc.) for viewing.

Amendment or Withdrawal of Maintenance Plan

This Maintenance Plan can be amended or withdrawn by the property owner and its successors with the written approval of the IDEM Office of Land Quality.

Contact information for person/persons responsible for implementing this plan.

[NAME]
[ADDRESS]
[PHONE #]

Site Owner and Operator:

[NAME]
[ADDRESS]
[PHONE #]

OLQ: [OLQ Program Area]
[ADDRESS]
[PHONE #]

Inspection / Maintenance Activity Log: The following table should be used to track and monitor maintenance activity to insure that remedial objectives continue to be met in the future. This table can be included in the proposed remedial action plan (or equivalent document).

Inspection Date	Inspector	Inspection Criteria	Maintenance Action Needed	Previous Maintenance Completed?

C) TECHNICAL SPECIFICATIONS
SOIL-BENTONITE SLURRY TRENCH CUTOFF WALL

TECHNICAL SPECIFICATIONS
SOIL-BENTONITE
SLURRY TRENCH CUTOFF WALL

(This technical specification is to be used to guide the writer in the contract requirements for Slurry Trench Cutoff Wall construction for a specific site. Included are_____ to be filled in with project specific data. Also included are [ ] which denote options to be considered for specific design requirements. Optional subsections are denoted by *. Parenthetic remarks ( ) are included when appropriate to provide the writer with additional, nonessential information. Most [ ] and * are used to include Slurry Trench Cutoff Wall designs which go beyond the standard design and may include addition of proprietary additives, injection of air for vapor phase extraction of organics. All [ ], ( ), and * should be filled in or omitted from the writer's specification.)

SCOPE OF WORK

This section of the specifications includes requirements for the Slurry Trench Cutoff Wall and related work as indicated on the drawings and as hereinafter specified. The work consists of furnishing all plant, labor, equipment and materials and of performing all operations as required to construct the slurry trench cutoff wall.

Reference Standards

Following is a list of standards that will be referenced in this specification. Such referenced standards shall be considered part of these specifications as if fully repeated herein.

REFERENCE	TITLE OR DESCRIPTION
API Spec 13A	API Specification for Oil-Well Drilling-Fluid Materials
API RP 13B	API Recommended Procedure for Field Testing Drilling Fluids
ASTM D 4380	Density
ASTM C 143	Test Method for Slump of Portland Cement Concrete
ASTM D 1140	Materials Finer than No. 200 Sieve in Mineral Aggregate by Washing

ASTM D 422	Particle Size Analysis of Soils
ASTM D 2216	Moisture Content Determination
ASTM D 4318	Liquid Limit, Plastic Limit and Plasticity Index of Soils
EM 100-2-1906 or ASTM D 5084	Permeability Testing

Abbreviations and Definitions

A. API - American Petroleum Institute

B. ASTM - American Society for Testing and Materials

C. EM - Engineering Manual of the Department of the Army, Corps of Engineers

D. Owner - The Owner as referred to herein is _____.

E. Owner's Representative - The Owner's Representative is _____ (or individuals) designated by the Owner to act on its behalf in the execution of these specifications.

F. Slurry Trench - A narrow vertical-walled trench of specified width excavated by the slurry trench method and backfilled with the specified materials to form a cutoff wall of permeability. The terms "Slurry Trench" and "Slurry Wall" will be used interchangeably in these specifications.

G. Slurry Trench Technique - A method of excavating a narrow vertical-walled trench using a specified slurry mixture to support the trench walls, form a filter cake on and in the trench walls, and prevent movement of groundwater into or through the excavated trench.

H. Water-Bentonite Slurry - A stable colloidal suspension of powdered bentonite in water. The terms "slurry" and "water-bentonite slurry" will be used interchangeably in these specifications.

I. Soil-Bentonite Slurry Backfill - A homogeneous mixture of specified soil material, bentonite and water. The terms "soil-bentonite slurry backfill" and "backfill" will be used interchangeably in these specifications.

J. Slurry Trench Specialist - An individual who has had proven and successful experience in slurry trench construction and is knowledgeable of: (1) the proper mixing methods employed to mix slurry and backfill; (2) the use, testing and control of bentonite as a slurry; (3) construction equipment; (4) excavation and backfill operations; and (5) testing for slurry trench quality control.

K. Working Platform - The working platform is the surface of compacted fill and/or excavated surface from which the slurry wall is constructed. The work platform is relatively level, stable and well drained with a specified minimum width and specified minimum clearance above the groundwater table.

QUALIFICATION OF CONTRACTOR

The Contractor shall submit evidence that he is experienced and competent to construct a soil-bentonite slurry trench. This evidence will insure that the Contractor will have sufficient competent experienced personnel to carry out the operations specified. In particular, a slurry trench specialist (as approved by the Engineer) shall supervise the construction, slurry preparation and quality control.

SLURRY TRENCH CUTOFF

An impervious slurry trench cutoff wall shall be constructed to the lines, grades and cross sections as indicated on the drawings. The trench shall have essentially vertical walls, a minimum width of _____ inches, and shall extend through the overburden and key a minimum depth of _____ ft into the aquiclude. A generalized description of the overburden through which the slurry trench cutoff is to be excavated is indicated by boring logs included in the drawings.

MATERIALS

Slurry

Slurry shall consist of a stable colloidal suspension of bentonite in water and shall be controlled in accordance with the most current API Standard 13B, "Standard Procedure for Testing Drilling Fluids," and the following requirements:

A. At the time of introduction of the slurry into the trench, the slurry shall be a mixture of not less than 18 pounds per barrel (42 gallons) of bentonite and water. Additional bentonite may be required depending on the hardness and temperature of the water and the quality of the bentonite. The slurry shall have a minimum apparent viscosity of 15 centipoise or 40 seconds reading through a Marsh Funnel Viscosimeter, and a maximum filtrate loss of 25 cubic centimeters in 30 minutes at 100 psi, and unit weight $\geq$ 64 pcf.

B. The slurry mixture in the trench shall have a unit weight not less than 64 pcf (1.03 gm/cc), not greater than 85 pcf (1.36/gm/cc), or as approved by the Engineer.

Bentonite

Bentonite used in preparing slurry shall be pulverized (powder or granular) premium grade sodium cation montmorillonite and shall meet the most current API Standard 13A "API

Specifications for Oil-Well Drilling-Fluid Materials."

Water

Fresh water, free of excessive amounts of deleterious substances that adversely affect the properties of the slurry shall be used to manufacturer bentonite slurry. It is the responsibility of the Contractor that the slurry resulting from the water shall always meet the standards of this Specification.

Additives

Admixtures of the type used in the control of oil-field drilling muds such as softening agents, dispersants, retarders or plugging or bridging agents may be added to the water or the slurry to permit efficient use of bentonite and proper workability of the slurry. However, no additives shall be used except as approved by the Engineer.

Backfill

The material for trench backfilling shall be composed of slurry and selected soils obtained from the designated borrow area or trench spoils. The soil shall be friable and free from roots, organic matter or other deleterious materials. The backfill shall be thoroughly mixed and reasonably well graded between the following gradation limits:

Screen Size (U.S. Standard)	Percent Passing By Dry Weight
No. 200	15% - 60%

(NOTE: Backfill design should accommodate, if possible, in-situ soils.)

EQUIPMENT

Trench Excavation

Excavation of the slurry trench cutoff wall shall be accomplished by use of any suitable earth-moving equipment or combination thereof such as a backhoe and/or clamshell so that the required width trench can be carried to its final depth of cut continuously along the trench line. Special chopping, chiseling or other suitable equipment may be used as necessary to satisfactorily accomplish the required excavation. The width of the excavating tool shall be equal to or greater than the specified width of the cutoff wall. Additional equipment such as air lift pumps and slurry desanders shall be used if required to clean the trench bottom and/or slurry in accordance with the requirements of the specification.

Slurry Batching Plant

The slurry batching plant shall include the necessary equipment including a mixer capable of producing a colloidal suspension of bentonite in water, pumps, valves, hoes, supply lines, and all other equipment as required to adequately supply slurry to the trench. Storage ponds may be provided (if needed) to store initially mixed slurry to allow hydration and to serve as a reserve in cases where substantial slurry loss from the trench through underlying previous zones or other reasons may occur. The slurry shall be agitated or recirculated in the storage ponds as required to maintain a homogeneous mix. All slurry for use in the trench shall be prepared using a suitable mixer. No slurry is to be made in the trench. Mixing of water and bentonite shall continue until bentonite particles are fully hydrated and the resulting slurry appears homogeneous.

Backfill Mixing and Placing

Equipment for mixing and placing backfill may consist of a suitable type of earthmoving or grading equipment, such as bulldozers, or blade graders, or blenders such as a pug mill. Equipment will be capable of thoroughly mixing the backfill materials into a homogeneous paste having the required gradation and properties and placing the material in the trench as hereinafter specified.

EXECUTION OF THE WORK

Slurry Trenching

Excavation shall be carried to final depth at the point where excavation is started and then the final depth of cut shall be carried along the line of the trench. Excavation shall proceed continuously from the starting point to the finishing point. Slurry shall be introduced into the trench at the same time trenching is begun and shall be maintained in the trench during excavation and until backfilled. The Contractor shall maintain the stability of the excavated trench at all times for its full depth. The level of the bentonite slurry shall always be maintained at least 2 ft above the local groundwater level and shall not be permitted to drop more than 3 ft below the surface of the slurry trench working platform except as approved by the Engineer. The Contractor shall have personnel, equipment and materials ready to raise the slurry level at any time. To this end, the Contractor shall have personnel on call to raise the slurry level.

Key

Unless otherwise directed, the bottom of the slurry trench will be keyed the minimum specified penetration into the underlying aquiclude beneath the site as indicated by soil borings. In the event that the backhoe or clamshell is unable to achieve the minimum specified penetration into weathered rock without the assistance of ripping teeth, blocks or percussion chisels, the minimum penetration requirements may be modified and the trench will extend to the depth where refusal of the excavating equipment is encountered. The final depth and penetration of the trench shall be measured and checked by the Contractor and approved by the Engineer immediately following excavation.

Cleaning Trench Bottom

The removal of undesirable sediments in the trench will be accomplished by the excavator. At the beginning of each shift (if necessary, i.e., soundings indicate buildup) and after each cut, the trench bottom will be scraped clean by adequate repeated passes of the excavator's bucket, horizontally across the trench.

The accumulation of sediments in the trench will be minimized by proper construction practices. The length of trench supported only by slurry shall be minimized. As much as possible, the toe of the backfill slope will be kept close to the face of the excavation. Soundings will be taken at regular intervals to determine if sediments are present. Any sediments accumulated on the trench bottom or on the backfill slope will be removed by the excavating tool or by flushing with clean slurry. Desanding will be used if other means are not successful in controlling the density of the slurry. Airlift cleaning will be used in extreme cases and then only after due consideration of the effect on the stability of the trench and the associated disposal problems are addressed.

Backfill Mixing

Backfill material shall be mixed and blended in mechanical blenders, by windrowing, disk harrowing, bulldozing, blading, or by other approved methods. Mixing and blending shall be performed in such a manner as to produce the required gradation of backfill. The backfill material shall be thoroughly mixed into a homogeneous mass, free from large lumps or pockets of fines, sand or gravel. Occasional lumps of up to 6 inches in their largest dimensions will be permitted. Just prior to placing, the backfill material shall have a slump of 3 to 6 inches. To this end, the materials shall be sluiced with slurry during blending operations. Sluicing with water will not be permitted.

Backfill Placement

The backfill shall be placed continuously from the beginning of the trench, in the direction of the excavation, to the end of the trench. The toe of the slope of the trench excavation shall precede the toe of the backfill slope so that the toe of the backfill shall not be less than 50 ft following the toe of the excavation, or as required to permit proper cleaning of the trench bottom and to permit inspection and measurement. Placing operations shall proceed in such fashion that the surface of the backfill below the slurry shall follow a reasonably smooth grade and shall not have hollows, which may trap pockets of slurry during subsequent backfilling. Free dropping of backfill material through the slurry will not be permitted. Initial backfill shall be placed by lead-in slope (1h:lv) or by lowering a clamshell bucket or backhoe to the bottom of the trench until the surface of the backfill rises above the surface of the slurry. Additional backfill may then be placed in such manner that the backfill enters the trench by sliding down the forward face of the previously placed backfill. To accomplish this, sufficient backfill shall be piled on the edge of the existing backfill to cause a slump and sliding action on the face of the in-place backfill. The backfill shall not be dropped or deposited in any manner that will cause segregation. An acceptable substitute for the initial placing of backfill by the use of a clamshell bucket, shall be to begin excavation at a point outside of the limits of work which will provide a sufficient distance for the backfill face to form (i.e., lead-in trench)

by pushing the backfill into the trench, before the toe of the backfill reaches the point where the cutoff is required.

TREATMENT FOR TOP OF CUTOFF TRENCH

Upon completion of backfill placement and before drying of the backfill can occur, the cutoff trench shall be capped in accordance with the details shown on the Drawings.

CLEAN-UP

After completion of the backfill and capping, all remaining excavated material and slurry shall be removed and the surface shall be cleaned and leveled as directed by the Engineer. Excess slurry shall be disposed of by spreading in thin layers on adjacent areas designated by the Engineer. No slurry shall be left in ponds, and all ponds shall be pumped dry and backfilled.

QUALITY CONTROL

The Contractor shall maintain his own quality control for the cutoff wall construction under the direction of a qualified Engineer. Testing requirements are summarized in Table 1 and specified herein.

Trench Continuity and Key

The Contractor shall be responsible for demonstrating to the satisfaction of the Engineer that the trench is continuous and keyed the minimum specified depth into the underlying aquidude. Trench continuity shall be assured by the action of movement of the trench excavation equipment such that the digging tools can be passed vertically from top to bottom of the trench as well as moved horizontally along the axis of the trench without encountering unexcavated material. Penetration of the bottom of the trench into the aquiclude shall be demonstrated by observation of the cuttings removed from the trench and by direct measurement of trench depth to the satisfaction of the Engineer.

Slurry and Backfill

A. Materials

- Bentonite: Certificate of Compliance with the specification shall be obtained from the material manufacturer.

- Backfill Mix: Backfill material shall be tested prior to placement in the trench by conducting tests to determine slump and gradation. Testing frequency will be as directed by the Engineer, and as shown in Table 1.

B. Slurry Introduced in the Trench

A complete series of tests shall be conducted from the mixer or pond containing slurry ready for introduction in the trench at least twice per shift or each time a pond is prepared. The tests shall include:

- Unit weight of the slurry
- Filtrate loss of the slurry
- Viscosity of the slurry
- pH of the slurry

C. Slurry in the Trench

Slurry in the trench shall be tested at least twice per shift. Samples shall be obtained from near the bottom of the trench near the point of trenching and tested for unit weight.

Documentation

Results of all tests performed in accordance with the specification will be recorded on forms acceptable to the Engineer and signed by the Contractor's Project Engineer. These forms will be available to the Engineer at all times for his inspection. Copies of all forms will be submitted daily to the Engineer for his reference.

Work Plan

The Contractor shall submit a detailed operating plan regarding proposed construction procedures and schedules. This shall include, but not be limited to, the Contractor's plan for:

A. Coordinating the construction, maintenance and removal of working platforms, mixing pads, and haul roads with the Owner

B. Site set-up

C. Material and equipment storage

D. Water-bentonite slurry mixing, transportation and recirculation

E. Chemical analysis and supply of water

F. Control of drainage, spills, wastes, etc.

G. Quality control

H. Clean-up

Submittals

In addition, the following specific information shall be submitted prior to the start of slurry wall construction:

A. Soil-bentonite slurry mix design and trial mix reports, including mix proportions, density, moisture content, gradations, and hydraulic conductivity shall be performed.

B. Specifications of the batch plant and layouts showing locations of equipment, ponds, tanks, pumps, valves, hoses and supply lines.

C. Source of all imported material, including bentonite. Shipment of materials to the site shall be accompanied by the shipper's written verification of the quality or specification of the material, a copy of which shall be retained by the Contractor.

D. Certification of bentonite quality, showing compliance with API Standard 13A.

E. Certification of quality of any admixture.

Upon completion, the Contractor shall submit the results of the quality control testing referenced elsewhere in these specifications.

D) GEO-SOLUTIONS – SOIL BENTONITE SLURRY WALL SPECIFICATIONS

Soil-Bentonite Slurry Wall Specifications
Especificaciones para Muros Colados de Suelo-Bentonita

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Abstract

Specifications for the construction of Soil-Bentonite slurry walls have been developing for over 30 years. In this paper, the elements of good specifications and recommended parameters are discussed. Recent new provisions in specifications and their potential contributions to the cost and/or quality of the finished product are evaluated. Examples include requirements for low slurry sand content, undisturbed backfill sampling, cleaning the backfill, and other recent additions to "standard" specifications. Recommendations are made as to the best methods for field sampling of the slurry trench backfill and testing for permeability in the field and laboratory.

Resumen

Las especificaciones para la construcción de muros colados de suelo-bentonita han estado desarrollándose por más de 30 años. En este artículo se discuten los elementos que hacen buenas especificaciones y los parámetros recomendados. Se evalúan nuevas cláusulas recientemente introducidas en especificaciones y su contribución potencial al costo y/o calidad del producto final. Los ejemplos incluyen requisitos para bajo contenido de arena en el lodo bentonítico, toma de muestras inalteradas del relleno, limpieza del relleno y otras adiciones recientes a las especificaciones "estándar". Se recomiendan los mejores métodos para la toma en campo de muestras del relleno de la trinchera y ensayos de permeabilidad en el campo y el laboratorio.

1 INTRODUCTION

The technique of slurry wall construction has become more commonplace on geotechnical projects. It remains, however, a method that requires the skills and onsite expertise of experienced slurry specialists. Thousands of slurry walls have been installed since the early 1970's. The vast majority of these installations have been soil-bentonite (SB) slurry walls. At its most basic level, this technique involves digging a long slot under bentonite slurry and backfilling it with a blended mixture of the excavated soil, dry bentonite and bentonite slurry to form a relatively impervious barrier. Usually the trenches are dug with a hydraulic excavator and the backfill is mixed on the ground next to the trench with earthmoving equipment.

From the perspective of the casual observer, slurry wall methods may look crude and prone to variability of the end product. Actually, standard methods, when properly executed under the guidance of a knowledgeable slurry specialist, produce an effective low-permeability barrier at low cost. Nevertheless, engineers are constantly looking for better ways to control the process and to ensure the quality of the end product.

In some cases, more detailed specifications have improved construction methods. In other cases, new kinds of specifications add only to the cost of the work without improving overall quality and sometimes actually have been a detriment to the final product or have created unfortunate conflicts.

In this paper, the authors discuss the typically specified slurry wall parameters and some implications of different kinds of specifications for each of them. The recommendations in this paper are specific to the construction of SB slurry walls and may not apply to other types of slurry walls.

2 SLURRY PARAMETERS

2.1 Slurry Test Methods

The test methods that are used in the slurry construction process have been derived from the oil well drilling industry and were originally specified by the American Petroleum Institute in

their Standard Procedure for Field Testing Drilling Fluids (API RP13B). There now are corresponding ASTM specs for most of the same tests. The standard tests used for slurry work include:

- Viscosity-Marsh Funnel
- Unit weight-Mud Balance
- Filter press
- Sand content

These tests are all relatively simple for a slurry specialist to run in the field and are generally all that are necessary to control slurry properties.

There is another viscosity test that is occasionally included in slurry wall specs, the rotational (or direct-indicating) viscosimeter. This instrument is more complex than is needed for field purposes and there is little practical field experience working with it on slurry wall projects, although it can be useful for laboratory studies. It is, however, generally unsuitable for production work in the field.

2.2 Freshly Mixed Slurry Properties

The test that is most useful to determine initial (freshly mixed) slurry properties is the Marsh Funnel (MF) test. The results of this test are related to bentonite content, the type of bentonite used and the degree of hydration. If there are impurities in the mix water that interfere with the hydration of the bentonite, this test will usually give the slurry specialist an indicator of that problem. While a "40 second MF" slurry is typical of an initial bentonite slurry, variations from this value, both up and down, should be allowed to adjust the in-trench slurry as necessary. Water quality and bentonite quality have a major effect on slurry properties and may require the use of a slurry with a different viscosity.

The specific gravity or density of the slurry as freshly mixed is often specified, but this is not particularly useful. Because of the high efficiency of bentonite and job-to-job differences in bentonite and water quality, slight differences in density can make large differences in viscosity. The difference in performance of a slurry with a specific gravity of 1.03 vs. 1.04 can be very large, and the typical mud balance used to measure specific gravity has a resolution of only 0.01. Often, specifications will have minimum values of specific gravity that are impractical to attain with the specified bentonite. For example, a specific gravity (often seen in specifications) of 1.05 will usually result in a slurry that is too thick when standard bentonite is mixed with good quality water.

For the same reason, it is not good practice to specify the minimum bentonite content of slurry. Minimum values of 5% are often specified and can result in slurry that is too thick, depending on water and bentonite quality. Most slurry mixing equipment is not capable of proportioning by weight anyway. Contractors constantly adjust volumetric mix ratios to achieve viscosities appropriate for their circumstances.

The filter press test is a test that is much over-specified in slurry wall work. The test is designed to measure water loss of a slurry under a pressure of 690 kPa (100 psi) and the thickness of the resulting filter cake. It has particular value to the oil well industry where boreholes are very deep and a thicker filter cake can prevent the return of drilling fluid. In an excavated trench, a thicker filter cake is not a problem and may actually improve the overall quality of the wall. Since a lower filtrate is also related to hydration of the slurry and proper mixing of the slurry, it is really a test that should concern the contractor more as an economic issue; lower filtrate values should result in lower slurry losses through the trench walls.

It is appropriate to say a few words about Wyoming-type bentonite clays. There are essentially three kinds of bentonite that are marketed for slurry wall applications. The most common is "standard" 90 barrel yield bentonite as specified in API Publication 13A, Section 4. The second is "untreated" or "natural" bentonite as specified in API Publication 13A, Section 5. And the third is "chemically resistant" bentonite that is specially formulated by the bentonite manufacturers and is sold under various trade names. There are other types of materials, including "high yield" bentonites (e.g. 180 barrel yield) that are never used in these applications because they result in too little clay in the final product. Occasionally, a severe chemical environment will mandate the use of alternative materials such as attapulgite or a chemically resistant bentonite, but this is rare.

After conducting hundreds of bentonite design mix studies, the authors conclude that the only bentonite-related factor of real importance in the final permeability of the wall is the bentonite content, by weight. Even in cases of chemical contamination, the so-called "chemically resistant" bentonites seldom show a performance improvement for this application. There is also usually no practical difference in performance between the standard bentonite and the "natural" bentonite. The authors prefer standard bentonite because it produces more reliable slurry

properties. Because of the cost differential between these products, the authors strongly recommend first trying the standard bentonite in all design mix programs and specifying this material if design mixes produce acceptable results.

Specifications will often require a minimum bentonite content in the backfill, generally expressed as a percentage of bentonite added to the backfill by dry weight. Unless otherwise specified, this is taken to mean all the bentonite that is added to the backfill, whether in the form of slurry or in the form of additional dry bentonite added at the time of backfill blending. This type of specification inevitably leads to confusion because there is no way to measure the slurry component in the field; some gets mixed in as the trench is excavated, and some is added at various times to produce the desired consistency. The authors strongly recommend the use of the term "additional dry bentonite" in project specifications; it should be made clear that slurry added to the backfill at any time is excluded from this calculation. Of course, mix designs conducted in the laboratory should use the same convention. Typical ranges of dry bentonite may be from 0-3%, and sometimes higher as dictated by design specifications. Experience has shown that the bentonite contribution from the addition of the slurry is usually in the range of 0.5 to 1.5% added by dry weight.

It is also appropriate to include some comments on the quality of the water used to mix the slurry. Acceptable slurry can generally be made from most water sources, but any suspect water should be subjected to testing in a design mix program. Waters with high calcium content (hardness > 250 ppm) may require the use of soda ash or other pre-treatment. Specifications often list a maximum hardness of 50 ppm, which may be difficult to find even from potable sources, and unnecessarily restrictive. Excessively turbid water or water with high magnesium content or a low pH can also be problematic and should be avoided. Recycled water (sewage effluent) and industrial plant water have been used on some projects, but often create their own special challenges. If non-potable water is planned for a project, it should be used during the design mix stage too.

Another parameter that is frequently specified is hydration time (typically 8 or 24 hours) for the mixed bentonite slurry. Complete hydration is generally defined as the point when the slurry has reached a stable filter loss and viscosity. With some types of mix plants, hours of hydration may be necessary. In others, the slurry is essentially completely hydrated when it leaves the plant after a few minutes of mixing. In fact, this topic is one that would be better left out of specifications entirely. If a contractor uses poorly hydrated slurry, he will have problems controlling the slurry properties in the trench, but none of the consequences are detrimental to the project. In fact, as discussed in the section on filter press tests, it could be argued that the use of poorly hydrated slurry will result in thicker filter cakes and increased bentonite consumption, all positive in terms of final wall permeability.

2.3 In-Trench Slurry Properties

Controlling the in-trench slurry properties is the heart of the slurry wall operation. Many specifications prescribe a fixed interval, such as twice daily, when all the standard in-trench slurry tests should be made and set forth parameters that the tests must meet for specification compliance. In practice, the knowledgeable slurry specialist will instead test the slurry many times per day, at different locations, using a limited number of tests, (primarily viscosity), to determine what is happening in the trench and what modifications are needed. Most specifications do not recognize the amount of variability that is typically encountered in the field.

The tests that are specified for in-trench slurry are typically the same as for freshly mixed slurry. Once again, the most important parameter to control is viscosity. Slurry specialists may use a thicker viscosity in situations where trenching is proceeding through highly pervious materials or where it is desired to increase slurry weight by suspending more sand and fines. In other cases, the slurry may need to be thinned as it loses water into the sidewalls or thickens for other reasons.

The specific gravity or density of the in-trench slurry is monitored using the mud balance. As trenching proceeds, the slurry picks up weight due to entrained materials. Additional weight helps trench stability; however, if the slurry gets too heavy or too viscous, then the backfill will have more difficulty displacing the slurry as it is placed. Usually, the specific gravity is required to be a minimum of 1.10 to 1.40 to maintain trench stability, depending on the soil type. Typical specifications also require that the slurry have a specific gravity no heavier than 0.25 (15 pcf) less than that of the backfill. For a backfill with a specific gravity of 2.0 (125 pcf), this computes to a maximum slurry specific gravity of about 1.75 (109 pcf). Some specifications set an additional

upper limit as low as 1.36 (85 pcf). This may be unrealistic in sandy soils and too low to maintain trench stability in many cases. In general, the authors recommend keeping the slurry specific gravity at least 0.25 less than the backfill, thereby avoiding the pitfalls of over-specifying.

A related factor is sand content. The sand content of slurry is dependent on the viscosity of the slurry, the material through which the trench is being dug (and becomes suspended in the slurry) and the methods employed by the slurry contractor. Typical values for a trench being dug in sandy soil may be as high as 30% without impacting the quality of the installation. Some recent specifications have included maximum limits on sand content in the range of 10-15%. Mathematically, it can be shown that 15% sand content limits the specific gravity to about 1.26 (79 pcf), which can be much less than necessary to maintain trench wall stability. In the opinion of the authors, such arbitrarily low limits are counter-productive and invariably increase costs and controversy. On a relatively fast moving slurry wall project in a sandy soil, this provision will slow production considerably and usually for no discernable purpose. The use of large desanding machines is often not practical and almost never effective, as the only efficient (i.e. timely and practical) means to reduce sand content is to remove old slurry and replace it with fresh slurry. In the authors' experience, there is really no effective way to desand slurry on an SB slurry wall site without drastically increasing construction costs and reducing productivity. The effect of working with desanders for a long time or exchanging and wasting large quantities of slurry will quickly be reversed as soon as trenching starts again. In the authors' opinion, rather than trying to specify this controversial parameter, it is preferable to monitor and deal with any sedimentation during the trenching operation.

The last test often applied to in-trench slurry is the filter press test. The results from this test are heavily influenced by sand content for the in-trench slurry and have no value from an operational or quality standpoint. It is sometimes assumed that low filtrate losses produce improved trench wall stability. However, in practice, trenches have been maintained stable with very high filtrate values. In the case of cement-bentonite slurry walls, for example, filtrate values of 100-200 cc's are common. The authors recommend deleting this test from specifications for in-trench slurry.

3 SOIL-BENTONITE BACKFILL

3.1 Mixing and Placing SB Backfill

SB backfill is usually mixed and placed with earthmoving equipment such as bulldozers and excavators. The typical specification will require that the backfill is mixed "until homogeneous and a slump of 7 to 16 cm is measured". The slump cone (ASTM D143) is a simple test; after it is performed a few times, a trained operator and slurry specialist can usually begin to assess the proper slump by visual observation. It is more difficult to determine what the term "homogeneous" means for a given project. The mixed SB is usually allowed to contain occasional clods of clay and rocks up to a certain size. All particles should be coated with bentonite slurry and large particles (> 10 to 15 cm) should be removed or segregated. On projects with very hard clay, the tracks of a bulldozer can be useful in reducing clod size. When large rocks are encountered, the excavator can segregate the oversize materials (although the occasional cobble is not detrimental to wall quality). The authors have found that the ideal equipment spread uses a bulldozer paired with a small track-mounted excavator for optimum production and quality in mixing and placement of the SB backfill material.

Occasionally, specifications require the use of a pugmill to mix backfill. In the authors' experience, this equipment is not well suited for SB slurry walls because it relies on a constant flow of feedstock material and the materials excavated from slurry walls are poorly suited (wet and sticky) for conveying in and out of the mill and tend to create a highly variable end product. Pugmills have a very short mixing cycle and it is easy to get inconsistent results, unless the feedstock is pre-mixed or relatively homogeneous before mixing. Frequent on-off cycling of the pugmill can lead to additional inconsistencies as the beginning and end of the process again tend to be different blends. Pugmills can also entrain air into the SB, creating longer backfill slopes and making placement under slurry more difficult. With the traditional methods of mixing with bulldozers and excavators, the mixing process can continue as long as necessary for any batch of material.

The most important aspect of the backfill blending process is to mix backfill that complies with parameters set by the specifications for the proportions of key components. An engineer may set these requirements based on experience or they

may be developed during the course of a design mix program. Most design mixes will focus on the allowable gradation range for the blended backfill, particularly the fines content, and the required amount of bentonite added to the blend.

Most soils found at a site can be used in backfill blends or, at the worst, can be amended slightly to meet a target gradation. SB backfill needs a fines content of least 15-20% (preferably but not necessarily plastic fines) to be stable under most circumstances. At the coarse end, it makes little sense to add gravel to a blend that does not naturally have gravel.

Contaminated soils can be used successfully in SB backfill. Contaminated sites are generally subjected to a design mix study and the contaminated soil should be used as the base material in the study. In most cases, there is little detrimental effect of contaminants and what there is can be counteracted by slight increases in bentonite content.

Dry bentonite is added in the field at the point of mixing. Typically a certain weight of bentonite is added to a known volume of backfill. This may be accomplished by setting the bentonite bags along the trench at distances proportional to depths or by adding known weights of bentonite to bucket counts of backfill blend in a remote mixing area.

Sometimes the slurry specialist will vary the slump of the backfill to improve workability. For example, the slump may be made stiffer (to reduce the length of open trench) if the work platform is steeper than normal, or if the aquaclude on the bottom of the trench has a steep dip. The slurry specialist may increase the slump to improve the flow of the backfill around a corner.

Some specifications require a dike of soil beside the trench to limit unmixed particles of soil from dropping into the trench during backfill mixing. The authors recommend cleaning the top of the trench with the excavator (about 1 bucket wide on each side) of all loose materials. This provides a "clean zone" that is more effective at preventing accidentally dropped materials, allows visual inspection of the top of the trench for cracks, and is much easier to monitor.

3.2 Field Sampling of SB Backfill

Testing of the SB backfill requires a sampling method to obtain test specimens. Usually, "grab samples" are obtained by the slurry specialist from the mixed materials on the work platform, immediately prior to placement in the trench. These samples are placed in sealed plastic bags and sent to the laboratory for testing. A typical sampling interval is one sample for laboratory testing per 400-1000 m^3 of backfill, which is about one test per one to three days of normal production.

Some specifications require "undisturbed" samples of the backfill at depth. This method has the advantage of obtaining in situ samples, but has several potential drawbacks. First, since the SB is placed in at a wet consistency, some period of consolidation and "setting" time is normally necessary prior to sampling. The time delay can be unacceptable for quality control and final acceptance on a typical project. Second, unconsolidated SB is difficult material to sample since the material is soft, wet, and may contain stones. Shelby tubes are recommended and piston sampling tools are sometimes required for adequate recovery. It may not be possible for backfill materials containing gravel particles to be sampled "undisturbed". Third, most drilling & sampling methods have a relatively poor record for maintaining verticality. This problem is exacerbated when the sampling is performed in a deep and narrow trench, where the exact center of the trench may be poorly located. This can result in the sampling tool recovering the trench wall instead of the SB backfill. For example, at about 10 m deep, a drill stem 3% out of vertical can exit a 1 m wide trench, if the drilling begins in the middle of the trench. Finally, the trench may be constructed nominally vertical (some specifications require within 3%), but local soil variations, boulders, etc., can cause the trench to deviate. For these reasons, in situ sampling is limited by practical concerns to about 10 to 15 m in depth, and even then may require repeated efforts to obtain representative samples. In situ sampling, when employed, is usually performed at 120 to 150 m horizontal intervals.

The authors recommend not relying on in situ sampling for final wall acceptance. The conventional method of obtaining a grab-sample that is reconstituted in the laboratory is a more reliable and timely test.

3.3 Laboratory Testing of SB Backfill

Samples of SB from slurry wall construction are usually sent to a laboratory for testing. The tests typically performed are grain size and permeability (or hydraulic conductivity) and less often, Atterberg Limits. With respect to grain size, the fines content (percent finer than 0.075 mm or #200 sieve) is the property of interest. Adequate fines content (at least 15-20%)

generally results in an acceptable permeability and a backfill with greater resistance to piping. A well-graded material is highly recommended but specific requirements for intermediate sieves (e.g. #4, #40, #100, etc.) usually result in unnecessary complications or the wholesale rejecting of otherwise usable site soils with no improvement in quality. Reuse of the site soils is highly recommended if at all possible for simplicity as well as economy.

Experience has shown that high fines content soils (clays) can be used as backfill; it is not necessary to add gravels to predominately clay mixtures to flatten their grain size curve and reduce fines. The only limitation in using clayey soils is that a longer period of consolidation may be required prior to final capping when these soils are used as backfill

Permeability is the most commonly specified performance parameter for SB walls. Triaxial (or flexible wall) tests, as per ASTM D5084, are the industry standard test. On most projects, samples of the backfill are gathered from the mixing operation, just prior to placement in the trench for testing. Laboratory permeability testing of SB samples can be challenging since SB samples are semi-fluid and require some type of preparation prior to mounting on a test pedestal. Some laboratories tamp the SB into a temporary tube placed inside the sample membrane and then induce consolidation prior to testing. Others form a test specimen by consolidating the SB in a cell with a sliding piston. By pressurizing the cell, the SB is pre-consolidated and a "cookie" of SB is created that is more easily handled and tested.

Consolidation pressures and the testing gradient must be specified for the triaxial test. Some specifications require effective confining pressures as low as 40 kPa; the authors recommend 50 to 100 kPa. As for gradients, the lower the gradient, the less additional consolidation of the sample will undergo during the test, but more time is required. Gradients of 10 to 30 are typically used for these tests. The wrong combination of a confining pressure and gradient can create problems for the laboratory and the potential for failing the specimen.

Specifications sometimes include a requirement (or option) for on site permeability testing of the SB using a modified filter press. This test, known as the filter press perm, quick perm, or Q-test can be used to get a relatively rapid indication of SB permeability for field quality control purposes. Use of the Q-test requires a low-pressure regulator (0-200 kPa) and a correlation (and correction factor) with the laboratory triaxial tests. Most slurry specialists can run this test and obtain reasonable results overnight. Usually, one laboratory triaxial test is required for every 5 Q-tests.

3.4 In Situ Testing of SB Slurry Walls

Engineers are always looking for ways to test the permeability of a slurry wall in place. No test has yet been developed to accomplish this goal.

Methods that involve inserting some kind of pumping element into the wall and then pumping in or out are not likely to provide reliable results. Pumping out will most likely cause a hydraulic fracture of the wall and bad results. Pumping in only works as a rising head test because of the low permeabilities involved; interpreting data is difficult and the results can be heavily influenced by a well being off center in the wall.

Pumping from one side of the completed wall and looking for drawdown on the other side will only find the grossest flaws and then only if the wells are fortuitously located near the flaw.

The only method shown to have reliably assessed the bulk transmissivity of a slurry wall is to create a substantial test cell and then do a pumping test. Unfortunately, these tests are very time consuming and expensive and not justifiable for the typical project. Trying to economize by making a very small test cell will result in using techniques not typical of a longer wall and, therefore, not be a good model.

4 CONSTRUCTION CONSIDERATIONS

4.1 Key at the bottom of the Trench

Most standard slurry wall specifications contain a clause related to the key required at the bottom of the slurry wall, typically 0.7 to 1 m (two or three feet) into an underlying aquaclude. Clearly the key is one of the most important aspects of the design of any slurry wall, yet engineers using standard specifications frequently do not address it on a site-specific basis.

In cases where the key material at the bottom is of low quality, a deeper key may be necessary. Where the key at the bottom is very hard or variable as it would be in the case of a weathered rock, a 1 m (three foot) key may be more than necessary and may be very expensive to attain. Aggressive efforts to make a key may actually damage the rock beneath the key and create flow paths that could short-circuit the barrier. The authors recommend specifying a key to a design

minimum depth, or to the refusal of the excavating equipment, whichever is less.

4.2 Keying Between Sections

Almost every project involves keying the excavation of a SB wall into a previously backfilled section, usually to close a loop around a site, although there may be other reasons to join sections together.

The standard way of doing this when the new and old segments cross at some angle is to dig through the crossing point by some amount on both the old and new segment. The "overlap" distance is typically specified at a minimum of 1.5 m (5 ft.) With standard survey control, overlaps longer than this are excessive and wasteful.

When the old and new segments are on the same line, the same procedure can be followed, digging out approximately 1.5 m of the old wall measured at the bottom. Alternate procedures of trying to lap wall segments by digging alongside the old wall are not recommended because slight deviations in verticality can result in a soil window being left at the bottom.

4.3 Cleaning Of the Trench Bottom

The specification provision that typically causes the most controversy on SB slurry wall sites is the one related to cleaning of the trench bottom. The concern is that, during some period of inactivity on the site, sand will settle out of the slurry and cause the deposition of a pervious zone that will subsequently be covered by backfill. Specifications typically require that the depth of the bottom of the trench and the surface of the backfill be measured at ten or twenty foot horizontal intervals after excavation is completed for the day and before it starts in the morning. The intent is to measure if excessive sand has been deposited during the work stoppage. In most cases, the amount of sand that sediments out is minimal and usually less than can be measured.

Good technique involves bringing the toe of the backfill up close to the excavated face after the completion of the day's excavation work. The following morning, the bottom of the trench can be cleaned completely by the excavator and a portion of the previous day's backfill dug out of the toe. The theory is that the new backfill will scour any sedimentation off the previous face or mix it to the point where it is not a problem. Of course, any sedimented material is completely surrounded by bentonite slurry and this also would tend to diminish any effects of the sedimentation.

The problem is that there is no effective way to clean the portion of the backfill that is out of the reach of the excavator. For trenches that may be as deep as 50 feet or more, the excavator can typically reach only the very bottom of the slope that may be hundreds of feet long. Specifications often mention acceptable means of cleaning of the trench bottom as using clamshells, airlifts, pumps or similar equipment. All of these methods have practical limitations and may cause more problems than they solve. On many sites, there is simply no room beside the open trench to accommodate the lifting equipment to operate any of these devices. The excavated spoil may be on one side of the trench, waiting to be blended and landfill slopes, structures, or other features frequently constrict the other side. Even when there is access for lifting equipment, using a clamshell is a clumsy operation that certainly destroys filter cake and risks knocking more material from the sides of the trench onto the backfill surface. Airlifts and pumps at best can suck a hole in the surface of the backfill. They cannot clean even a small part of the surface because they cannot be moved laterally in viscous slurry. If they are picked out of the slurry and moved, they will still miss parts of the backfill surface. Furthermore, since the backfill surface is sloped, the length of the suction line must constantly be changed, impeding the progress of the work. The authors have witnessed attempts to drag a small bucket or sled down the backfill slope with the idea of scraping off any accumulated sand. It is impossible to control this device as it comes down a backfill face hundreds of feet long dragged by cables that increasingly apply lifting forces as the bucket-sled approaches the bottom.

The bottom line on cleaning the trench bottom is that there is no effective way to do it beyond the reach of the excavating equipment. The time spent attempting cleaning would be far better spent in production so as to increase the distance between all the potential faces. Specifications that require cleaning of the backfill face after eight hours of work stoppage always result in controversy at the site, sometimes followed by ineffective measures taken just to satisfy an engineer or a standard specification with no practical improvement in quality.

Occasionally, real sedimentation is measured at the bottom of the trench or up on the backfill slope. This may be caused by small trench collapses, breakdowns in the slurry quality, or excessive time with the trench left open. In these

cases, the contractor effectively only has two choices. One is to walk the excavator out over the trench (preferably on crane mats) to the point where the trench can be cleaned. The second choice is to simply continue backfilling and come back at a later date to re-excavate the affected area or otherwise re-mix it. (Deep soil mixing and jet grouting have been used to make these kinds of repairs.)

Other than these situations, a small amount of sedimentation is always going on, even during excavation and backfilling and is just a part of the process. The authors hesitate to suggest a standard for what is too much sedimentation. What is normal in one situation might not be in another. Certainly typical sedimentation is less than 15 cm (6 inches) on a trench of 15 m (50 foot) depth.

4.4 Measuring Trench Width

Trench width is normally assured by specifying that the excavating bucket have a minimum width equal to the desired trench width. While it is possible to measure trench width directly with mechanical callipers or a sonar-like device, these types of measurements are costly, time consuming and generally not advised. For most slurry wall applications, if there is some decrease of the trench width by squeezing, it will show at the surface in the form of cracks and a narrowed trench

4.5 Capping and Consolidation of Slurry Walls

A completed slurry wall must be capped to protect it from desiccation, traffic, and root growth. Since the SB material is very soft when placed, a cap of substantial material also protects the public and limits (or even eliminates) future maintenance.

The SB material is very wet when placed and therefore subject to consolidation. However, with the narrow trench widths usually constructed for slurry walls, the backfill tends to adhere to the trench walls and resist substantial settlement. Experience has shown that most of the consolidation for SB slurry walls is over in about 2 weeks (for 1 m wide walls, less for thinner, more for thicker walls). A good specification will require the contractor load the top of the slurry wall with excess materials (excess backfill, trench spoil, etc.) to a height of 0.5 to 1.0 m. This load prevents desiccation prior to placement of the final cap, and helps accelerate settlement. After a period from a few days up to two weeks, the load is removed and the slurry wall can be permanently capped. On larger projects, capping is phased with other slurry wall operations so that capping follows excavation and backfilling with minimal delay.

5 CONCLUSIONS

When writing specifications for SB slurry walls, engineers need to be cognizant of the impact of key specification sections on the construction process. There are many specification provisions that can have severe consequences on the constructibility and cost of slurry wall projects. Specifications should account for specific site conditions and project needs of the site in question and not be simply copied from other projects.

REFERENCES

American Petroleum Institute (1990), *"Recommended Practice Standard Procedures for Field Testing Water-Based Drilling Fluids"*, Specification RP 13B-1, Washington, DC.

American Society for Testing and Materials (2000), *Annual Book of ASTM Standards*, Section 4: Construction, Vols. 4.02 and 4.09, West Conshohocken, PA.

Geo-Solutions Inc. (2003) *"Standard Soil-Bentonite Slurry Wall Specification"* www.geo-solutions.com

Millet, et al (1992), *"USA Practice Slurry Wall Specifications 10 Years Later,"* *Slurry Walls: Design, Construction, and Quality Control*, ASTM STP 1129, Paul, Davidson and Cavalli, Eds., American Society for Testing and Materials, Philadelphia.

Millet and Perez (1981), *"Current USA Practice: Slurry Wall Specifications"* Journal of Geotechnical Engineering Division ASCE Vol. 107 No. GT8.

CONSTRUCTION QUALITY ASSURANCE PLAN FOR LOW PERMEABILITY BARRIER WALL

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CEC Project 141-284

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1.0 INTRODUCTION

1.1 BACKGROUND

This Construction Quality Assurance (CQA) plan has been developed for construction of the Low Permeability Barrier Wall (LPBW) at the Duck Creek Generating Station in Canton, Illinois. The CQA plan will provide a comprehensive program to ensure that the LPBW is constructed according to the design requirements and will function as designed. Adherence to execution of the CQA plan will ensure and document that construction is in accordance with the design and plans approved by the Illinois Environmental Protection Agency (IEPA).

The CQA plan specifies the comprehensive oversight, material testing, and documentation during the construction phase. It specifies the certification required to be done by an Illinois Licensed Professional Engineer so that the constructed feature meets or exceeds the design standards. By providing oversight during the construction phase, Ameren Missouri and the CQA Consultant will determine that the LPBW is built as specified. In addition, the IEPA will have access to the site to observe construction of the LPBW.

1.2 DESCRIPTION OF REQUIREMENTS

This CQA plan generally includes construction oversight, testing, and approval procedures that will be employed during construction to determine that the constructed components meet the design specifications. The primary areas to be addressed in this CQA plan include:

- Materials Quality Control
- Acceptance Criteria
- Construction Control and Documentation (As-Built) Surveying
- Erosion and Sediment Controls
- Reporting Requirements

An acceptance report documenting each major phase of construction, including the results of CQA testing, daily summary reports, daily inspection reports, and as-built drawings shall be submitted upon completion of construction activities.

2.0 QUALITY ASSURANCE MANAGEMENT

2.1 GENERAL RESPONSIBILITIES

A brief description of the CQA plan components and general responsibilities is given below.

CQA Officer

Ameren will retain a CQA Officer for the project who will report directly to Ameren's Construction Supervisor. The CQA Officer shall be a Professional Engineer licensed in the State of Illinois who is a person other than the Owner (Ameren) or an employee of the Owner who will supervise and be responsible for inspection, testing and other activities required to be implemented as part of the CQA Program. Primary responsibility for the quality of the construction rests with the Contractor; the CQA Officer (and Field Representative(s)) will monitor the Contractor for adherence to the Contractor's CQA Program and take split or duplicate samples or parallel tests as appropriate to validate the Contractor's findings.

The CQA Officer will be present at the outset of major project activities and at critical times during construction. The CQA Officer will exercise his/her own professional judgment to be present at the project site as required to assume full responsibility for the inspections and testing performed by those persons under his/her direct supervision. The CQA Officer, along with his/her field representatives, shall be responsible for documentation of sampling, testing and inspection including daily inspection reports and weekly summary reports.

CQA Consultant

If the designated CQA Officer is not able to be on-site during the construction activities, a CQA Consultant or CQA designee will be assigned to perform the duties of the CQA Officer. The CQA Consultant will have necessary experience and training to perform the duties assigned to him by the CQA Officer. This does not relieve the CQA Officer of the above responsibilities which may be performed by the CQA Consultant. In addition, the CQA Officer will designate in writing a person who will exercise professional judgment in carrying out the duties of the CQA Officer as the designated CQA Consultant and will sign a statement that the CQA Officer assumes full responsibility for inspections performed and reports prepared by the designated CQA Consultant.

Licensed Surveyor

Surveying will be performed under the direction of a Professional Land Surveyor licensed in the State of Illinois. A Surveyor shall be present to document construction under the direct supervision of the CQA Officer.

Field Engineer

Field Engineer(s) will carry out the testing and documentation procedures specified in this CQA Plan under the direct supervision of the CQA Officer.

Field Technicians

Testing procedures may be delegated to one or more Engineering Technicians. These individuals will work under the direct supervision of the CQA Officer.

2.2 CQA MEETINGS

Construction quality assurance meetings shall be held periodically to discuss the status of activities and documentation required by the CQA Plan and to maintain lines of communication between the Owner, Owner's Representative, Engineer, Operator, contractors, and the CQA Officer. The CQA Consultant shall record the meeting attendees and meeting minutes in the daily summary report for that day.

2.3 CONSTRUCTION SURVEILLANCE AND TESTING SCHEDULE

The construction surveillance and testing activities listed in this section are required in order to effectively administer the CQA plan. These requirements are based on American Society of Testing Materials (ASTM) standards and industry standards for quality control testing frequencies. The testing requirements are summarized in Table 1. Testing frequencies are dependent upon the uniformity of the material being evaluated. The proposed testing frequency may be modified by the CQA Officer with approval of the Owner and Engineer upon review of construction testing if the statistical distribution of the material properties warrants more or less frequent testing.

3.0 CONSTRUCTION QUALITY ASSURANCE

The Contractor's CQA plan for this project will be developed based on information furnished by the selected contractor, for review and approval by Ameren. Specific work scope items including specific tests, inspections and the frequency of these tests will be finalized upon approval of the Contractor's CQA Plan. The following sections describe typical tests, inspections and other QA-related activities that are performed at various stages of the construction.

3.1 MATERIALS QUALITY CONTROL

The CQA Officer will supervise the activities of the Field Engineer and Field Technicians who are specialized in the areas of materials testing (soils, slurry and soil/bentonite backfill components), in-situ testing, and geotechnical engineering. Materials to be tested include:

1. Slurry and/or Soil/Bentonite Backfill Mix, and
2. LPBW Cap.

Material specifications are based on the current design and hydrogeologic data for the proposed improvements. The tests and frequencies specified may be modified with the CQA Officer, Owner and Engineer approval.

Materials will be tested on-site and in qualified off-site laboratories. Tests will be performed in accordance with the current approved version of the applicable ASTM and API standards. In addition, a review will be performed of certification test data supplied by the manufacturers and contractors. Material testing will be completed in accordance with the schedules shown on Table 1.

3.2 BORROW AREAS

It is anticipated that fill for the LPBW cap will be provided from an on-site borrow source, and topsoil previously stripped prior to construction of the LPBW will be placed on top of the LPBW cap.

3.3 ACCEPTANCE CRITERIA

The minimum acceptance criteria which apply to the earthen materials used for construction are contained in Table 1. The construction material is expected to meet or exceed the specifications listed in Table 1. The soil properties obtained from each test and the averages for tests will be monitored for consistency.

3.4 DOCUMENTATION SURVEYING

Documentation surveying will be performed to prepare as-built drawings of the newly constructed LPBW. Surveying will be performed utilizing conventional surveying practices by a Professional Land Surveyor. A site control point tied into the State Plane Coordinate System will be provided by Ameren. The surveyors will work with and report to the CQA Officer.

At regular intervals coinciding with the CQA Officer's acceptance report, as-built drawings of the newly constructed features will be prepared. The as-built drawings will document the location, size, and elevation of the constructed features. The as-built drawings will be certified by an Illinois Licensed Professional Engineer and will become part of the record of completed construction.

3.5 SLURRY AND SOIL/BENTONITE BACKFILL MIX

3.5.1 Slurry Mix Design

The Contractor shall submit a slurry mix design that meets the material specifications using the water available on site. The submittal shall include the results of swell tests (ASTM D5890) and filter cake permeability tests using the soil and bentonite to be used for this work and the water from the site.

3.5.2 Soil-Bentonite Slurry Backfill

The Contractor shall submit a mix design for the Soil-Bentonite slurry backfill that meets the material specifications. The backfill design shall utilize an economical mix as required consisting of excavated materials, dry bentonite, bentonite slurry and other materials (coal combustion residuals may not be used) to produce the required permeability. The submittal shall include the results of permeability tests (ASTM D5084), particle size (ASTM D422) and slump (C143) with varying amounts of dry bentonite and any supplemental material added and using site water to determine the most economical mix.

3.6 EXCAVATION CONTROL

The Contractor shall be responsible for demonstrating to the satisfaction of CQA Officer that the LPBW is continuous and to the minimum specified depth. Trench continuity shall be assured by the action of movement of the trench excavation equipment such that digging tools can be passed vertically from top to bottom of the trench as well as moved horizontally along the axis of the trench without encountering unexcavated material. Adequate depth of the trench shall be demonstrated by direct measurement of the depth to the satisfaction of CQA Officer.

The intent of the construction is to "key" the base of the LPBW a minimum of five (5) feet into the underclay, or native soils underlying the mine spoil. The depth of the LPBW shown on the

profile is based on widely spaced soil borings; actual field conditions may vary from that shown on the contract drawings.

The CQA Officer will be responsible for the following activities:

1. Observe and verify the soil types excavated and the depths of the LPBW during excavation.
2. Monitor stockpiling activities to ensure that excavated soils are segregated into stockpiles of similar soils.
3. Identify and ensure that the LPBW is installed in accordance with the plan.

3.7 CAP INSTALLATION

After completion of the LPBW, a cap will be constructed in accordance with the approved cap design. The cap construction will be observed by the CQA Officer. The Contractor will have previously submitted for approval by Ameren, the design of the soil cap for the LPBW. The soil cap will be installed by the Contractor once initial settlement of the LPBW is completed.

In order to minimize erosion and to shed precipitation the cap should be compacted and mounded to an approximate elevation 18 inches above the adjacent ground and tapered over an approximate width of five feet to either side of the trench. Testing of the cap will typically be by visual inspection only.

The CQA Officer shall be responsible for the following:

1. Upon completion of the LPBW, inspect the cap to ensure construction was completed in accordance with the Ameren approved Cap Design.
2. Identify unexpected conditions. Document areas of repair and the methods used for repair and include in the daily summary report. Record locations of unexpected conditions and repairs on the as-built drawings.

3.8 SEEDING AND FERTILIZER

Prior to the placement of the seed and fertilizer, the cap will be observed by the CQA Officer to be free of deleterious materials. The following activities will be performed for the seeding and fertilizer installation:

1. Prior to construction of the LPBW, topsoil from the site will be stockpiled for use after cap installation.
2. Prior to seeding and fertilizing, document that the seed and fertilizer meet the Specifications.
3. Observe the installation of the seeding and fertilizer. Document areas of repair and methods used for repair and include in the daily summary report. Record locations of unexpected conditions and repairs on the as-built drawings.

3.9 EROSION AND SEDIMENT CONTROLS

As referenced in Section 2.3.1 of the Construction Specifications POS-000159, the Contractor shall be responsible for erosion controls and sediment stability by implementing best management practices. A description of the erosion and sediment control plan can be found in the project Surface Water Pollution Prevention Plan (SWPPP), provided in Appendix A of the Bid Documents.

During construction, the CQA Consultant will observe that the SWPPP is implemented and that areas damaged by erosion are promptly repaired. The CQA Consultant will be responsible for the following activities:

1. Monitor the effectiveness of the erosion and sediment control features on a regular basis throughout the project.
2. Provide recommendations to the contractor concerning the addition or repair of erosion control features which are required to comply with the specifications.
3. Review Contractor's SWPPP reports as required.

4.0 REPORTING REQUIREMENTS

Thorough documentation will be prepared to verify that the LPBW is constructed according to the design specifications. Observations, photographs, testing, and reports will be used to document the construction.

4.1 PHOTOGRAPHIC RECORDS

Photographs will be taken to document the work. The photographs may be included in the daily inspection reports, daily summary reports, and the construction acceptance reports. At a minimum, each photograph shall be accompanied by the following:

1. The date, time, and location of the photograph;
2. The type of activity; and
3. The name and signature of the photographer.

4.2 DAILY INSPECTION REPORT

A daily inspection report shall be prepared by the CQA Officer and the designated inspectors to document each person's daily observations and testing. This report shall be hand-written or typed and shall contain the following information at a minimum:

1. The date, weather conditions, and location of the observation or test.
2. A description of the type of inspection.
3. A description of the equipment and methods used by the contractor to complete the work.
4. A description of the testing procedure.
5. The personnel involved in the inspection, sampling, and testing activities.
6. A summary of surveying checks made to determine proper stake-out locations and precise location, size, and elevation of the constructed features.
7. A description of materials obtained for future testing, including location of sampling and sampling methods.
8. The test data.
9. The results of the activity.
10. A summary of irregularities or deficiencies which were observed by the CQA Officer concerning the construction surveillance or testing results and the measures that were taken to correct such irregularities or deficiencies.
11. Observations regarding construction surveillance activities by the CQA Officer.
12. A review of the Contractor's weekly and daily reports for compliance with the Storm Water Pollution Prevention Plan (SWPPP).
13. The signature of the Inspector.

4.3 DAILY SUMMARY REPORT

A daily summary report shall be prepared by the CQA Officer for each day of activity. The report shall contain the following information:

1. The date, weather conditions, and a summary of the construction locations.
2. A summary of the equipment and personnel on the project.
3. A summary of any meetings and a list of the meeting's attendees.
4. A description of all materials used and references or a summary of the material testing results and documentation.
5. An opinion as to whether the testing meets the applicable specifications.
6. A summary of the calibration and recalibration of test equipment.
7. The daily inspection report from each inspector.
8. The signature of the CQA Officer.

Both Daily Inspection Reports and Daily Summary Reports will be prepared when multiple Inspectors and the CQA Officer/CQA Consultant are working at the site. When only one CQA Officer/CQA Consultant is monitoring construction activities, only the Daily Summary Report will be prepared.

4.4 CONSTRUCTION ACCEPTANCE REPORT

A Construction Acceptance Report shall be prepared under the direct supervision of the CQA Officer after completion of construction and submitted to Ameren Missouri. The report shall document that the construction was performed in accordance with the project specifications and contain the following:

1. A summary of the CQA construction surveillance activities.
2. A summary of the CQA on-site material tests.
3. A summary of the CQA off-site laboratory test results.
4. A summary of surveying checks.
5. As-built drawings of constructed features.
6. A summary of deficiencies, if any, recorded by the CQA Officer during the construction period.
7. A summary of the results of the corrective action taken by the contractor to rectify the deficiencies.
8. An opinion as to the impact of the deficiency and associated corrective action on the quality of the constructed facility.
9. Copies of summary reports including Contractors SWPPP reports.
10. SWPPP daily/weekly reports (by contractor).
11. A certification by the CQA Officer that the construction has been prepared and constructed in accordance with the engineering design.

TABLE

TABLE 1

MINIMUM TESTING FREQUENCIES FOR SOILS, SLURRY AND SOIL/BENTONITE BACKFILL MIX

The final CQA plan for this project will be developed based on information furnished by the selected contractor, for review and approval by Ameren. Specific work scope items including specific tests, inspections and the frequency of these tests will be finalized upon approval of the contractor's CQA Plan The following sections describe typical tests, inspections and other QA-related activities that are performed at

PROPERTY	TEST METHOD	MINIMUM TESTING FREQUENCY	SPECIFICATION
Borrow Accpetance			
Grain Size Distribution	ASTM D 422	Borrow Areas 1 test per 10,000 cyd	100% < 3 inches
Standard Proctor	ASTM D 698	Borrow Areas 1 test per 5,000 cyd	Maximum Dry Density 100 pcf
Atterberg Limits	ASTM D 4318	Borrow Areas 1 test per 5,000 cyd	PI > 10 LL > 20%
Nuclear Density	ASTM D 2922	5 tests per acre	95% Standard Proctor
Moisture Content	ASTM D 3017	5 tests per acre	plus or minus 2% of optimum
Slurry Mix (Design to Be Provided by Contractor)			
Swell Tests	ASTM D5890	TBD by Contractor	To be Provided by Contractor
Filter Cake Permeability Tests	API	TBD by Contractor	To be Provided by Contractor
Chemical Testing of Water Source	TBD by Contractor	TBD by Contractor	TBD by Contractor
Soil-Bentonite Slurry Backfill (Design to Be Provided by Contractor)			
Specification for Oil-Well Drilling Fluid Materials	API Spec 13A	TBD by Contractor	To be Provided by Contractor
Procedure for Field Testing Drilling Fluids	API Spec 13B	TBD by Contractor	To be Provided by Contractor
Permeability	ASTM D5480	TBD by Contractor	1×10^{-7} cm/sec
Particle Size	ASTM D422, D1140	TBD by Contractor	To be Provided by Contractor
Slump	ASTM C143	TBD by Contractor	To be Provided by Contractor
Density	ASTM D4380	TBD by Contractor	TBD by Contractor
Moisture Content Determination	ASTM D2216	TBD by Contractor	TBD by Contractor
LL, PL, and PI of Soils	ASTM D4318	TBD by Contractor	TBD by Contractor
Unit Weight	API Spec 13B	TBD by Contractor	TBD by Contractor
Filtrate Loss	API Spec 13B	TBD by Contractor	TBD by Contractor
Viscosity	API Spec 13B	TBD by Contractor	TBD by Contractor
pH	API Spec 13B	TBD by Contractor	TBD by Contractor

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

PEOPLE OF THE STATE OF ILLINOIS,	)	
	)	
Complainant,	)	
	)	
v.	)	**PCB No. 13-41**
	)	
AMEREN ENERGY RESOURCES GENERATING COMPANY, INC., an Illinois corporation,	)	
	)	
Respondent.	)	

AGREED MOTION TO JOIN MEDINA VALLEY AS RESPONDENT

The Complainant, PEOPLE OF THE STATE OF ILLINOIS, by LISA MADIGAN, Attorney General of the State of Illinois, and the Respondent, AmerenEnergy Resources Generating Company, Inc. ("AERG"), pursuant to Section 2-405 of the Code of Civil Procedure, 735 ILCS 5/2-405 (2014), and Section 101.403(a) of the Board's Regulations, 35 Ill. Adm. Code 101.403(a), hereby jointly move to join as Respondent AMERENENERGY MEDINA VALLEY COGEN, LLC, an Illinois limited liability company ("MEDINA VALLEY"), and in support of this motion state as follows:

1. Section 2-405 of the Code of Civil Procedure provides, in pertinent part:

> (a) Any person may be made a defendant who, either jointly, severally or in the alternative, is alleged to have or claim an interest in the controversy, or in any part thereof, or in the transaction or series of transactions out of which the controversy arose, or whom it is necessary to make a party for the complete determination or settlement of any question involved therein, or against whom a liability is asserted either jointly, severally or in the alternative arising out of the same transaction or series of transactions, regardless of the number of causes of action joined.

* * *

2. Section 101.403(a) of the Board's Regulations provide, in pertinent part:

a) The Board, on its own motion or the motion of any party, may add a person as a party to any adjudicatory proceeding if:

1) A complete determination of a controversy cannot be had without the presence of the person who is not already a party to the proceeding;

2) The person who is not already a party to the proceeding has an interest that the Board's order may affect; or

3) It may be necessary for the Board to impose a condition on the person who is not already a party to the proceeding.

* * *

3. On April 17, 2014, Respondent AERG moved for the substitution of MEDINA VALLEY as the Respondent in this matter.

4. On December 2, 2013, Ameren Corporation ("Ameren"), a Missouri corporation, completed a transaction resulting in the divestiture of its generation business including the Duck Creek Energy Center. As part of this transaction, certain liabilities including all claims by the State of Illinois relating to the use of coal combustion material as sub-base within the rail line at Duck Creek, were retained. (Motion for Substitution at ¶ 1).

5. Subsequent to the above referenced transaction, AERG and MEDINA VALLEY entered into an Assignment and Assumption Agreement, pursuant to which AERG assigned and MEDINA VALLEY assumed any liabilities arising from the Complaint filed in this matter (Motion for Substitution at ¶ 2).

6. By order dated August 7, 2014, the Board denied the motion for substitution. The order further provides the issue of joining MEDINA VALLEY as a Respondent pursuant to Section 101.403(a) is not addressed because no such motion is yet on file. Order at p. 5.

7. Pursuant to the Assignment and Assumption Agreement, MEDINA VALLEY is legally responsible for the violations alleged in the complaint herein.

WHEREFORE, the Complainant, People of the State of Illinois, and the Respondent, AmerenEnergy Resources Generating Company, Inc., respectfully request that the Board enter an order pursuant to Section 2-405 of the Code of Civil Procedure, 735 ILCS 5/2-405 (2014), and Section 101.403(a) of the Board's Regulations, 35 Ill. Adm. Code 101.403(a), joining AMERENENERGY MEDINA VALLEY COGEN, LLC as Respondent and granting it such other relief as the Board deems appropriate.

Respectfully submitted,

AMEREN ENERGY RESOURCES GENERATING COMPANY, INC., an Illinois corporation

BY: _____

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PEOPLE OF THE STATE OF ILLINOIS
LISA MADIGAN
ATTORNEY GENERAL

MATTHEW J. DUNN, Chief
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Dated: July 14, 2016

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

PEOPLE OF THE STATE OF ILLINOIS,	)	
	)	
Complainant,	)	
	)	
v.	)	**PCB NO. 13-41**
	)	**(Enforcement – Land)**
AMERENENERGY RESOURCES GENERATING CO., an Illinois corporation, And AMERENENERY MEDINA VALLEY COGEN, LLC, an Illinois limited liability co.,	)	
	)	
Respondents.	)	

NOTICE OF FILING

To: Amy Antoniolli, @ *aantoniolli@schiffhardin.com*
Francis Lyons, @ flyons@schiffhardin.com

PLEASE TAKE NOTICE that I have today filed with the Office of the Clerk of the Pollution Control Board a Motion for Relief from Hearing Requirements, a copy of which is herewith served upon you.

s/Raymond Callery
RAYMOND CALLERY, Assistant Attorney General

Dated: July 18, 2016

Raymond Callery
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BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

PEOPLE OF THE STATE OF ILLINOIS,	)	
	)	
Complainant,	)	
	)	
v.	)	**PCB NO. 13-41**
	)	**(Enforcement – Land)**
AMERENENERGY RESOURCES GENERATING CO., an Illinois corporation, And AMERENENERY MEDINA VALLEY COGEN, LLC, an Illinois limited liability co.,	)	
	)	
Respondents.	)	

MOTION FOR RELIEF FROM HEARING REQUIREMENT

NOW COMES Complainant, PEOPLE OF THE STATE OF ILLINOIS, by LISA MADIGAN, Attorney General of the State of Illinois, and pursuant to Section 31(c)(2) of the Illinois Environmental Protection Act ("Act"), 415 ILCS 5/31(c)(2) (2014), moves that the Illinois Pollution Control Board grant the parties in the above-captioned matter relief from the hearing requirement imposed by Section 31(c)(1) of the Act, 415 ILCS 5/31(c)(1) (2014). In support of this motion, Complainant states as follows:

1. On July 15, 2016, a Stipulation and Proposal for Settlement and Agreed Motion to Join Medina was filed with the Illinois Pollution Control Board in this matter.

2. The parties have reached an agreement on all outstanding issues in this matter as outlined in the Stipulation.

3. All parties agree that a hearing on the Stipulation and Proposal for Settlement is not necessary, and respectfully request relief from such a hearing as allowed by Section 31(c)(2) of the Act, 415 ILCS 5/31(c)(2) (2014).

WHEREFORE, Complainant, PEOPLE OF THE STATE OF ILLINOIS, hereby requests that the Board grant this motion for relief from the hearing requirement set forth in Section 31(c)(1) of the Act, 415 ILCS 5/31(c)(1) (2014).

PEOPLE OF THE STATE OF ILLINOIS
LISA MADIGAN, ATTORNEY GENERAL,

MATTHEW J. DUNN, Chief
Environmental Enforcement/Asbestos
Litigation Division

BY: s/Raymond J. Callery

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