October 23, 2007

Mr. James N. Speakman, PhD, PE
Senior Vice President
ENSAFE
5724 Summer Trees Drive
Memphis, Tennessee 38134

Proposal for Explosive Demolition
Ground Vibration and Noise Monitoring
Milan Army Ammunition Plant
Milan, TN
WPC Proposal CHS-505-2007

Dear Mr. Speakman:

WPC understands that as part of a CERCLA Subpart X Permit Application for the Milan Army Ammunition Plant (hereafter referred to as the Milan AAP), an updated analysis of ground vibration and noise measurements from explosives demolition at the Ammunition Destruction Area (ADA) is desired. Based on our conversations with you, explosive demolitions at the ADA are typically around 200 lb of net explosive weight conducted under 10 feet of soil. These conditions vary significantly from those previously analyzed in 1956 (see Doelle et al., 1957¹).

WPC will conduct measurements of ground vibrations and noise/overpressure during normal demolition activities at the ADA and prepare a report summarizing our findings and conclusions from these measurements signed by a Professional Engineer (PE) registered in the state of Tennessee. The estimated cost of these services is $20,000.00. The following sections detail our proposed scope of work, our qualifications, and the associated costs estimates.

SCOPE OF WORK

Our proposed scope of work consists of the following activities:

1. Available Documentation Review.
2. Planning and Implementation of onsite Ground Vibration and Noise Monitoring during Explosive Demolition at ADA.
3. Site Data Analyses
4. Summary Report Submittal

Available Documentation Review:
Upon receiving authorization to begin work, WPC will conduct a thorough review of the available documentation related to ground vibrations and noise from explosive detonations at the Milan AAP. This documentation will include the Doelle et al. (1957) Report; the US Army Environmental Hygiene Agency Environmental Noise Assessment Report No. 52-34-0431-86 dated July, 1986; Tennessee and Federal regulations regarding ground vibrations and noise from open surface mining (which is similar to explosive demolition activities); and relevant technical literature. Relevant information from this review, such as air blast pressures with distance in the Doelle et al. (1957) Report, will be noted for use in the remaining scope of work items.

Onsite Ground Vibration and Noise Monitoring:
Concurrent with the Available Documentation Review, WPC will plan a ground vibration and noise monitoring program for the site to coincide with the scheduling of explosives demolition at the ADA. Relevant information from the available documentation review will be incorporated into this monitoring plan, as will site access and training issues. WPC will require ENSAFE to provide information relating to ADA scheduling and Milan AAP site access.

Once a monitoring program has been developed, WPC will send personnel and equipment to Milan AAP to conduct the ground vibration and noise measurements. WPC will provide and install Instantel MiniMate Plus seismographs with external tri-axial geophones and linear microphones for these measurements. The MiniMate Plus seismograph, manufactured by Instantel Incorporated of Ontario, Canada, is a portable data acquisition system that uses a tri-axial geophone to measure velocities on three axes.
relative to the demolition operations and activities: vertical, transverse, and longitudinal. The attachment of a linear microphone allows for the noise and overpressure measurements to be taken concurrently with vibration measurements. A typical instrumentation setup used for monitoring blast vibrations and noise during the demolition of the Old Cooper River bridges in Charleston, SC is shown in Figure 1. A similar instrumentation setup is expected to be used during the Milan AAP monitoring.

Figure 1. Ground Vibration and Noise Monitoring Setup used during Old Cooper River Bridge Demolition.

Ground vibration monitoring will be conducted in general accordance with the International Society of Explosives Engineers (ISEE) Field Practice Guidelines for Blasting Seismographs (1999) and ASTM Work Item WK7731 Test Method for Measurement of Ground-Borne Vibration. The outdoor noise measurements will be conducted in general accordance with ASTM E1014 “Standard Guide for Measurement of Outdoor A-Weighted Sound Levels”, with the noted exception that no meteorological measurements were taken concurrently with the sound measurements. However, WPC personnel will take atmospheric temperature and relative humidity measurements during
sensor placement and will obtain nearby atmospheric measurements available to the public from other commercial and public agencies (e.g. weather.com and NOAA, respectively).

In addition to the ground vibration and noise measurements, WPC will perform a brief exterior examination of several typical residential and commercial properties nearest to the ADA. This examination will be conducted to determine the general type of construction and relative condition of these structures. This information is useful in determining which ground vibration standard could be considered as appropriate for use at the site. These examinations will be conducted from outside the property boundaries of residential homes outside the Milan AAP boundaries and should not be considered precondition surveys.

**Site Data Analyses:**

WPC will conduct detailed analyses of the previous and current ground vibration and noise data from the ADA explosive demolition monitoring. These analyses will include:

1. Development of Ground Vibration and Noise Attenuation (i.e. Dissipation) Relationships with Scaled Distance.
2. Development of Ground Vibration and Noise Level Contours from the ADA.

Analysis of ground vibration and noise attenuation relationships with Scaled Distance (SD) normalizes the measurements of the various explosive demolitions with net explosive weight, thereby allowing direct comparison of all the measurements. An example of SD attenuation relationships is provided in Figure 2, which shows the air blast pressure data from Table H (Doelle et al., 1957).

From the available data, WPC will construct contours of ground vibrations and noise levels from the ADA. These contours will be plotted on site maps provided to WPC by ENSAFE. An example of ground vibration contours developed by WPC from site data is provided in Figure 3.
Figure 2. Air Blast Peak Pressures with Scaled Distance (after Doelle et al., 1957).

Figure 3. Example of Ground Vibration Contours generated from Vibration Measurements (Automotive Plant, Upstate SC).
Once the attenuation and contour plots have been generated, WPC will compare the data to relevant applicable Local, Federal, and International standards, regulations, and guidance relating to ground vibration and noise generated from open surface mining and transportation projects. These standards, regulations, and guidance documents include but are not limited to Siskind et al. (1980)\(^2\), US Army Corp of Engineers ETL 1110-1-142, FTA (1995)\(^3\), and AASHTO (1996)\(^4\).

**Summary Report Submittal:**
At the conclusion of our fieldwork and subsequent analyses, WPC will submit a summary report signed by a Professional Engineer registered in the state of Tennessee. This report will contain our monitoring data, subsequent analyses, conclusions based on our analyses, and recommendations on how to apply the supplied data.

**QUALIFICATIONS**

**Company**
WPC is a geotechnical, environmental, and construction materials testing firm with over 15 years experience with monitoring construction and demolition activities. Recent WPC ground vibration and noise monitoring during blasting includes the demolition of the Old Cooper River Bridges (i.e. the John P. Grace Memorial and Silas Pearman Bridges) in Charleston, SC. WPC developed and implemented the ground vibration and noise monitoring plan for this project, which included blast demolition of the truss sections over Town Creek near existing residential and commercial properties. A photograph of demolition of the John P. Grace Bridge main truss section is presented in Figure 4.

In addition to our project work, WPC engineers have published several technical papers regarding construction vibrations and are actively involved in ongoing ground vibration research with the Pile Driving Contractors Association (PDCA) and the Citadel in developing and analyzing a pile driving noise and vibration database.


Personnel

The development of the ground vibration and noise monitoring plan and subsequent implementation and analyses for the Milan AAP will be overseen by Edward L. Hajduk, D.Eng, PE. Dr. Hajduk is a Licensed Professional Engineer with over nine years of experience in geotechnical engineering and instrumentation. Dr. Hajduk is also an assistant professor of civil engineering at the Citadel in Charleston, SC. Dr. Hajduk has extensive experience in ground vibrations and geotechnical/structural instrumentation. Notable projects include developing construction vibration criteria for the Charleston, SC area (Hajduk et al., 2004\(^5\)), the Old Charleston High School Project, developing the monitoring plan for existing structures and ground vibrations for the old Cooper River Bridges Demolition project, developing the monitoring plan for the existing Maryland abutment during pile driving operations for the new Maryland Abutment for the Woodrow Wilson Bridge project, and conducting ground vibration monitoring for numerous driven pile projects in the Charleston, SC area. Dr. Hajduk is the lead researcher in the development of driven pile ground vibration case history database for the Pile Driving Contractors Association (PDCA) (www.piledrivers.org/vibrationdb.php).


Mr. Craig Skiles will conduct the major portion of field measurements. Mr. Skiles is a project professional at WPC Inc. with over 4 years of experience in ground vibration monitoring and structural condition assessments. Mr. Skiles experience related to ground vibration and existing structure monitoring includes Hopsewee Plantation, the Old Cooper River Bridges Demolition, the Woodrow Wilson Bridge, Bridge 91 over the Yadkin River, and conducting pre-construction surveys and ground vibration monitoring for numerous driven pile projects in the Charleston, SC area.

COMPENSATION FOR SERVICES AND SCHEDULE

Based on our cursory review of the provided project information and our experience with similar projects, we estimate that a monitoring plan can be developed in one (1) week. Mobilization to the site to conduct field measurements will require a minimum of ten (10) days notification, in order that we can procure the required instrumentation and desired personnel. We estimate that field monitoring can be conducted in one (1) week, provided that WPC has access to site during the week and that a minimum of one (1) explosive demolition per day will occur at the ADA during our visit. We recommend that a minimum of five (5) explosive demolition blasts be monitored.

The total estimated cost for our proposed scope of work is $20,500. Table 1 presents a detailed breakdown of our cost estimate.

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**TOTAL:** $20,500

NOTES:

1. Based on travel from Charleston, SC to Milan, TN.
2. Engineer Site Visit for 1 day. Includes travel expenses.
Based on our conversations, we anticipate that our work will be scheduled at a time when at least one blast per day will occur, with the possibility that multiple blasts can be coordinated per day. It is our intent to monitor at least five (5) blasts with variable vibration monitor placements. If we reach this number in less than five days we will pass these savings on to you with reduced time in the field, or alternately collect additional data with the remaining days, depending on budget constraints. We understand any training/security badging, etc. will likely be limited to a few hours the first morning of our visit. If our personnel require escorts on the site premises, the escorts are to be provided by base personnel. Our base mobilization fee includes our field personnel to have a two wheel drive vehicle that we will provide (will drive it to site from Charleston). If field conditions dictate us needing a four wheel drive vehicle, we will rent a vehicle locally and pass that cost on to Ensafe at cost plus 15%. If after mobilization, weather delays or other delays beyond our control will be billed at the unit rate of $1,300.00 per day from the unit rates in Table 1.

CLOSURE

Our “Agreement for Professional Services” is attached and is incorporated as a part of this proposal. Please indicate your acceptance of our proposal by signing the attached “Agreement for Professional Services” and returning the signed copy to our office. We will execute the “Agreement for Professional Services” and return a copy to you for your files. We will then proceed with the performance of our services.

WPC appreciates this opportunity to provide the proposed services to you. Please us at (843) 884-1234 with any questions regarding this proposal or if you require any additional information.
Respectfully submitted,

WPC, Inc.

Edward Hajduk, D.Eng., P.E.
Senior Engineer

Donovan L. Ledford, PE
Geotechnical Department Manager

Attachments: Agreement for Professional Services