20-80-002-1993

MEMORANDUM

DEPARTMENT OF ENVIRONMENTAL QULAITY

WASTE DIVISION

TO: Hassan Vakili and Part B Team Supervisors

FROM: Richard Essex

DATE: April 14, 1993, references revised November 13, 2002

SUBJECT: Seismic Impact Zone, Part A Demonstration Requirements.

Section 250 A.6. of the revised VSWMR is a siting criterion that prohibits the siting of new sanitary landfills or lateral expansions of existing units in Seismic Impact Zones. SIZs, as defined by the Regulations, encompass most of Virginia with the exception of extreme southeastern VA (Chesapeake and Virginia Beach) and the eastern shore. Therefore, the vast majority of applicants currently seeking landfill permits in the Commonwealth will have to make the demonstration required by § 250 A.6.

No specific requirements for the SIZ demonstration have been established. This has caused considerable consternation for the regulated community. Below is an attempt to clarify the requirements for the stipulated demonstration. Please note that the requirements outlined below are only intended to satisfy the "siting criterion" and do not address actual design features for mitigation of seismic effects. Please forward any comments concerning the adequacy of the demonstrations, outlined below, directly to me. My office number is 1-0552.

Seismic Impact Zone Demonstration

I. Simple Determination

A. See Algermissen et al. (1990) to determine if proposed facility is within a seismic impact zone.

B. Multiply the horizontal acceleration, with a 10% chance of occurring in 250 years (as taken directly from Algermissen et al., 1990), by the soil amplification factor appropriate for the site. Controlling variables for a soil amplification factor are depth, density, and grain size. (i.e., deep coarse-grained, and unconsolidated sediments may cause significant amplification of the maximum horizontal acceleration as calculated for the underlying bedrock.) Soil amplification factors generally range between 1.0 and 2.0.

C. Determine liquefaction potential at the proposed site. This determination should consider both liquefaction opportunity and liquefaction susceptibility. {Seed et al. (1983) and Seed and Idriss (1982) are two referenes that address liquefaction potential}

D. Indicate that all containment structures including liners, leachate collection systems, and surface water control systems will be designed to withstand the acceleration calculated in I.B. It should also be shown that the landfill facility will be constructed to mitigate any instability that might result from liquefaction.

II. Site Specific Determination:

A. See Algermissen et al. (1990) to determine if proposed facility is within a seismic impact zone.

B. Do a site specific evaluation to determine the horizontal acceleration with a 10% chance of occurring in 250 years. This evaluation, at a minimum, should consider the following:

1. Local seismic sources (point, linear, zone).
2. A calculation of magnitude frequency distribution for the area in question.
3. A calculation of ground motion attenuation.
4. Extreme cumulative probability of ground motion for a 250 year period. One acceptable algorithm for this calculation is:

$F_{max,t}(a) = e^{-\Phi t[1-F(a)]}$ Algermissen et al. (1990)

$F_{max,t}(a)$	probability
a	amplitude
t	time
Φ	mean rate of occurrence
F(a)	cumulative distribution of ground motion

C. Multiply the calculated horizontal acceleration, with a 10% chance of occurring in 250 years by the soil amplification factor appropriate for the site. (See I.B. in the simple determination above.)

D. Determine liquefaction potential (See I.C. in the simple determination above.)

E. Indicate that all containment structures including liners, leachate collection systems, and surface water control systems will be designed to withstand the acceleration calculated in I.C. It should also be shown that the landfill facility will be constructed to mitigate any instability that might result from liquefaction.

SUGGESTED REFERENCES

Algermissen, S.T., Perkins, D.M., Thenhaus, P.C., Hanson, S.L., and Bender, B.L., 1982, Probabilistic Estimates of Maximum Acceleration and Velocity in Rock in the Contiguous United States, USGS, Open-File Report, 82-1033.

Algermissen, S.T., Perkins, D.M., Thenhaus, P.C., Hanson, S.L., and Bender, B.L., 1990, Probabilistic Earthquake Acceleration and Velocity Maps for the United States and Puerto Rico., USGS, Miscellaneous Field Study maps, MF-2120.

Inyang, H.I., 1991, Aspects of Landfill Design for Stability in Seismic Zones., Journal of Environmental Systems, 21:223–235.

Inyang, H.I., 1991, Hazardous Waste Facilities in Seismic Zones., Dept. of Civil Engineering University of Wisconsin-Platteville, Platteville, WI 53818.

Seed, H.B., Idriss, I.M., and Arango, I., 1983, Evaluation of Liquefaction Potential Using Field Performance Data., Journal of Geotechnical Engineering, 109:458.

Seed, H.B., Idriss, I.M., and Arango, I., 1982, Ground Motions and Soil Liquefaction During Earthquakes, Monograph Series, Earthquake Engineering Research Center, Berkley CA 94720.