TECHNICAL MEMORANDUM

Seismic Impact Zone Demonstration, Ponds M5 and M7, Reid Gardner Station

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This technical memorandum is the seismic impact zone demonstration for Ponds M5 and M7 and was created to satisfy the requirements of §257.63 of the U.S. Environmental Protection Agency's Coal Combustion Residuals (CCR) Rule. This demonstration must be placed in the Station's operating record as it becomes available, but not later than October 17, 2018 per §257.63(c)(1), §257.63(c)(3), and §257.105(e). Within 30 days of placement, the State Director must be notified as required by §257.106(d) and §257.106(e). Also, within 30 days of placement, the assessment must be placed on a publicly accessible Internet site per §257.107(d) and §257.107(e).

Background

Ponds M5 and M7 are existing CCR surface impoundments at NV Energy's Reid Gardner Station. The Station is no longer operational and can no longer create CCR waste. However, the impoundments contain legacy CCR waste and still accept other flows from the Station. Ponds M5 and M7 are adjacent CCR units that consist of earthen embankments lined with two layers of geomembrane with an interstitial leak detection and collection system (CH2M, 2016a). Although the impoundments are lined, they are classified as existing unlined CCR surface impoundments per §257.71(a)(3)(i) of the CCR Rule (CH2M, 2016b).

Ponds M5 and M7 were designed, permitted, and constructed prior to the publication of the CCR Rule and in conformance with applicable State regulations and guidance documents (CH2M, 2016a). The Ponds M5 and M7 design was submitted to the State of Nevada, Division of Water Resources (State Engineer) as part of an application package dated May 7, 2010 (NV Energy, 2010). The application package included the design report (CH2M HILL, 2010), the design geotechnical report, (Converse, 2009), specifications (CH2M, 2016a), and drawings (CH2M, 2016a). The Ponds M5 and M7 design was approved, and their construction authorized, by the State Engineer on June 22, 2010. The request for permanent approval to impound water was submitted to the State Engineer on July 20, 2011 and included a Construction Certification Report (CH2M, 2016a). The authorization to impound water was granted by the State Engineer on September 2, 2011.

Seismic Impact Zone Determination

Ponds M5 and M7 are in a seismic impact zone per the definitions in §257.53 of the CCR Rule. That section defines a seismic impact zone as "an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 50 years." According to the 2014 U.S. Geological Survey (USGS) National Seismic Hazard Map, the entire State of Nevada has a peak acceleration greater than 0.1 g (Attachment 1; USGS, 2014a).

A seismic Site Class of C should be used for design based on recommendations in the design geotechnical report (Converse, 2009). This recommendation was based on standard penetration test blow count data obtained during the design geotechnical exploration.

Requirements and Guidance for Seismic Impact Zone Demonstrations

NV Energy must demonstrate that Ponds M5 and M7 were designed to resist seismic loading because the impoundments are in a seismic impact zone. More specifically, the NV Energy must demonstrate that "all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site" (§257.63(a)).

Per §257.53, maximum horizontal acceleration in lithified earth material is defined to be "the maximum expected horizontal acceleration at the ground surface as depicted on a seismic hazard map, with a 98% or greater probability that the acceleration will not be exceeded in 50 years, or the maximum expected horizontal acceleration based on a site-specific seismic risk assessment." This equates to a peak ground acceleration with a 2% change of exceedance in 50 years or a return period of approximately 2,500 years.

Although §257.63 of the CCR Rule does not contain specific requirements for seismic impact zone demonstrations, guidance is provided in Section VI.C.5 of the preamble (register pages 21366 and 21377). This technical memorandum has been organized to mirror that guidance, which states that for CCR "units located in seismic impact zones, as part of any demonstration, owners and operators should include" the following items, taken verbatim:

- A determination of the expected peak ground acceleration from a maximum strength earthquake that could occur in the area
- A determination of the site-specific seismic hazards such as soil settlement
- A facility design that is capable of withstanding the peak ground acceleration. Seismic designs broadly should include…
    - A response analysis to quantify the demands of earthquake motion on facility structures (i.e. landfills, surface impoundments, liners, covers, and leachate collection systems, surface water handling systems)
    - Liquefaction analyses of both waste and foundation soils to evaluate stability under seismic loading
    - Slope stability and deformation analyses
    - Design modifications to accommodate seismic risks should include
        - Conservative design risk factors
        - Use of ductile materials
        - Built-in redundancy for critical system components
        - Other measures capable of mitigating the potential for seismic upset
- In practice, the Agency [US EPA] recognizes that the CCR unit may sustain some limited damage during an earthquake, but ultimately, the CCR unit must remain capable of preventing harmful release of CCR, leachate, and contaminants both during and after the seismic event.

Peak Ground Acceleration Determination

According to the USGSs web-based U.S. Seismic Design Maps tool, the peak ground acceleration with a 2% chance of exceedance in 50 years at Ponds M5 and M7 is 0.276 g (Attachment 2; USGS, 2014b). This value is for a location with a seismic Site Class of B. This result is consistent with the 0.2 to 0.3 g range shown on the 2014 USGS National Seismic Hazard Map (Attachment 1; USGS, 2014a).

The USGSs web-based U.S. Seismic Design Maps tool also provides a site coefficient (F_{PGA}) of 1.124 for converting a seismic Site Class B peak ground acceleration to a value for seismic Site Class C (Attachment 2; USGS, 2014b). Multiplying the site coefficient by the Class B value of 0.276 g gives a peak ground acceleration of 0.310 g for a Class C site. This value will be used for analysis because the site has a seismic Class of C (Converse, 2009), and is what was used in the Initial Ponds M5 and M7 Safety Factor Assessment (CH2M, 2016c).

Site-Specific Seismic Hazard Determination

This section of the document will discuss potential seismic hazards to determine which apply to Ponds M5 and M7. According to published reference documents, “the most important seismic hazards” include ground shaking, structural hazards, liquefaction, landslides and slope failures, retaining structure failures, lifeline hazards, and tsunami and seiche hazards (Kramer, 1996).

Ground shaking “can be considered the most important of all seismic hazards because all other hazards are caused by ground shaking” (Kramer, 1996). This is a potential seismic hazard of concern for Ponds M5 and M7 because the impoundments are in a seismic impact zone per the definitions in §257.53 of the CCR Rule.

Structural hazards include the damage or collapse of buildings and other structures. This seismic hazard is not a potential hazard of concern for Ponds M5 and M7 because there are no buildings, occupied structures, or structurally significant structures associated with the impoundments. Each impoundment contains three steel mixing bridges founded on reinforced concrete piers. However, the potential for bridge failure to cause a harmful release of CCR is considered low because bridges are not a structural component of the earthen embankments. They potential risk associated with the bridge collapse is that debris could rip or puncture the liner system. The bridges were designed for seismic loading, so it is considered unlikely that a collapse could occur. If a bridge were to collapse, however, it is considered unlikely that a structural element would penetrate the CCR, the primary (upper) liner, the interstitial drainage layer, and the secondary (lower) liner, and cause a harmful release. Therefore, structural hazards do not appear to be a relevant seismic hazard for the ponds.

Soil liquefaction can cause landslides and other slope failures, lateral spreading, sand boils, and soil settlement, when susceptible soils are situated below the groundwater level. This seismic hazard is not a potential hazard of concern for Ponds M5 and M7 because liquefaction in this location is not considered possible because of the soil and groundwater conditions (CH2M, 2016c). The impoundments are founded on dense or cemented sands and gravels, and the depth to groundwater is on the order of 100 feet (Converse, 2009).

Earthquake shaking can also cause landslides or slope failures where the slope configuration or soil shear strengths creates susceptibility. Seismically induced landslide hazards are not a potential hazard of concern for Ponds M5 and M7 because of the surrounding topography and underlying geology. The surrounding ground surface is relatively flat, and the few native slopes are shallowly sloping, short, and made of dense or cemented soils. Slope failure of the pond embankments is a potential hazard of concern for Ponds M5 and M7, and is discussed later in the ponds design section of this demonstration.

Retaining wall failures sometimes occur during or after earthquake ground shaking. This is not a potential hazard of concern for Ponds M5 and M7 because there are no retaining structures at or near the impoundments.

Lifelines are defined as “a network of facilities that provide the services for commerce and public health (Kramer, 1996). Seismic lifeline hazards are not potential hazard of concern for Ponds M5 and M7 because there are no lifelines adjacent to or associated with the impoundments. Although there are electric power and process wastewater utilities at Ponds M5 and M7, they only serve the impoundments and it is unlikely that their presence or failure would affect commerce or public health. And because the Station no longer produces power, failure of the process wastewater piping would not affect power generation or cause a CCR release to the environment.

Seismic waves and ground movement can cause tsunamis and seiches, which are large waves in the sea and enclosed bodies of water, respectively. Tsunamis are not a potential hazard of concern for Ponds M5 and M7 because the site is not near the sea. Seiches are not considered a potential hazard of concern for Ponds M5 and M7 because subsurface conditions make it unlikely that seiches would occur. In order “for an earthquake to cause significant seiche waves that could overtop the dam, it would likely need to be accompanied by either a large landslide, or coseismic movement of the reservoir basin (vertical fault displacement within the reservoir, or tilting of the reservoir basin)” (Bureau of Reclamation, 2015). Landslides and other slope failure inside the ponds are unlikely because the slopes are engineered cut or fill slopes with acceptable factors for safety. And there are no indications of faults or fractures underneath the ponds that could cause ground movement.

Facility Design

A seismic site response analysis is not needed for the design of Ponds M5 and M7 because the ground shaking value used for analysis, the peak ground acceleration, is conservative and has been adjusted to be site-specific. The USGS tool used to determine the peak ground acceleration (Attachment 2; USGS, 2014b) uses seismic design parameters from major U.S. building codes (CH2M, 2016c). The code values are generally conservative, and were modified to the Ponds M5 and M7 location using a seismic site coefficient and the results of a geotechnical exploration (Converse, 2009). Omitting a seismic site response for select dam design is in keeping with the local standard of practice and regulations for dam design (CH2M HILL, 2010).

Liquefaction analysis was not required for the design of Ponds M5 and M7 because the groundwater depth is on the order of 100 feet below ground surface, which eliminates liquefaction as a credible concern(CH2M, 2016c). The potential for liquefaction of the CCR waste is not a concern because the material is already assumed to be liquid in all stability analyses (solid CCR waste would improve stability).

Slope stability analyses performed as part of design (CH2M HILL, 2010) and for CCR Rule compliance after construction (CH2M, 2016c) found acceptable factors of safety against slope instability. Deformation analyses are not necessary for Ponds M5 and M7 based on site conditions, engineering judgment, construction quality documentation (CH2M, 2016a), and published recommendations (Bureau of Reclamation, 2015). The Bureau states that “deformation analysis is generally not required if all of the following [seven] conditions are satisfied.” The Ponds M5 and M7 site meets all seven conditions, which include (1) absence of sensitive clay or other liquefiable soil, (2) compaction to 95% relative compaction [no referenced standard], (3) 2.5:1 (horizontal: vertical) or flatter slopes, (4) peak ground acceleration of not more than 0.35 g, (5) factor of safety of 1.5 or greater for steady-state seepage condition, (6) minimum freeboard of 3 feet, and (7) absence of dam features that could be harmed by small embankment movements.

Conservative risk factors, or factors of safety, were used in design (CH2M HILL, 2010). The factors were in keeping with published reference documents, selected based on engineering judgment, and reviewed and approved by State regulators. And as demonstrated by the Initial Ponds M5 and M7 Safety Factor Assessment (CH2M, 2016c), the design met the safety factor requirements in the CCR Rule.

Ductile materials and ductile elements were included in the design of Ponds M5 and M7. The materials used in the liner system and leak detection and collection system included high-density polyethylene (HDPE) geomembrane, HDPE drainage net, HDPE piping, polyester geotextile, and gravel (CH2M, 2016a). These materials are ductile in nature and not subject to brittle failure modes. The liner anchor trenches were sized so that, in the event of an earthquake, the liners would pull out of the trenches before the tensile strength of the liner was exceeded.

Redundant features were built into the design of critical systems at Ponds M5 and M7. A minimum of two layers of geomembrane liner were used across the pond and three layers were used in liquid collection areas such as sumps (CH2M, 2016a). Two leak collection and detection sumps were installed rather than one. Extra layers of liner, extra welds, and extra clamps were used to seal liner penetrations. Leak detection and collection piping was encased in drain gravel, which will allow the flow of water even if the pipes become clogged.

There are no surface water control structures around Ponds M5 and M7 required to prevent the release of CCR. However, there are stormwater run-on controls including a one to two-foot-tall earthen stormwater diversion berm (CH2M, 2016d), a low-water road crossing, an 18-inch diameter concrete drainage culvert (CH2M 2010), and riprap lined ditches. These minor structures in the vicinity of the pond are not critical to the operation of the impoundments, and can be readily accessed for repair after a seismic event. The foundations and structures for the steel mixing bridges were designed to withstand seismic loading.

Conclusion

This technical memorandum demonstrates that the "structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for" Ponds M5 and M7 as required by §257.63(a). Furthermore, the demonstration contains the elements required and recommended by the CCR Rule. Finally, redundant, ductile, and conservative design features have been included in the design of Ponds M5 and M7 so that the impoundment may be "capable of preventing harmful release of CCR, leachate, and contaminants both during and after the seismic event."

Certification

This section contains the certification by a qualified professional engineer as required by §257.63(b) of the CCR Rule.

This seismic impact zone demonstration meets the requirements of §257.73(a) of the CCR Rule.

References

Bureau of Reclamation. 2015. *Design Standards No. 13., Embankment Dams, Chapter 13: Seismic Analysis and Design, Phase 4: Final.* U.S. Department of the Interior. May.

CH2M. 2016a. *Construction History, Ponds M5 and M7, Reid Gardner Generating Station.* Technical Memorandum. August 26.

CH2M. 2016b. *Documentation of Liner Type, Ponds M5 and M7, Reid Gardner Generating Station.* Technical Memorandum. August 12.

CH2M. 2016c. *Initial Safety Factor Assessment, Ponds M5 and M7, Reid Gardner Generating Station.* Technical Memorandum. August 12.

CH2M. 2016d. *Initial Inflow Design Flood Control System Plan, Ponds M5 and M7, Reid Gardner Generation Station.* October.

CH2M HILL. 2010. *Design Report, Mesa Evaporation Ponds M5 and M7, NV Energy, Reid Gardner station, Moapa, NV.* Technical Memorandum. April 30.

Converse Consultants. 2009. *Geotechnical Investigation, Mesa Evaporation Ponds, Reid Gardner Station, Clark County, Nevada.* Converse Project No. 08-33243-01. May 4.

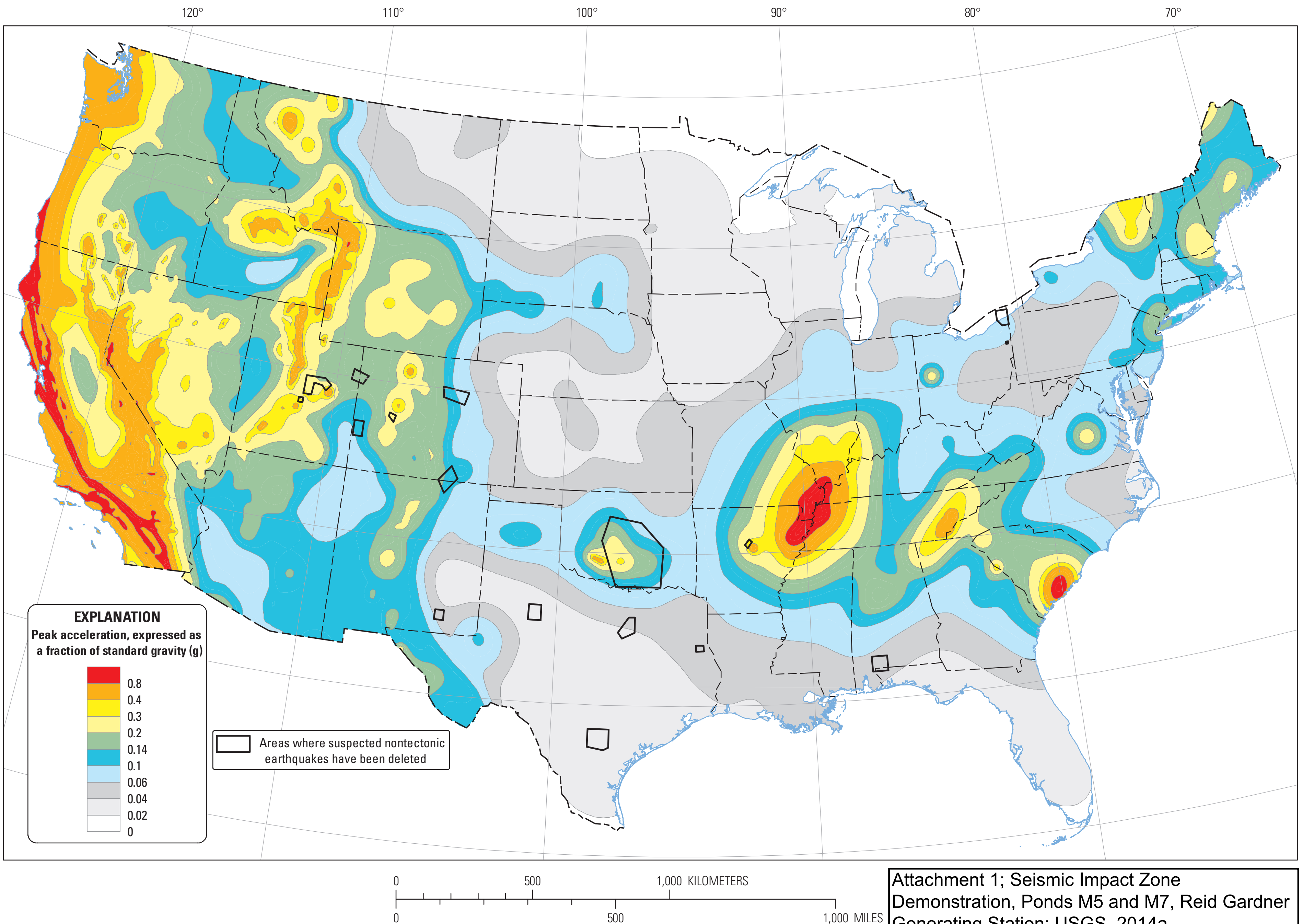
Kramer, Steven L. 1996. *Geotechnical Earthquake Engineering.* Prentice-Hall Inc.

NV Energy. 2010. *Application for Approval of Plans and Specifications for Construction of Dam Mesa Evaporation Ponds M5 and M7, Reid Gardner Station, Moapa, Nevada.* Cover Letter. May 7.

USGS. 2014a. *Two-percent probability of exceedance in 50 years map of peak ground acceleration.* https://earthquake.usgs.gov/hazards/hazmaps/conterminous/index.php#2018. Downloaded on June 28, 2018.

USGS. 2014b. *U.S. Seismic Design Maps.* https://earthquake.usgs.gov/designmaps/us/application.php. Web-based tool. Accessed on June 28, 2018.

Attachment 1
USGS Peak Ground Acceleration Map



Attachment 1; Seismic Impact Zone Demonstration, Ponds M5 and M7, Reid Gardner Generating Station; USGS, 2014a

Two-percent probability of exceedance in 50 years map of peak ground acceleration

Attachment 2
USGS Seismic Design Map

Attachment 2; Seismic Impact Zone Demonstration, Ponds M5 and M7, Reid Gardner Generating Station; USGS, 2014b

USGS Design Maps Detailed Report

ASCE 7-10 Standard (36.642°N, 114.631°W)

Site Class C – "Very Dense Soil and Soft Rock", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1] $S_S = 0.644$ g

From Figure 22-2 [2] $S_1 = 0.203$ g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class C, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ **or** $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index *PI* > 20, • Moisture content *w* ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient F_a

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = C and S_S = 0.644 g, F_a = 1.142

Table 11.4–2: Site Coefficient F_v

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at 1–s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = C and S_1 = 0.203 g, F_v = 1.597

Attachment 2; Seismic Impact Zone Demonstration, Ponds M5 and M7, Reid Gardner Generating Station; USGS, 2014b

Equation (11.4–1): $S_{MS} = F_aS_S = 1.142 \times 0.644 = 0.736$ g

Equation (11.4–2): $S_{M1} = F_vS_1 = 1.597 \times 0.203 = 0.324$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

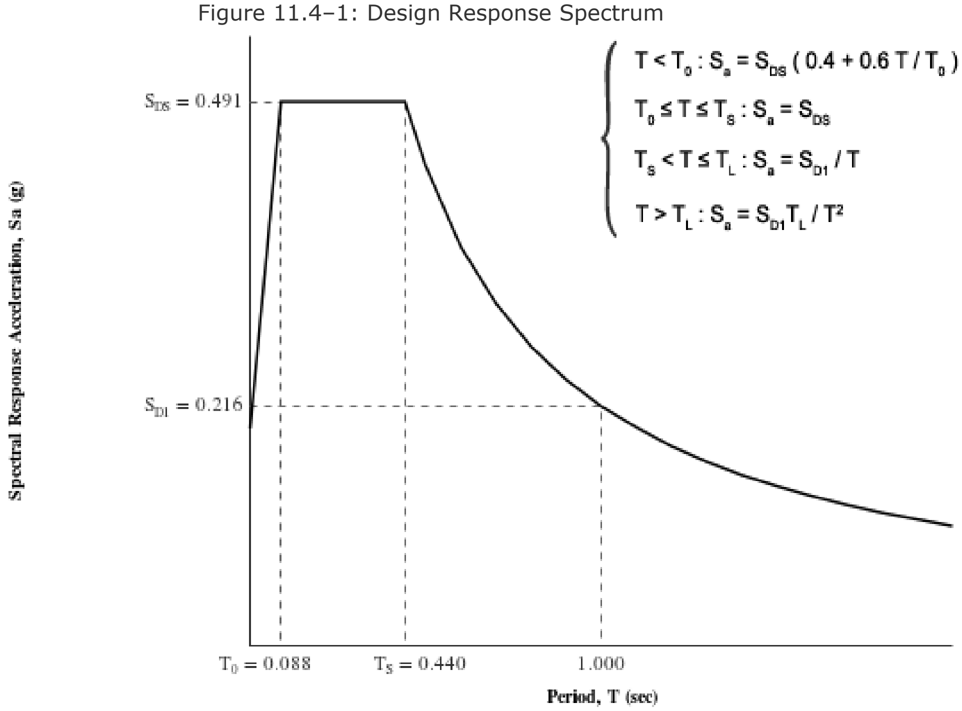
Equation (11.4–3): $S_{DS} = ⅔ S_{MS} = ⅔ \times 0.736 = 0.491$ g

Equation (11.4–4): $S_{D1} = ⅔ S_{M1} = ⅔ \times 0.324 = 0.216$ g

Section 11.4.5 — Design Response Spectrum

From Figure 22-12 [3] T_L = 6 seconds

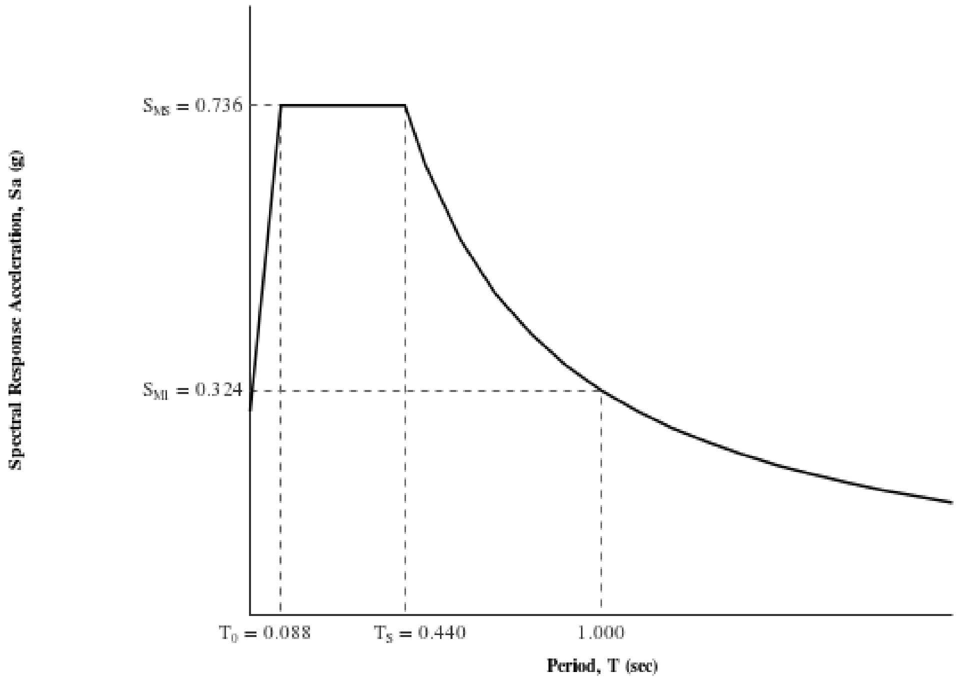
Figure 11.4–1: Design Response Spectrum



Attachment 2; Seismic Impact Zone Demonstration, Ponds M5 and M7, Reid Gardner Generating Station; USGS, 2014b

Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Attachment 2; Seismic Impact Zone Demonstration, Ponds M5 and M7, Reid Gardner Generating Station; USGS, 2014b

Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.276

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.124 \times 0.276 = 0.31$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = C and PGA = 0.276 g, F_{PGA} = 1.124

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 0.858

From Figure 22-18 [6] C_{R1} = 0.895

Attachment 2; Seismic Impact Zone Demonstration, Ponds M5 and M7, Reid Gardner Generating Station; USGS, 2014b

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 0.491 g, Seismic Design Category = C

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.216 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

Attachment 2; Seismic Impact Zone Demonstration, Ponds M5 and M7, Reid Gardner Generating Station; USGS, 2014b

References

1. *Figure 22-1*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf