INITIAL SAFETY FACTOR ASSESSMENT
PLANT CRIST GYPSUM STORAGE AREA
GULF POWER COMPANY

EPA's "Disposal of Coal Combustion Residuals from Electric Utilities" Final Rule (40 C.F.R. Part 257 and Part 261), §257.73(e), requires the owner or operator of an existing CCR surface impoundment to conduct periodic safety factor assessments. The owner or operator must document that the minimum safety factors outlined in §257.73(e)(1)(i) through (iv) for the critical embankment section are achieved.

The CCR surface impoundment located at Gulf Power Company's Plant Crist, also referred to as the Plant Crist Gypsum Storage Area, is located on Plant Crist property north of Pensacola, Florida. The CCR surface impoundment is formed by an engineered perimeter embankment. The critical section of this CCR unit has been determined to be located at the tallest point of the perimeter embankment, located on the western side of the facility.

The analyses used to determine the minimum safety factor for the critical section resulted in the following minimum safety factors:

Loading Condition	Minimum Calculated Safety Factor	Minimum Required Safety Factor
Long-term Maximum Storage Pool (Static)	2.4	1.5
Maximum Surcharge Pool (Static)	2.4	1.4
Seismic	2.2	1.0

The embankments are constructed of soils that have potential susceptibility to liquefaction due to soil classification and grain size. The minimum calculated liquefaction safety factor is greater than 5.0, which exceeds the required minimum safety factor of 1.2.

I hereby certify that the safety factor assessment was conducted in accordance with 40 C.F.R. Part 257.73 (e)(1).

10/12/16

James C. Pegues, P.E.
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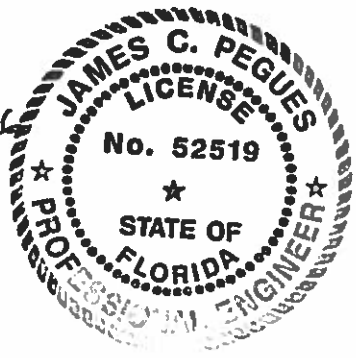


SOUTHERN COMPANY

Engineering and Construction Services Calculation

Calculation Number:
TV-CR-FPC165656-001

Project/Plant:	**Unit(s):**	**Discipline/Area:**
Plant Crist Gypsum Storage Area	-	TS-ENVSFS
Title/Subject: Factor of Safety Analysis		
Purpose/Objective: Analyze Factor of Safety of the Gypsum Storage Area		
System or Equipment Tag Numbers: NA	**Originator:** Joshua A. Lippert, P.E.	

Contents

Topic	Page	Attachments (Computer Printouts, Tech. Papers, Sketches, Correspondence)	# of Pages
Purpose of Calculation	2		
Summary of Conclusions	2		
Methodology	2		
Assumptions	2		
Criteria	3		
Design Inputs/References	4		
Body of Calculation	4-7		
Total # of pages including cover sheet & attachments:	7		

Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
0	Issued for Information	JAL/10-5-16	GHM/10-5-16	JCP/10-5-16

Notes:

Purpose of Calculation

Gulf Power Company's Plant Crist operates a flue gas desulfurization system (FGD scrubber) on Units 4 through 7. This process produces gypsum as a by-product. The FGD gypsum is sluiced to a storage facility for dewatering and storage. The Gypsum Storage Facility is constructed of a compacted soil perimeter berm and has a composite liner system, including a full underdrain system. This calculation is intended to calculate the stability of the perimeter berm and stacked gypsum at the gypsum facility.

Summary of Conclusions

The results of the analyses are summarized below. Output graphics are located in the body of the calculations. The analyses indicate that the exterior berms and gypsum stack are stable with a factor of safety against sliding greater than 2.0 for all analyzed cases.

Condition	Minimum Required Factor of Safety	Calculated Factor of Safety
Static with Maximum Storage Pool	1.5	2.37
Static with Maximum Surcharge Pool	1.4	2.37
Seismic	1.0	2.28

Methodology

The calculation was performed using the following method and software:

SLOPE/W, Version 8.15, Copyright 1991-2016 GEO-SLOPE International Ltd., Calgary, Alberta, Canada, using the Morgenstern-Price method.

Strata (Version alpha, Revision 0.2.0), Geotechnical Engineering Center, Department of Civil, Architectural, and Environmental Engineering, University of Texas.

Assumptions

The slope stability model was run using the following assumptions:

- Gypsum will be stacked/sluiced to a maximum height of EL186, approximately 85 feet above the base grade.

- Gypsum berms used as interior perimeter berms (future operational berms) will be constructed as shown on the design drawings with a 3H:1V outboard slope and a 3H:1V inboard slope. The berms will be constructed with 24-foot top widths and will be approximately 20-feet high.
- The gypsum is assumed to gain strength as it consolidates.
- The drainage system will be kept free and clear and will remain functional for the duration of sluicing operations.
- The properties of unit weight, phi angle, and cohesion of the soil and gypsum were taken from Table 4-7 of the geotechnical report. Material properties are as follows:

Soil Type	Unit Weight, pcf	Cohesion, psf	Phi Angle, deg
Foundation Soil	110	100	30
Embankment	110	100	32
Compacted Gypsum	85	0	40
Sluiced Gypsum Top (prior to consolidation)	70	0	23
Sluiced Gypsum (after consolidation)	80	0	25

Criteria

The slope stability analyses were based on the most recent design and as-built drawings available at the time of this calculation. Soil and gypsum properties were obtained from the June 2007 *Plant Crist Gypsum Storage Area Hydrogeological and Geotechnical Investigation Report* by the Earth Science and Environmental Engineering (ES&EE) group of Southern Company Generation.

The following scenarios were evaluated for the fully stacked condition:
1. Static with Maximum Storage Pool
2. Static with Maximum Surcharge Pool
3. Seismic Loading – Maximum storage pool plus seismic loading of 0.012g

Seismic site response was determined using a one-dimensional equivalent linear site response analysis. The analysis was performed using Strata and utilizing random vibration theory. The input motion consisted of the USGS published 2008 Uniform Hazard Response Spectrum (UHRS) for Site Class B/C at a 2% Probability of Exceedance in 50 years. The UHRS was converted to a Fourier Amplitude Spectrum, and propagated through a representative one dimensional soil column using linear wave propagation with strain-dependent dynamic soil properties. The input soil properties and layer thickness were randomized based on defined statistical distributions to perform Monte Carlo simulations for 100 realizations, which were used to generate a median estimate of the surface ground motions.

The median surface ground motions were then used to calculate a pseudostatic seismic coefficient for utilization in the stability analysis using the approach suggested by Bray and Tavasarou (2009). The procedure calculates the seismic coefficient for an allowable seismic displacement and a probability exceedance of the displacement. For this analysis, an allowable displacement of 0.5 ft, and a probability of exceedance of 16% were conservatively selected, providing a seismic coefficient of 0.012g for use as a horizontal acceleration in the stability analysis.

Design Inputs/References

Southern Company Services, Inc., 2007, *Plant Crist Gypsum Storage Area, Hydrogeological and Geotechnical Investigation Report*, Birmingham, AL

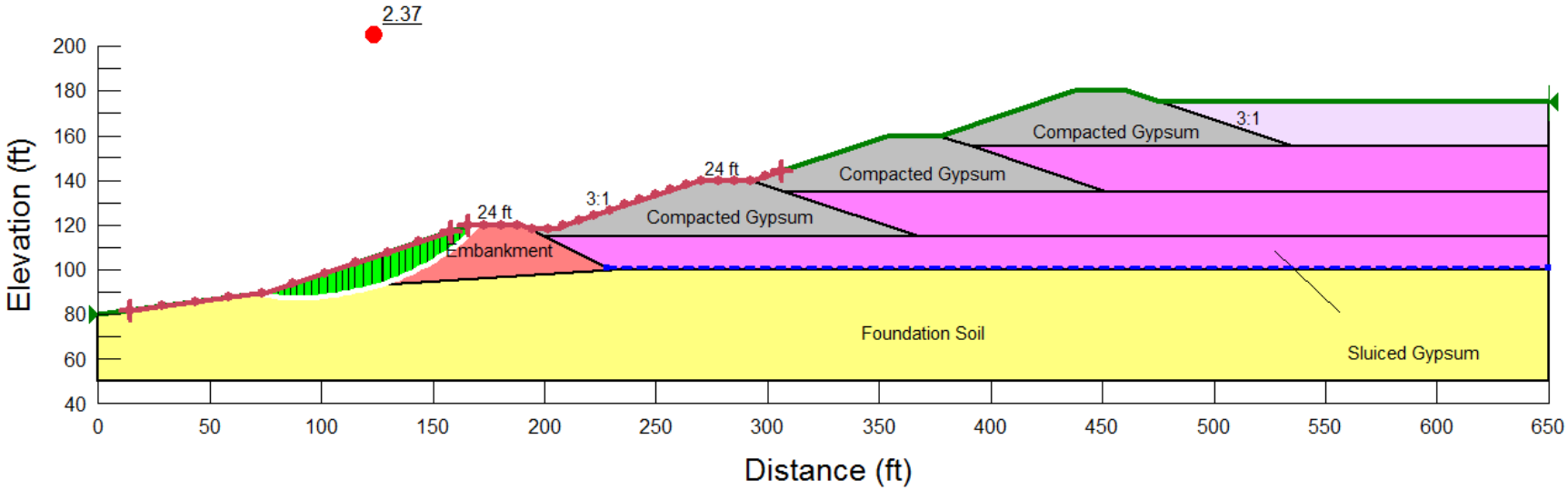
Design and Operation Plan (D&O) Drawings E4C39038, E4C39046, and E4C39047

Bray, J. D. and Travasarou, T., *Pseudostatic Coefficient for Use in Simplified Seismic Slope Stability Evaluation*, Journal of Geotechnical and Environmental Engineering, American Society of Civil Engineers, September 2009

Body of Calculation

See following pages.

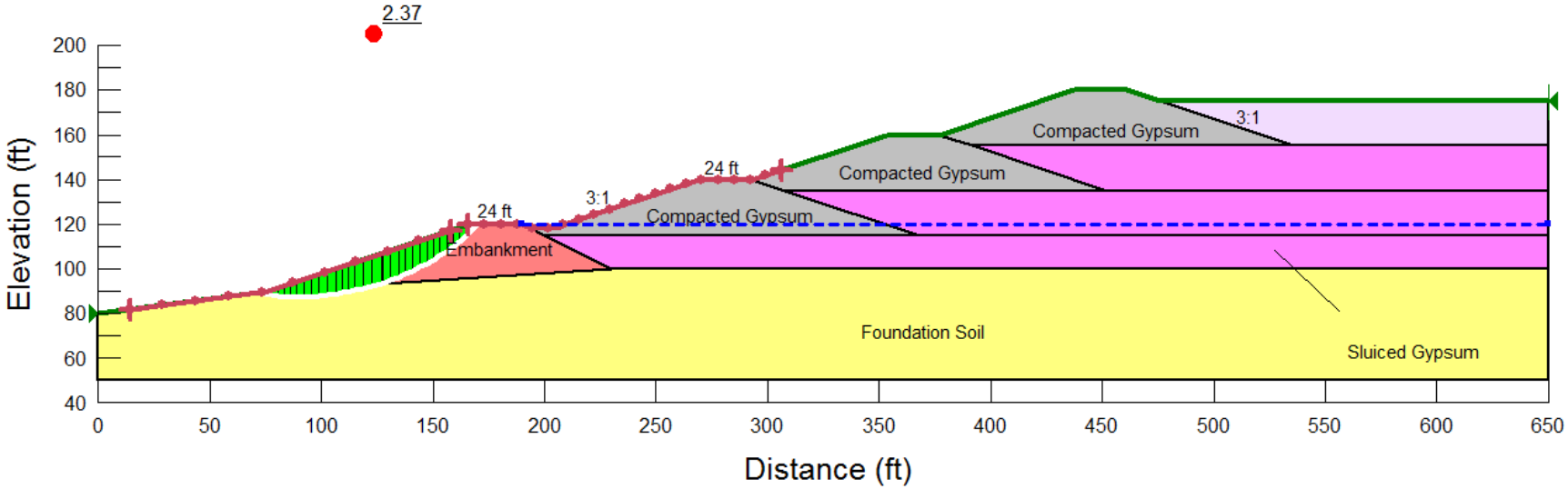
Plant Crist Gypsum Storage Facility
Name: Static - Max Storage Pool
Method: Morgenstern-Price
Horz Seismic Coef.: 0



Materials
- Sluiced Gypsum Top
- Compacted Gypsum
- Sluiced Gypsum
- Embankment
- Foundation Soil

Name: Sluiced Gypsum Top Unit Weight: 70 pcf Cohesion': 0 psf Phi': 23 °
Name: Compacted Gypsum Unit Weight: 85 pcf Cohesion': 0 psf Phi': 40 °
Name: Sluiced Gypsum Unit Weight: 80 pcf Cohesion': 0 psf Phi': 25 °
Name: Embankment Unit Weight: 110 pcf Cohesion': 100 psf Phi': 32 °
Name: Foundation Soil Unit Weight: 110 pcf Cohesion': 100 psf Phi': 30 °

Plant Crist Gypsum Storage Facility
Name: Static - Max Surcharge Pool
Method: Morgenstern-Price
Horz Seismic Coef.: 0



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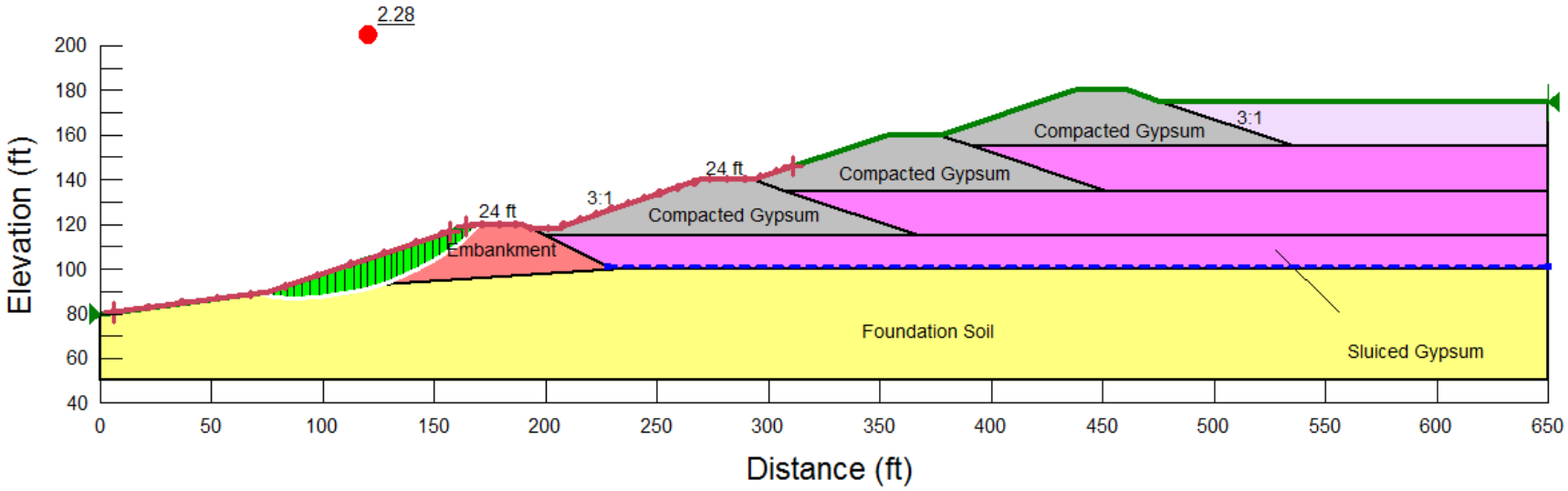
Plant Crist Gypsum Storage Facility
Name: Seismic
Method: Morgenstern-Price
Horz Seismic Coef.: 0.012



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