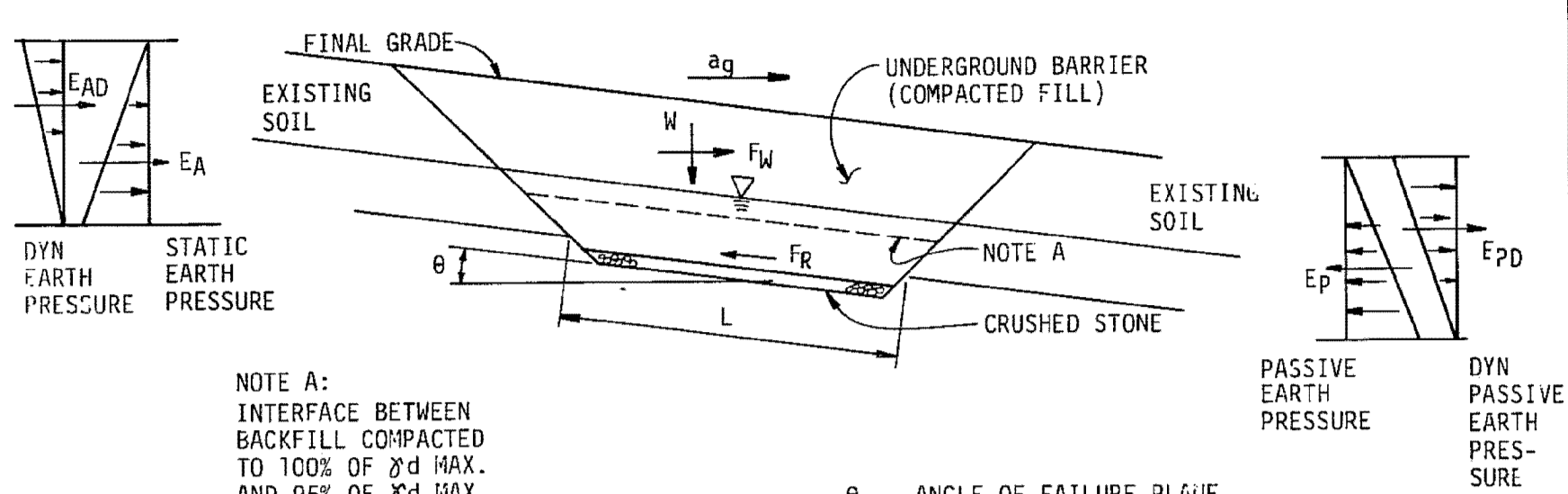


REVISED BY AMENDMENT 59

FIGURE 2.5-583
WATTS BAR NUCLEAR PLANT
REMEDIAL TREATMENT FOR POTENTIAL SOIL LIQUEFACTION
STABILITY ANALYSIS SUMMARY

LOAD DIAGRAM



NOTE A:
INTERFACE BETWEEN
BACKFILL COMPACTED
TO 100% OF γ_d MAX.
AND 95% OF γ_d MAX.

θ -- ANGLE OF FAILURE PLANE

ANALYSIS CASES

CASE	DESCRIPTION	FACTOR OF SAFETY
I	DURING EARTHQUAKE BUT PRIOR TO LIQUEFACTION (REDUCED PASSIVE PRESSURE ASSUMED TO ACT)	$FS = \frac{F_R + (E_{PX} - E_{PDX})}{E_{AX} + E_{ADX} + F_{WX} + W_X} \geq 1.0$
II	AFTER EARTHQUAKE AND AFTER LIQUEFACTION (NO PASSIVE PRESSURE ASSUMED)	$FS = \frac{F_R}{E_{AX} + W_X} \geq 1.0$
F_R	SLIDING RESISTANCE DUE TO THE SHEAR STRENGTH OF THE COMPACTED FILL. $F_R = \sum N_{EFF} \tan \phi + CL$	
F_W	HORIZONTAL SEISMIC FORCE CAUSED BY THE ACCELERATION OF THE UNDERGROUND BARRIER. $F_W = W_{ag}$, ($F_{WX} = F_W \cos \theta$)	
E_A	EARTH PRESSURE * = $\frac{\gamma H^2 K_a}{2}$, ($E_{AX} = E_A \cos \theta$)	
E_{AD}	DYNAMIC EARTH PRESSURE * = $E_A a_g$, ($E_{ADX} = E_{AD} \cos \theta$)	
E_p	PASSIVE EARTH PRESSURE * = $\frac{\gamma H^2 K_p}{2}$, ($E_{PX} = E_p \cos \theta$)	
E_{PD}	DYNAMIC PASSIVE EARTH PRESSURE * = $E_p a_g$, ($E_{PDX} = E_{PD} \cos \theta$)	
W	WEIGHT OF BARRIER, $W_X = W \sin \theta$	
X	COMPONENT OF FORCE/LOAD ALONG THE FAILURE PLANE	
*	INCLUDES WATER PRESSURE	

MATERIAL PROPERTIES

	UNIT WEIGHTS (PCF)			R TEST (NAT'L MOISTURE)		R TEST (SATURATED)	
	γ_M	γ_{SAT}	γ_{SUB}	ϕ	C(TSF)	ϕ	C(TSF)
IN SITU MATERIALS							
ALLUVIAL CLAYS AND SILTS	120	123	61	28°	0.4	14°	0.2
ALLUVIAL SANDS							
PRIOR TO EARTHQUAKE	119	124	62	28°	0.4	14°	0.2
DURING EARTHQUAKE	119	124	62	20°	0.2	10°	0.1
AFTER LIQUEFACTION	-	120	58	-	-	0°	0
BASEL GRAVEL	120	130	68	-	-	30°	0
COMPACTED FILL (BORROW MATERIALS)							
@ 95% $\gamma_{D_{MAX}}$							
TRENCH A	117	126	64	-	-	15°	0.1
TRENCH B	117	126	64	-	-	15°	0.1
@ 100% $\gamma_{D_{MAX}}$							
TRENCH A	123	130	68	-	-	14°	0.25
TRENCH B	123	130	68	-	-	14°	0.35
SPOIL MATERIAL ⁷	110	115	53	-	-	24°	0
CRUSHED STONE							
				ϕ	C(TSF)	ϕ	C(TSF)
1032 SECTION MATERIAL	135	143	81	39°	1.0	40°	0.5
1075 SECTION MATERIAL	135	143	81	40°	0	40°	0

UNDERGROUND BARRIER ANALYSIS SUMMARY

STATION	SAFETY FACTORS TRENCH A ¹				STATION	SAFETY FACTORS TRENCH B ¹			
	DURING EARTHQUAKE ⁵ FAILURE PLANE		POST EARTHQUAKE ⁶ FAILURE PLANE			DURING EARTHQUAKE ⁵ FAILURE PLANE		POST EARTHQUAKE ⁶ FAILURE PLANE	
	A ³	B ⁴	A ³	B ⁴		A ⁸	B ⁹	A ⁸	B ⁹
0+78	1.36	1.62	3.09	4.79	0+50	1.85	1.48 ¹⁰	7.00	18.32 ¹¹
1+28	1.53	1.66	5.44	7.20	1+00	1.93	1.43 ¹⁰	6.00	18.13 ¹¹
1+78	1.42	1.44	5.54	8.37	1+50	1.83	1.61 ¹⁰	4.57	29.71 ¹¹
2+28	1.35	1.35	10.32	18.43	2+00	1.78	1.74 ¹⁰	5.24	24.03 ¹¹
2+78	1.42	1.45	6.98	8.14	2+50	1.00	1.88 ¹¹	2.28	10.02 ¹²
3+28	1.28	1.20	4.55	4.65	3+00	1.39	1.06 ⁴	2.57	4.14 ¹²
3+78	1.22	1.21	4.05	4.21	3+50	2.21	1.09 ⁴	8.73	4.37 ⁴
4+28	1.23	1.16	4.07	4.63	4+00	1.79	NA	16.57	NA
4+78	1.17	1.12	3.05	3.31	4+50	1.78	NA	17.50	NA
5+28	1.11	1.10	2.69	2.90	5+00	1.82	NA	18.49	NA
5+78	1.03	1.17	1.63	2.34	5+50	2.26	NA	34.39	NA
6+28	1.05	1.11	1.66	2.02	6+00	2.18	NA	32.65	NA
6+78 ²									
7+28	1.20	1.23	1.79	1.87					
7+78	1.16	1.11	1.66	1.62					
8+28	1.22	1.17	1.64	1.76					
8+78	1.22	1.17	1.66	1.61					
9+78	1.41	1.32	2.20	1.98					

NOTES:

- SEE FIGURE 2.5-586 FOR A PLAN SHOWING THE LOCATIONS OF THE CROSS-SECTIONS.
- NOT INCLUDED. SOIL PROFILE NOT IDENTIFIED.
- FAILURE PLANE IN COMPACTED FILL IMMEDIATELY ABOVE CRUSHED STONE.
- FAILURE PLANE AT INTERFACE OF 95%/100% $\gamma_{D_{MAX}}$ COMPACTED FILL.
- STABILITY DURING EARTHQUAKE INCLUDING PASSIVE PRESSURE CALCULATED USING REDUCED STRENGTHS.
- STABILITY AFTER EARTHQUAKE ASSUMING NO PASSIVE PRESSURE.
- MATERIAL FROM ORIGINAL POWERHOUSE EXCAVATION, INCLUDES BASEL GRAVEL AND SHALE BLASTED FROM EXCAVATION. SPREAD BY PANS AND ONLY COMPACTION IS BY SPREADING EQUIPMENT.
- FAILURE PLANE AT BASE OF CROSS-SECTION.
- THE USE OF CRUSHED STONE AS WELL AS EARTH FILL ALLOWED FOR SEVERAL POTENTIAL FAILURE PLANES. THE FACTORS-OF-SAFETY GIVEN REPRESENT THE MINIMUM FS FOR POTENTIAL FAILURE PLANES OTHER THAN THAT GIVEN IN NOTE. 8.
- FAILURE PLANE AT INTERFACE BETWEEN 1032 CRUSHED STONE MATERIAL AND 95% $\gamma_{D_{MAX}}$ COMPACTED FILL.
- FAILURE PLANE AT INTERFACE BETWEEN 1032 AND 1075 CRUSHED STONE MATERIALS.
- FAILURE PLANE AT INTERFACE BETWEEN 1075 CRUSHED STONE MATERIAL AND 100% $\gamma_{D_{MAX}}$ COMPACTED FILL.
- NA-NOT AVAILABLE-NO OTHER DEFINED POTENTIAL FAILURE PLANE.