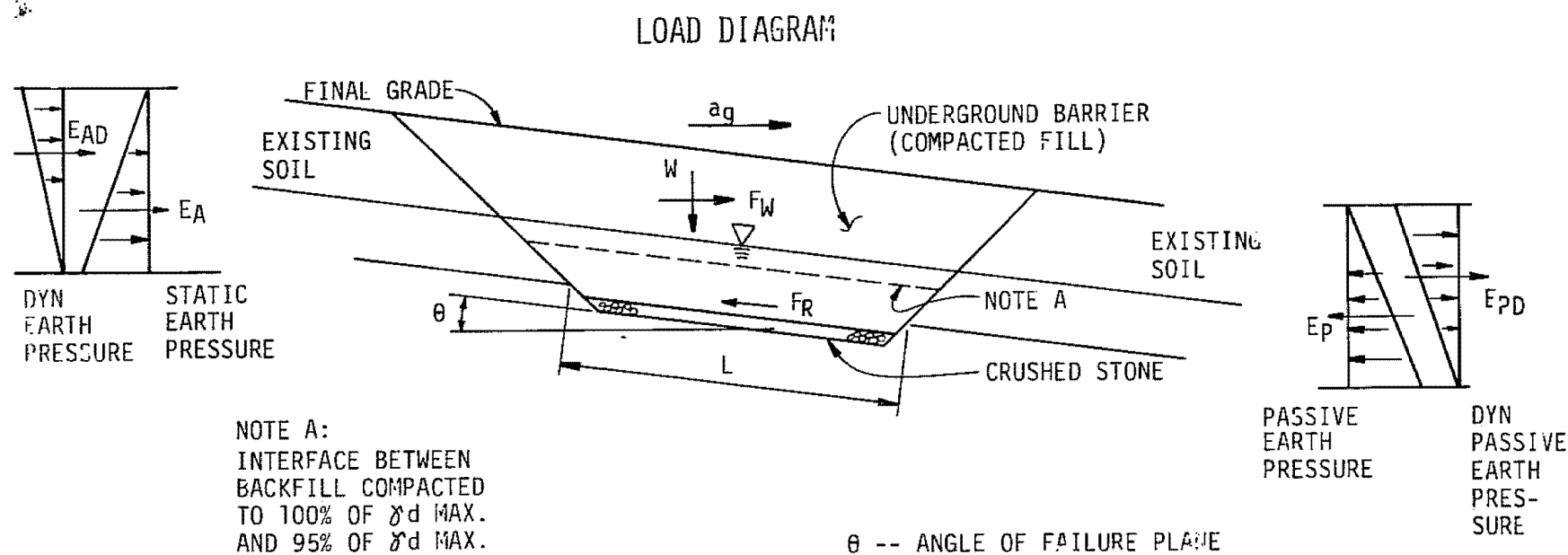


REVISED BY AMENDMENT 59

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



NOTE A:  
INTERFACE BETWEEN  
BACKFILL COMPACTED  
TO 100% OF  $\delta_d$  MAX.  
AND 95% OF  $\delta_d$  MAX.

$\theta$  -- ANGLE OF FAILURE PLANE

ANALYSIS CASES

| CASE     | DESCRIPTION  | FACTOR OF SAFETY  |
|----------|--|---|
| I        | DURING EARTHQUAKE BUT PRIOR TO LIQUEFACTION<br>(REDUCED PASSIVE PRESSURE ASSUMED TO ACT)                                     | $FS = \frac{F_R + (E_P - E_{PD})}{E_{AX} + E_{AD} + F_{WX} + W_X} \geq 1.0$ |
| II       | AFTER EARTHQUAKE AND AFTER LIQUEFACTION<br>(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.<br>$F_R = \sum N_{EFF} \tan \phi + CL$                   |   |
| $F_W$    | HORIZONTAL SEISMIC FORCE CAUSED BY THE ACCELERATION OF THE UNDERGROUND BARRIER.<br>$F_W = W a_g, (F_{WX} = F_W \cos \theta)$ |   |
| $E_A$    | EARTH PRESSURE * = $\frac{\gamma H^2 K_a}{2}, (E_{AX} = E_A \cos \theta)$  |   |
| $E_{AD}$ | DYNAMIC EARTH PRESSURE * = $E_A a_g, (E_{AD} = E_A \cos \theta)$   |   |
| $E_P$    | PASSIVE EARTH PRESSURE * = $\frac{\gamma H^2 K_p}{2}, (E_P = E_P \cos \theta)$   |   |
| $E_{PD}$ | DYNAMIC PASSIVE EARTH PRESSURE * = $E_P a_g, (E_{PD} = E_P \cos \theta)$   |   |
| $W$      | 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) |        |
|--|--------------------|----------------|----------------|-------------------------|--------|--------------------|--------|
|  | $\gamma_M$         | $\gamma_{SAT}$ | $\gamma_{SUB}$ | $\phi$                  | C(TSF) | $\phi$             | C(TSF) |
| <u>IN SITU MATERIALS</u>                 |                    |                |                |                         |        |                    |        |
| ALLUVIAL CLAYS AND SILTS                 | 120                | 123            | 61             | 28°                     | 0.4    | 14°                | 0.2    |
| ALLUVIAL SANDS                           |                    |                |                |                         |        |                    |        |
| PRIGR 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      |
| <u>COMPACTED FILL (BORROW MATERIALS)</u> |                    |                |                |                         |        |                    |        |
| @ 95% $\delta_{D_{MAX}}$                 |                    |                |                |                         |        |                    |        |
| TRENCH A                                 | 117                | 126            | 64             | -                       | -      | 15°                | 0.1    |
| TRENCH B                                 | 117                | 126            | 64             | -                       | -      | 15°                | 0.1    |
| @ 100% $\delta_{D_{MAX}}$                |                    |                |                |                         |        |                    |        |
| TRENCH A                                 | 123                | 130            | 68             | -                       | -      | 14°                | 0.25   |
| TRENCH B                                 | 123                | 130            | 68             | -                       | -      | 14°                | 0.35   |
| SPOIL MATERIAL <sup>7</sup>              | 110                | 115            | 53             | -                       | -      | 24°                | 0      |
| <u>CRUSHED STONE</u>                     |                    |                |                |                         |        |                    |        |
| 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

| SAFETY FACTORS<br>TRENCH A <sup>1</sup> |   |                |   | SAFETY FACTORS<br>TRENCH B <sup>1</sup> |         |   |                    |   |                     |
|---|---|----------------|---|---|---------|---|--------------------|---|---------------------|
| STATION                                 | DURING EARTHQUAKE <sup>5</sup><br>FAILURE PLANE |                | POST EARTHQUAKE <sup>6</sup><br>FAILURE PLANE |   | STATION | DURING EARTHQUAKE <sup>5</sup><br>FAILURE PLANE |                    | POST EARTHQUAKE <sup>6</sup><br>FAILURE PLANE |                     |
|   | A <sup>3</sup>                                  | B <sup>4</sup> | A <sup>3</sup>                                | B <sup>4</sup>                          |         | A <sup>8</sup>                                  | B <sup>9</sup>     | A <sup>8</sup>                                | B <sup>9</sup>      |
| 0+78                                    | 1.36  | 1.62           | 3.09  | 4.79                                    | 0+50    | 1.85  | 1.48 <sup>10</sup> | 7.00  | 18.32 <sup>11</sup> |
| 1+28                                    | 1.53  | 1.66           | 5.44  | 7.20                                    | 1+00    | 1.93  | 1.43 <sup>10</sup> | 6.00  | 18.13 <sup>11</sup> |
| 1+78                                    | 1.42  | 1.44           | 5.54  | 8.37                                    | 1+50    | 1.83  | 1.61 <sup>10</sup> | 4.57  | 29.71 <sup>11</sup> |
| 2+28                                    | 1.35  | 1.35           | 10.32   | 18.43                                   | 2+00    | 1.78  | 1.74 <sup>10</sup> | 5.24  | 24.03 <sup>11</sup> |
| 2+78                                    | 1.42  | 1.45           | 6.98  | 8.14                                    | 2+50    | 1.00  | 1.88 <sup>11</sup> | 2.28  | 10.02 <sup>12</sup> |
| 3+28                                    | 1.28  | 1.20           | 4.55  | 4.65                                    | 3+00    | 1.39  | 1.06 <sup>4</sup>  | 2.57  | 4.14 <sup>12</sup>  |
| 3+78                                    | 1.22  | 1.21           | 4.05  | 4.21                                    | 3+50    | 2.21  | 1.09 <sup>4</sup>  | 8.73  | 4.37 <sup>4</sup>   |
| 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 <sup>2</sup>                       |   |                |   |   |         |   |                    |   |                     |
| 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%  $\delta_{D_{MAX}}$  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%  $\delta_{D_{MAX}}$  COMPACTED FILL.
- FAILURE PLANE AT INTERFACE BETWEEN 1032 AND 1075 CRUSHED STONE MATERIALS.
- FAILURE PLANE AT INTERFACE BETWEEN 1075 CRUSHED STONE MATERIAL AND 100%  $\delta_{D_{MAX}}$  COMPACTED FILL.
- NA-NOT AVAILABLE-NO OTHER DEFINED POTENTIAL FAILURE PLANE.