

INTEROFFICE MEMORANDUM

JO/WO: 05996.01

DATE: April 3, 1997

SUBJECT: Geotechnical Design Criteria

FROM: PJTrudeau Boston 245/03

TO: SMMacie Denver 1E

CC: NTGeorges 245/03 NTG
JLDonnell Denver
SCSmith Denver

Stan,

In response to your IOM dated 4/2/97 regarding construction of the pads and the canister transfer facility at the PFSF:

1. It was expected that leveling of the site would not extend to the bottoms of the pads and that the holes for the pads would be excavated using an excavator that would provide minimal disturbance to the in situ soils. It is also expected that the in situ soils will stand vertically for the limited height required for constructing the pads and that they will provide sufficient lateral support to preclude the need for forms for placing concrete, thus providing savings during construction. Even if forms are required to construct the pads, protecting the in situ soils so that they can be used as the founding medium is expected to yield considerable savings over requiring excavation and replacement of the material underneath and adjacent to the pads with structural fill, assuming that sufficient sliding resistance can be developed between the pad and the structural fill.
2. Sliding resistance requirements were originally developed assuming that the casks were to be rigidly attached to the pads, so that the full inertia forces of the casks due to the earthquake would be transmitted to the pad. For that scenario, a frictional material at the base of the pad would not be capable of providing the necessary resistance to sliding. Based on my telephone conversation with you on March 21, 1997, I understand that the casks will not be attached to the pads, but, rather, they will be placed on top of the pads, and resistance to sliding between the casks and the pads will be a function of the coefficient of friction between the bottom of the casks (steel) and the top of the pads (concrete). Therefore, sliding resistance of the pads on compacted in situ soil or compacted structural fill may be acceptable, but it needs to be checked after the loads to be transmitted from the casks to the pads due to the earthquake are known. It was my understanding, based on our conversation on March 21, 1997, that the cask vendors were developing these loads based on their stability analyses for the casks.
3. The recommendation to start construction of the pads at the north assumed it would be easier to correct potential problems with respect to drainage associated with unexpected differences in estimated settlements, which could easily be $\pm 50\%$, if the initial pads were constructed "downstream" and closer to the retention basin. The same logic applies to constructing one of the southern quadrants first; i.e., I would recommend that the northernmost pad nearest the center of the site be constructed first, and monitored for settlement, and appropriate adjustments made in the design and construction of subsequent pads based on the actual settlement of the initial pads.

4. The proposed sequence of loading the casks from the north to the south is expected to ensure that any tilt of the pads will be downstream to facilitate drainage.

Is this restriction to facility operations significant?

5. These estimated settlements were developed based on conservative assumptions using information we currently know about these soils. I expect that actual settlements may be less than these estimates, but I cannot guarantee this. Yesterday I told you that the estimated settlement applied to the center of the pad and that settlements at the edge of the pad would be approximately half of this amount. This was based on the assumption that the pad distributes the cask loads uniformly to the founding soils. In reality, the pressure at the bottom of the pads due to the casks is expected to be higher immediately beneath each cask, which will tend to minimize the differential settlement across the pad.

The recommendation to raise the pads 4 inches, the thickness of the mud mat, is an attempt to minimize potential problems with site drainage due to the expected settlements.

Preloading can be reviewed, but it is not expected to help much because:

- elastic settlement (2.6" of the 5.3" total settlement) would simply rebound upon removal of the preload,
- primary consolidation (1.6") is due to recompression loadings, not virgin compression, and thus, would not be affected by preloading.

Therefore, only secondary compression (1.1") would be affected by preloading.

Most of the settlement is expected to occur within the first month; therefore, maintenance grading is not expected to be a continuous, ongoing operation for any given pad.

How extensive is the additional structural analysis? The costs of this analysis should be compared to the costs of alternatives for reducing the estimated settlement. These would include:

- excavating the top ~30 ft of soil and replacing it with compacted fill,
 - excavating the top ~30 ft of soil and revising the site grading to accommodate construction of the pads at that elevation, and
 - constructing the pads on deep foundations (piles or drilled caissons).
6. This can be accomplished using the information presented on Figure 6, "Allowable Bearing Pressure vs Footing Width and Depth." For example, Case 4 indicates that a 6 ft wide strip footing 10 ft deep has a gross allowable bearing pressure of 1.7 ksf to limit the settlement to 1". Once a settlement criterion is defined, we can develop additional dashed curves for Figures 6 & 7 for use in defining allowable bearing pressures.
 7. Settlement of the transporter has not been determined yet; therefore, it is not clear that it will be 5".



Paul J. Trudeau

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