ASYMMETRIC B-FACTORY COLLIDER NOTE

ABC-11

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DATE: August 1, 1990

Received by OSTI

TITLE: EFFECTS OF A MAJOR EARTHQUAKE ON THE
PEP HOUSING, STRUCTURES, AND UTILITIESNOV 28 1990

Summary:

1. The PEP tunnel, above-ground structures, and utility structures have been designed to withstand a major earthquake. This means they will experience minor or moderate damage in an earthquake which will cause widespread devastation in the surrounding region.

2. The earthquake on Oct. 17, 1989, which was not very severe locally, caused no damage to the PEP tunnel, buildings, or utilities. There was apparently some permanent displacement of the PEP tunnel. The PEP ring magnets moved enough to require re-alignment.

3. A major earthquake will probably cause sufficient displacement of the PEP tunnel and magnet systems to necessitate extensive re-alignment. This may be the dominant factor determining the length of the shutdown after the quake.

Discussion

PBQ&D, the A&E firm responsible for the design and construction of PEP, established engineering criteria for the tunnel construction which would enable it to resist a major earthquake without collapse but with some structural as well as non-structural damage. (Ref.4)

Earth Sciences Associates, a consulting firm, prepared a study in 1982 for the SLC project titled Seismic Considerations for Design of the SLC Tunnels (Ref.3) In essence, it confirms the validity of methods of design and analysis which had been in use for at least ten years. However, since we do not have the PBQ&D calculations we cannot be sure that they used these methods.

The Earth Sciences Associates report discusses the ways in which earthquakes may cause damage to underground structures. Of the six effects they list, in general only one is of concern at PEP: effects associated with soil liquefaction. Motion along a fault is not a concern because there does not appear to be an active fault intersecting the PEP tunnel.

Soil Liquefaction

There is a lens of clay around PEP region 10 which has been a source of water seepage into the tunnel. G. Fischer (Ref.1) notes that moderate positional discontinuities (6-12 mm) seem to have occurred during the Oct. 17, 1989 earthquake in both the PEP and SLC tunnels. He speculates that the earthquake moved the ground parallel to the slip plane of the clay lens around PEP IR 10 and the nearby SLC tunnel with it.

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There is no visible damage in either tunnel. It is likely that there will be movement in this area in future earthquakes, but the magnitudes are impossible to predict.

The hillsides around IR 2 are unstable and there have been slides in wet years. An earthquake at a time when the soil is saturated with water will very likely cause slides there. The previous slides have been more in the nature of a nuisance and have not interfered with operations since the soil ends up in the paved area in front of the IR hall where it can be disposed of with little difficulty.

There are two places at PEP where the soil is unconsolidated and may amplify the magnitude of earthquake-induced shaking and vibration: region 10 and IR 2. Also, in region 5 the housing rests on fill. (Footnote) These are the places where damage is most likely to occur.

The PEP magnet supports which were displaced and damaged by the Oct. 17 quake will be replaced in the currently favored design for the B factory. This is a good opportunity to apply the lessons of the quake in re-engineering the support system.

Footnote. According to G. Fischer, a small earthquake occurred during PEP construction, consolidated the fill on which the IR 4 support building is located and is said to have lowered the floor of the rf pad by 1/4 inch. (Ref L. Karvonen)

REFERENCES:

1. SLAC Site Geology, Ground Motion and Some Effects of the October 17, 1989 Earthquake, G.E. Fischer, SLAC Report No. 358, December, 1989.
2. Potential Earthquake effect on B-Factory at PEP. W. P. Savage May, 1990
3. Appendix C Seismic Considerations for Design of the SLC Tunnels. Earth Sciences Associates, May, 1982.
4. Seismic Memorandum No.4, PBQ&D. (Included in reference 2.)

PLEASE NOTE - Any of the above references may be researched by contacting Robbin Nixon at ext. 2938, a copy of each is filed with the original note.

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