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**From:** Harvey W. Parker [harveyparker@compuserve.com]  
**Sent:** Tuesday, February 03, 2009 8:49 AM  
**To:** White, John; Paananen, Ron  
**Cc:** Reilly, John  
**Subject:** Earthquakes and tunnels

John, in addition to the fact that tunnels are the best place to be in an earthquake, here are some thoughts.

A quick response is that our industry has safely constructed and operated tunnels for decades in very active earthquake zones all over the world in worse soils and groundwater conditions than we anticipate. One of the best examples is the Trans-Tokyo Bay tunnel which is in one of the most active earthquake zones in the world and is underwater for essentially all of its length. Our tunnel will be below the groundwater level but not underwater.

The other example is the BART Trans-Bay Tunnel in San Francisco. It was not the same type of construction since it was an immersed tube but there were bored tunnel connections to the tube and very important connections between immersed tube and tunnel which allow significant earthquake action. As I mentioned before, the BART system was not damaged at all in the Loma Prieta earthquake; it was inspected and re-opened for service.

I believe Gordon Clark wrote a paper on seismic design of the cut and cover tunnels. It is not about a deep bore and would be too technical but is relevant to illustrate that no matter what method of construction, safety and seismic safety are addressed carefully and completely. I think the Expert Review Panel also addressed seismic safety, again, not for a deep bore tunnel.

I have a meeting now but will be in the office this afternoon.

Best regards,  
Harvey