

seconds, but the exact time duration is unknown, as is the timing relative to the observed east penthouse movement. The first phase triggered other interior structural failures which led to the observed global collapse initiation about 7 s after the east penthouse moved downward. Debris may have fallen prior to the observed movement of the building exterior, but the duration and timing of the falling debris is unknown. The falling debris from the global collapse would also have transmitted impact loads to the foundation.

While this qualitative sequence of events is consistent with what might be construed as two arrivals in the PAL BHE traces shown in Figures B-5 and B-6, caution is required when interpreting signals that are small. For example, the signals in Figures B-3 and B-4 all recorded the same event, the collapse of WTC 1. Even so, signal amplitude and duration vary depending upon the location of signal arrival. The signal variations may be due to differences in the geological features along the signal path as well as local differences in construction. For instance, WTC 1 and WTC 2 were both located inside the foundation bathtub structure and had multi-story basements while WTC 7 was located north of the bathtub structure and had no basement. It is not known how these construction features may have affected signal transmission.

B.6 SCREENING OTHER SEISMIC EVENTS

Using all available seismic data from the six stations around New York City, 17 seismic signals were identified in the time window between the collapses of WTC 1 and WTC 7. These could have been generated by relatively large distant earthquakes (magnitude usually greater than 6), regional earthquakes (distance ranges between few tens to few hundreds of kilometers), and other signals generated by anthropogenic sources such as quarry blasts, chemical explosions, or impacts from heavy falling debris hitting the ground. To determine which seismic signals may have been generated by the WTC buildings, all of these signals were examined to identify their source and location. Table B-3 lists the 17 signals, beginning with ID #6 to distinguish these from the first five strong signals attributed to the events listed in Table B-2. The event origin time, location, and magnitude are provided.

B.6.1 Earthquakes

Two of the events listed in Table B-3 (#6 and #17) were associated with distant earthquakes, as confirmed in the Preliminary Determination of Epicenters bulletin from the National Earthquake Information Center, U.S. Geological Survey. The seismic records show teleseismic *P* wave arrivals from a strong earthquake (ID #6) that occurred in West Irian Jaya (New Guinea), Indonesia. There appears to be a weak teleseismic *P* wave arrival from a second, less intense distant earthquake (event #17 in Table B-3) at around 10 s after the arrival of the Rayleigh wave generated by the collapse of WTC 7. Since the teleseismic *P* waves (epicentral azimuth $\Delta = 61^\circ$) are usually strong only in vertical component records, this signal did not interfere with shear signals from WTC 7.

B.6.2 Local Quarry Blasts

The largest of the remaining signals listed in Table B-3 show relatively clear *P* and *S* arrivals, and were strong enough to be recorded at several stations in the region so that the source location could be identified. Based on the location and characteristics of seismic signals, local quarry blasts in the region were identified. Usually, seismic signals from a local quarry blast show strong short period surface