

Table B-2. Major seismic events previously reported.

Event Source	Event Time (EDT)			Table 5-1 of Chapter 5 of This Report (± 1 s) ^b	Equivalent earthquake Magnitude (Richter Scale, ± 0.1)	Dominant Period (s)	Sustained Signal Duration (s)
	ID	Kim et al., 2001	LEDO current Estimate ^a				
WTC 1 impact	1	8:46:26	08:46:29 $\pm$ 2	8:46:30	0.9	0.8	14 $\pm$ 2
WTC2 impact	2	9:02:54	09:02:57 $\pm$ 4	9:02:59	0.7	0.6	6 $\pm$ 2
WTC 2 collapse	3	9:59:04	09:59:07 $\pm$ 2	9:58:59	2.1	0.8	10 $\pm$ 1
WTC 1 collapse	4	10:28:31	10:28:34 $\pm$ 2	10:28:22	2.3	0.9	9 $\pm$ 1
WTC 7 collapse	5	17:20:33	17:20:42 $\pm$ 4	17:20:52 ^c	0.6	0.8	17 $\pm$ 2 ^d

a Derived from signal arrival and estimated travel times from WTC site to PAL

b Based upon events observed in videos and photographs; collapse times were based on collapse initiation, not time of ground impact

c NCSTAR 1-5A timing was based on downward movement of the WTC 7 roofline and not the downward movement of the east penthouse that occurred earlier.

d Total duration of BHE PAL signal in Fig. A-6, including a possible second arrival

B.4 CHARACTERISTICS OF SEISMIC SIGNALS FROM WTC EVENTS

Seismic records from the five major WTC events show no clear *P* or *S* wave arrivals. Short-period seismic surface waves, mainly of the Rayleigh type, are the predominant seismic waves on records at regional distances (few tens to few hundreds of kilometers). Figure B-3 shows the three-component seismic records at stations PAL and BRNJ from the collapse of WTC 1. NS- and EW-component records were rotated to longitudinal-component (BHR) and transverse-component (BHT) orientations to show the effect of wave propagation. The time of 10:28:34 EDT is the estimated origin time (i.e., the estimated travel time has been subtracted from the arrival time) for the PAL BHT signal at the "*Rg*" indicator (note that *Rg* indicates the arrival of a seismic surface wave of the Rayleigh type which propagated at 2.4 km/s). The time scale at the top and bottom of the figure illustrate the relative signal arrival times and durations. Vertical-component seismic records at local stations PAL, BRNJ, TBR, MANY and ARNY from the collapse of WTC 1 are shown in Figure B-4. The epicentral distance and azimuth at each station are given at the end of each trace.

Surface waves on the transverse-component are strongest at PAL, whereas at BRNJ, the transverse-component has the least amplitude. The seismic signals excited by the building collapses are basically due to vertical forces acting on the ground surface, and hence, seismic waves are strongly excited near the surface and subsequently travel as surface waves. In addition, the surface waves recorded at station PAL, located due north from the WTC, are strongest on the EW component record. This is a unique