9. CONCLUSIONS AND RECOMMENDATIONS

9.1 Summary and Conclusions Concerning Existing Capabilities

It will be apparent to the reader that the authors have relied on personal experience and on published and unpublished research results to make scientific judgements and extrapolations at many points in this assessment of global seismological detection and identification capabilities. In particular, we have in some instances extrapolated results available for North America to other parts of the world; this was necessary because for many parts of the world the required research has not been undertaken, or at any rate published. We will, therefore, present this chapter in two parts: this section will present the conclusions which can be drawn concerning the existing capabilities of the ensemble of conventional and array stations described in Chapter 2; the following section will contain some recommendations, which, for a modest investment of research effort and finances using existing facilities, may significantly improve on the currently defined capability.

The conclusions of this assessment can take the form of the P wave magnitude threshold at which existing seismological facilities have a certain capability of (a) detecting, (b) locating and (c) identifying a seismic event, and of how these capabilities can vary over the surface of the earth. For each of these functions we have defined as being adequate that threshold at which there is a 90 per cent probability of $\geq$4-station coverage, with adequate (2 or more quadrant) azimuthal coverage.

The lowest threshold derived is that for P wave detection; it is m4.5 (equivalent to 3 to 10 kiloton yield in hardrock) or lower for earthquakes or explosions occurring anywhere in the northern hemisphere, and deteriorates to a high value of m5.0 (equivalent to 10 to 20 kilotons) in part of the southern hemisphere. A fundamental conclusion of this assessment is that all extant capabilities are much poorer in the major portion of the southern hemisphere; this fact will not be emphasized further. In terms of locating the epicenters of events using detected P waves, the location accuracy will be typically better than 20 - 45 km for any seismic event larger than the P wave detection threshold magnitude for any region (see Figure 4) plus 0.2.

The 20-second earthquake Rayleigh wave detection threshold is about δm0.6 higher than the P wave threshold, leading to the conclusion that existing LPZ facilities are relatively less sensitive than existing SPZ facilities. The explosion Rayleigh wave detection threshold is about δm1.0 higher than the equivalent threshold for earthquakes. Thus, because of the difficulty of detecting explosion 20-second Rayleigh waves, the formally calculated threshold of explosion identification using the M versus m criterion remains at a rather high level, about m5.6 to m6.0 for the northern hemisphere. Matched filtering can reduce these values by about δm0.2 . It seems reasonable, therefore, to define the network system we have investigated as having a threshold capability of identifying 60 kiloton underground explosions in hardrock in the northern hemisphere.

Using stations available in the UN returns, this threshold is reduced to m5.0 in North America by taking advantage of the efficient