Deployment algorithms proposed to improve coverage in sensor networks often rely on the Voronoi diagram, which is obtained by using the position information of the sensors. It is usually assumed that all measurements are sufficiently accurate, while in a practical setting, even a small measurement error may lead to significant degradation in the coverage performance. This paper investigates the effect of measurement error on the performance of coverage control in mobile sensor networks. It also presents a distributed deployment strategy, namely the Robust Max-Area strategy, which uses information on error bounds in order to move the sensors to appropriate locations. To this end, two polygons are obtained for each sensor, and it is shown that the exact Voronoi polygon (associated with accurate measurements) lies between them. A local spatial probability function is then derived for each sensor, which translates the available information about the error bound into the likelihood of the points being inside the exact Voronoi polygon. Subsequently, the deployment strategy positions each sensor such that the total covered area increases. The sensors' movements are shown to be convergent under the proposed strategy.