Ultrashort baseline positioning systems are used to localize manned deep-sea submersibles. A long baseline positioning system is a significant supplement to an ultrashort baseline positioning system and provides more precise positioning. The long baseline beacon array design applied is a primary factor affecting the accuracy of long baseline positioning. However, beacon array designs have mainly been studied in autonomous underwater vehicles (AUVs). Because the characteristics and dive tasks between AUVs and manned deep-sea submersibles are different, the simple beacon array formations used in AUVs cannot be directly used in manned deep-sea submersibles.