To: Greek government

From: MCM Team #

Date: February 5, 2024

Subject: Search and rescue scheme and scheme evaluation of deep-sea crash submersible

Dear officer of the Greek government,

We are writing to explain the safety procedures for the MCMS Deep Sea manned deep dive project and to help them obtain the approval. With the development of deep-sea exploration technology, the era of deep sea understanding is coming. For manned deep diving technology, safety is one of the important factors that can not be ignored. The establishment of safety prevention mechanism not only needs to consider accident prevention, but also the search and rescue system after the accident.

In order to ensure the safety of submersibles owned by MCMS Company and solve the difficult problems of deep-sea search and rescue, Our team has developed a complete search and rescue plan, which is presented here for your evaluation

**Our approach:**

we successively established three basic models, which were used for the position prediction of submersibles, the evaluation of additional search devices and the strategic guidance of search and rescue, and finally formed a complete search and rescue plan.

Our approach

1. Determine the uncertainty factors as submersible weight, ocean current speed and ocean current direction respectively, and constrain the uncertainty. The former can be determined by prior weighing and instrument detection, while the latter can be determined by installing SINS and DVL.

2. It is decided that the rescue vessel shall carry echo sounder, side scan sonar and magnetometer, and the host ship shall carry side scan sonar, magnetometer and AUV.

3. AUV is determined as the main search and rescue device, sonar and other auxiliary devices, and the search and rescue strategy with the maximum density point as the search target is established.

**Our result and conclusions：**

1. The submersible position prediction model is placed in the Ionian sea area for simulation, and it can be found that the prediction accuracy is significantly improved after the uncertainty is constrained, which means that the final success rate of search and rescue can also be greatly improved.

2. According to the simulation results of the strategy, the search and rescue path and the trajectory of the submersible have a high degree of agreement in the second half. After the corresponding search equipment began to operate for a period of time, the search success rate began to gradually climb. In the first 4-5 hours after the crash, the probability of success will have several relatively large jumps, and then maintain a steady increase. The final search success rate will be about 75%. Considering that the strategy should be fault-tolerant, the final success rate of search and rescue can be close to 57% without restricting the uncertainty of the location of the crashed submersible.

3. By applying our strategy to the conditions of the Caribbean Sea for simulation, the final success rate of search and rescue under the two conditions reached 98% and 48% respectively, and it was concluded that the scheme was still highly applicable under different sea conditions. It is worth mentioning that when there are additional submersibles in the area, the results of the model optimization can increase the final success rate of search and rescue to 99%. Through sensitivity analysis, it can be concluded that the results of the scheme have quite high stability.

4. According to the comprehensive evaluation, our scheme has high accuracy, exploration and rapid response ability. Although it still lacks consideration for some special cases, it can be improved by adding more professional correction factors to further optimize the model

We hope that this solution can provide a strong guarantee for the security procedures of MCMS. If you have any further questions or problems with the model, please contact us and we will do our best to explain and/or improve the model.