To create an assurance case for the BlueROV2 system using the provided assurance case pattern, we'll follow the outlined steps to replace the placeholders with system-specific information and remove any placeholder decorators. The goal is to ensure the safety of the BlueROV2 system by mitigating identified hazards according to the ALARP principle. We'll start this process by laying out the hierarchical tree structure:

### Hierarchical Tree Format for BlueROV2 Assurance Case

Here's the hierarchical tree format for the BlueROV2 system:

1. \*\*G1: Hazards for BlueROV2 system addressed in accordance with ALARP principle.\*\*

- \*\*S1: Argument by risk reduction/elimination of each hazard\*\*

- \*\*G2: No intolerable risks present in the system.\*\*

- \*\*C1: Definition of "intolerable"\*\*

- \*\*S2: Argue that risk posed by any remaining hazards is negligible\*\* \_(Undeveloped)\_

- \*\*S3: Argue that no other risks have been identified\*\* \_(Undeveloped)\_

- \*\*G3: Risk from Obstacle encounter has been reduced as low as reasonably practicable\*\*

- \*\*C2: Assigned severity class is Major\*\*

- \*\*S4: Apply ReSonAte to estimate level of risk from hazard condition Obstacle encounter\*\*

- \*\*A1: Function Avoidance logic required by Obstacle encounter BTD is available\*\*

- \*\*G4: Model Obstacle encounter BTD accurately describes possible propagation of hazard Obstacle encounter\*\* \_(Uninstantiated/Undeveloped)\_

- \*\*G6: Possible hazard propagation paths correctly captured in BTD\*\* \_(Undeveloped)\_

- \*\*G7: Barriers in the BTD correctly describe their respective control action including any required system functions\*\* \_(Undeveloped)\_

- \*\*G8: All non-negligible threats have been identified\*\* \_(Undeveloped)\_

- \*\*G5: Quantitative risk estimates are accurate and below acceptable threshold\*\*

- \*\*G9: State probability distribution used for risk estimation is an accurate representation of expected system states\*\* \_(Undeveloped)\_

- \*\*G10: Estimated probability of Collision is below allowable threshold for severity class\*\*

- \*\*Sn1: Estimated risk level 10^-3 per hour\*\*

### Expanded Details

#### Goals Breakdown

- \*\*G1:\*\* The top-level goal is to ensure that the hazards for the BlueROV2 system are addressed according to the ALARP principle, ensuring it's as safe as reasonably practicable.

- \*\*G2:\*\* We assert that there are no intolerable risks present in the BlueROV2 system under the defined context of "intolerable."

- \*\*G3:\*\* This goal focuses on reducing the risk from the hazard "Obstacle encounter" to an acceptable level (ALARP).

- \*\*G4:\*\* Ensuring that the BTD model accurately describes possible propagation pathways for the Obstacle encounter hazard.

- \*\*G5:\*\* Verifying that quantitative risk estimates are both accurate and below the acceptable threshold.

- \*\*G6-G8:\*\* These are sub-goals to validate the obstacle encounter BTD, which need to be developed.

- \*\*G9-G10:\*\* Sub-goals for ensuring accurate state probability distributions and acceptable risk thresholds for collision consequences.

#### Strategies and Support

- \*\*S1:\*\* The primary strategy relies on addressing each hazard individually through risk reduction or elimination.

- \*\*S2-S3:\*\* These strategies argue that remaining risks are negligible and that no other risks have been identified (both undeveloped).

- \*\*S4:\*\* This strategy applies ReSonAte for risk estimation concerning the Obstacle encounter hazard.

#### Context, Assumptions, and Solutions

- \*\*C1:\*\* Provides the definition of what is considered intolerable within the system.

- \*\*C2:\*\* Indicates that the severity class assigned to Obstacle encounter is "Major."

- \*\*A1:\*\* An assumption that the required function Avoidance logic is available as specified in the BTD.

- \*\*Sn1:\*\* Solution indicating the estimated risk level for collision is 10^-3 per hour.

By following this structure and layout, we ensure the main objective of the BlueROV2 system—to safely navigate and avoid obstacles—is comprehensively addressed within the assurance case. The placeholders have been replaced with specific information relevant to the BlueROV2 system, and the undeveloped elements indicate areas that require further development.