Humans in Aerospace

Part I [65%]
An aerospace manufacturer has a process where a robotic arm is used to perform part of the assembly procedure for an aircraft frame. The arm is manually operated by a human and must pick up an object, translate the object to the destination, rotate it to align with the aircraft frame, and hold the object until it is installed. During operation of the robotic arm, the human robotic arm operator must maintain a visual on the arm. Impact of the arm with the aircraft frame would cause damage that would be timely and expensive to repair. The aerospace manufacturer has asked you to design the control interface used to manipulate the robotic arm.

You may assume that the base of the robotic arm is fixed in place and the arm has multiple powered joints. The end effector can be controlled in six degrees-of-freedom (in rotation and translation) along axes whose alignment the user can select. While the arm cannot be pre-programmed and must be manually controlled, there is an automatic clearance detection system integrated. You may make assumptions as you create your design. Please explicitly state what assumptions you made. Be prepared to discuss the following questions pertaining to your manual control interface and display:

a) What reference frames were selected for controlling the robotic arm? Are the control reference frames selected fixed across all task operations?
b) What control interfaces were selected? Why did you select these interfaces?
c) What is the relationship between the human input and the robotic system output for the interfaces selected?
d) Where should the operator be located for these tasks?

Part II [35%]
The aerospace manufacturer would like to assess how the manual control interface you designed in Part I performs in this pick-place-hold task for two different fixed operator viewpoints. Design a study to examine your interface for the performance of these two viewpoints. Specifically define how you would assess if your manual interface affects situation awareness of the environment, task time, task accuracy, and task precision.