

VALKYRIE LEVEL 1 SAFETY TRAINING

FOR STAFF & RESEARCHERS WORKING WITH THE NASA VALKYRIE (R5) ROBOT

This is intended for all students, researchers, and/or staff (from Northeastern University, UMass Lowell, and collaborating universities) that will be working with the Valkyrie robot (henceforth referred to as "Valkyrie" or "the robot"). Participation in this training certifies that you are aware of the safety precautions and procedures that must be taken in order to:

- Observe the robot while it is powered on and moving
- Operate the hoist for the robot
- Assist in monitoring the robot and deploying the emergency stop button if there is unexpected robot behavior
- Execute code on the robot that causes it to physically move with direct supervision and approval of a Valkyrie On-Site Lead
- Assist a Valkyrie On-Site Lead in removing a limb of the robot when it is powered off

Participation in this training does NOT grant you the ability to do the following:

- Operate the robot
- Power the robot on and off or access the "juice box"
- Be located within the robot operation area when the robot's motors are powered (blue LED ring)
- Store or deploy the robot without direct supervision of a Valkyrie On-Site Lead and/or someone with Level 2 Safety Training
- Augment the gantry, hoist, and lift systems for the robot
- Physically work directly on the robot (augmenting or repairing hardware, removing/driving screws, soldering, etc.) when it is powered off or otherwise

A small group of individuals are deemed "**Valkyrie On-Site Leads**". Members of this group are able to administer Level 1 Safety Training (this document), and can authorize or restrict what can and cannot be done with the robot. Whenever the robot is to be run, at least one individual from the following list must be present (as of January 2018):

- Jordan Allspaw and Murphy Wonsick

*Note that all definitions and figures are contained in separate reference documents in the training packet.

After an item has been reviewed, check the box.

(Only check those that apply to the individual, and leave blank the ones that do not apply)

Emergencies

- ☐ FOR ALL EMERGENCIES, CALL 911

Safety

- ☐ All 10 safety hazards identified in the NASA safety protocol have been reviewed and understood: Mechanical Hazards, Touch Temperature, Fire, Electric Shock, Electromagnetic Interference, Non-ionizing Radiation, Lift-related Injury, Toxic Materials, Falling Mass, Excessive Force. See attached document "TEST HAZARD ANALYSIS REPORT."
- ☐ All individuals working on Valkyrie must wear closed toe-shoes.
- ☐ A segment of the power cord hangs down from the top of the gantry over to the robot. Do not touch the power cord.
- ☐ Do not touch, disconnect, adjust, or manipulate any PCB, electrical connector, actuator, or other electrical component on the robot. Only Valkyrie On-Site Leads may service the robot, and the power supplies in the "juice box" must have their outputs disabled (power supply LCD should indicate "OFF") before any service on the robot.

Robot Operation Area

- ☐ The robot operation area is defined by black and yellow hazard tape on the ground.
- ☐ All individuals within the robot operation area are strongly advised to wear steel toe boots at all times.
- ☐ No one with only Level 1 Safety Training is authorized to operate or manipulate the gantry system to change the robot operation area configurations. Operation of the hoist control is allowed under supervision of a Valkyrie On-Site Lead and/or someone with Level 2 Safety Training.
- ☐ No one with only Level 1 Safety Training may deploy the robot (disconnect the static safety tether, connect the adjustable tether, and lower the robot from the stowed position), unless under direct supervision of a Valkyrie On-Site Lead and/or someone with Level 2 Safety Training.
- ☐ Level 1 Safety Training grants the ability to manipulate task apparatuses into the robot operation area that can be moved by hand without the need for power tools, pallet jack, or electric forklift.
- ☐ With only Level 1 Safety Training, the robot operation area may only be entered when the robot's state is "off, hanging" or "off, stowed".

Robot Use

- ☐ When the robot is running, no one with only Level 1 Safety Training is authorized to be within the robot operation area, and must be outside of the black and yellow hazard tape.
- ☐ Physically manipulating the robot is only permitted when the robot state is "off, hanging" or "off, stowed".

- ☐ A Valkyrie On-Site Lead must be present during any robot operation, but does not necessarily need to be directly involved in the operation. For robot operation to occur, at least two individuals with minimum Level 1 Safety Training and one individual with Level 2 Safety Training must be actively involved. If a Valkyrie On-Site Lead is directly involved with robot operation, only one other individual with minimum Level 1 Safety Training must be present.
- ☐ Before executing any code on the robot that will or potentially will cause the robot to move, a valid Valkyrie Test Plan must be filled out and approved by a Valkyrie On-Site Lead. This may potentially involve a detailed code and testing procedure review at the discretion of the Valkyrie On-Site Lead.
- ☐ If a Valkyrie On-Site Lead is directly involved with robot operations, a Valkyrie Test Plan is not needed, and testing can be approved verbally on a case-by-case basis.
- ☐ See attached document "Ring LED Legend" for details regarding the robot's state according to ring of LEDs in its chest.
- ☐ Anytime the robot has motor power turned on (blue LED ring), a person with minimum Level 1 Training must physically have their hand on the emergency stop button and stand within view of the robot. If said person needs to leave sight of the robot, it is their responsibility to ensure that someone else with minimum Level 1 Training will take over the emergency stop button position and notify the robot operator of the change.
- ☐ All personnel should actively communicate amongst one another with respect to the status of the robot, when it is being powered on, powered off, when it is getting ready to move, etc. At a minimum, the following events must be clearly announced before they occur to everyone in the immediate vicinity of the robot operation area.
 - Motor power on
 - Servoing of the robot's joints
 - Commencement of any test procedure that will or potentially will cause the robot to move
 - Emergency stop activation (either internal robot e-stop or external e-stop)

Loss of Level 1 Safety Training

- ☐ A person may be removed of their Level 1 Safety Training certification with the majority approval of the Valkyrie On-Site Leads.

Cognizance and Awareness

- ☐ If you see something that is not right or anyone who is not following the aforementioned rules, take initiative and say something. Either directly or if you are not comfortable, find and inform a Valkyrie On-Site Lead.
- ☐ If you think these rules need to be modified, make a proposal in writing and inform the following individuals by email: all Valkyrie On-Site Leads, all PI's and co-PI's.

Trainee Information

I, _____ (name of Trainee), acknowledge that I have read and understand the guidelines in this document. I agree that the information corresponding to each checked box above has been reviewed with me. I have been given the opportunity to ask questions and have received adequate answers. I will comply with all rules and regulations and not perform any of the actions listed here that I am unable to.

Trainee Name: _____ Signature: _____

Training Provided By: _____ Signature: _____