

PERT Chart based Laser Cutting Process Control on a Digital Simulation Platform

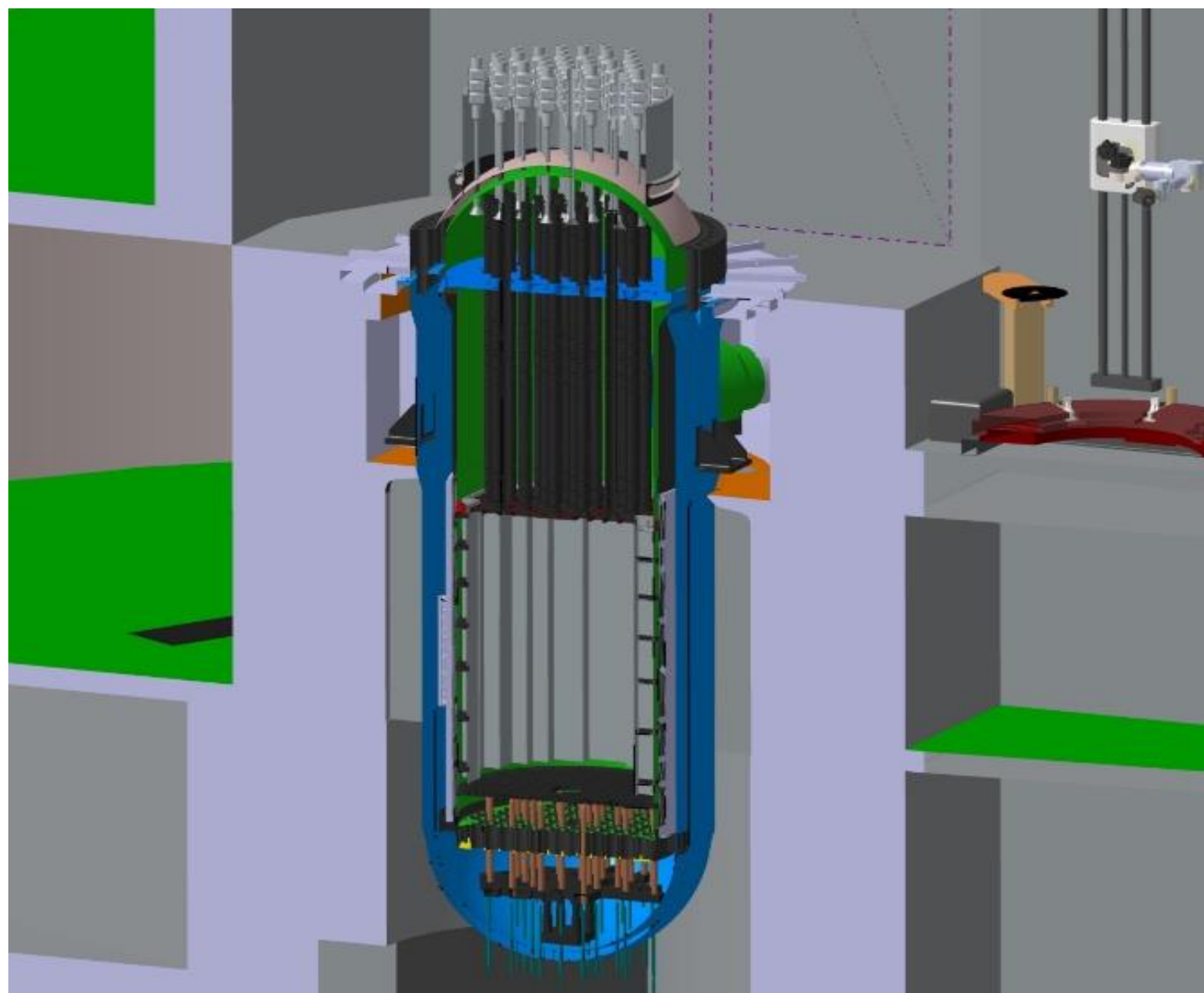
Ikjune Kim^{*1}, Dongjun Hyun¹, Jonghwan Lee¹, Sungmoon Joo¹, Jaehyun Ha¹, Taeyoung Ko¹

¹ Korea Atomic Energy Research Institute

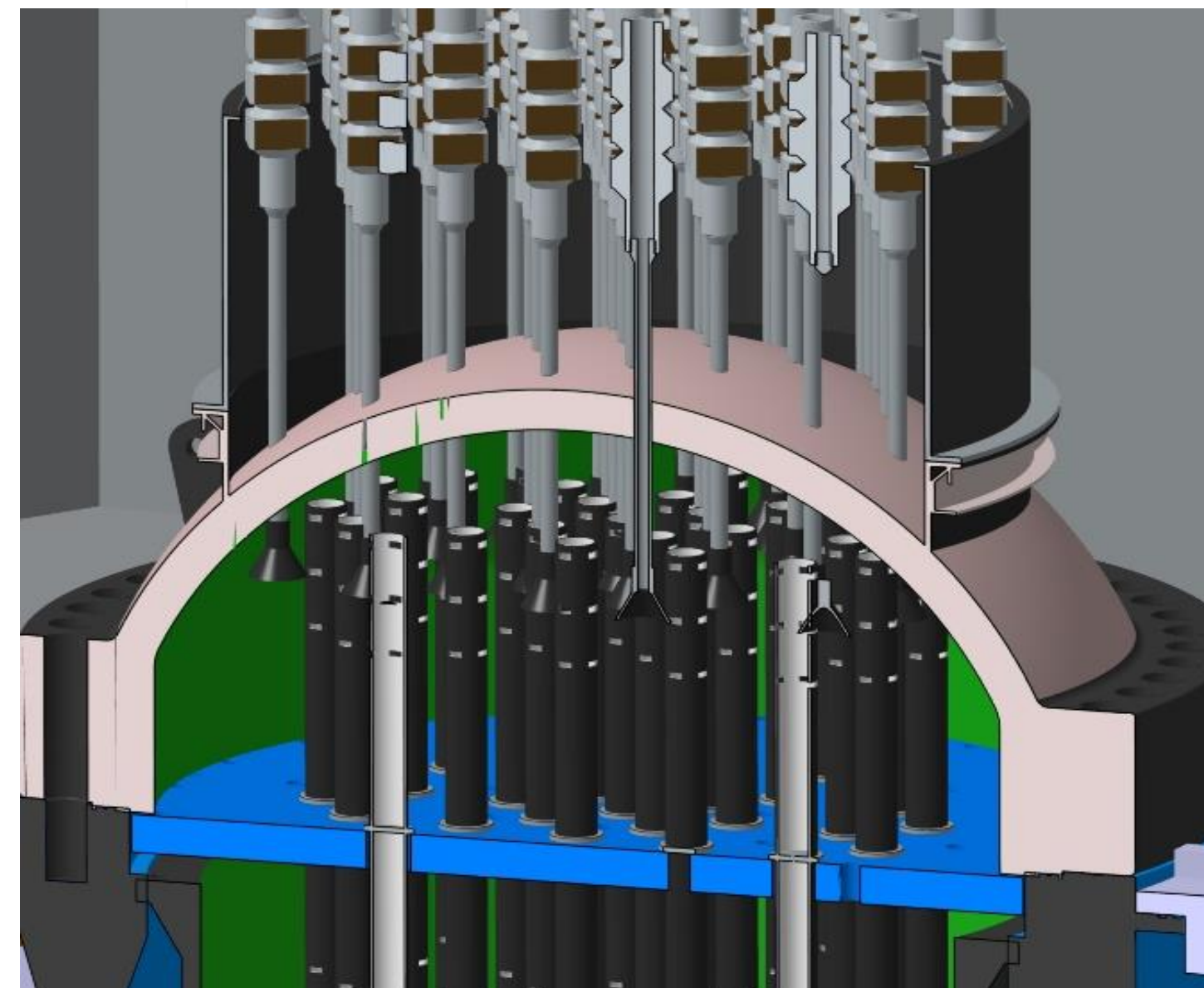
* ikjunekim@kaeri.re.kr

1. Introduction

- Dismantling the RPV internal structures
 - ✓ High radioactive part and has very complex geometry
 - ✓ Remote cutting with and an automated cutting system
 - Laser cutter, robot manipulator and control software
 - ✓ Laser cutting target part: Upper support plate

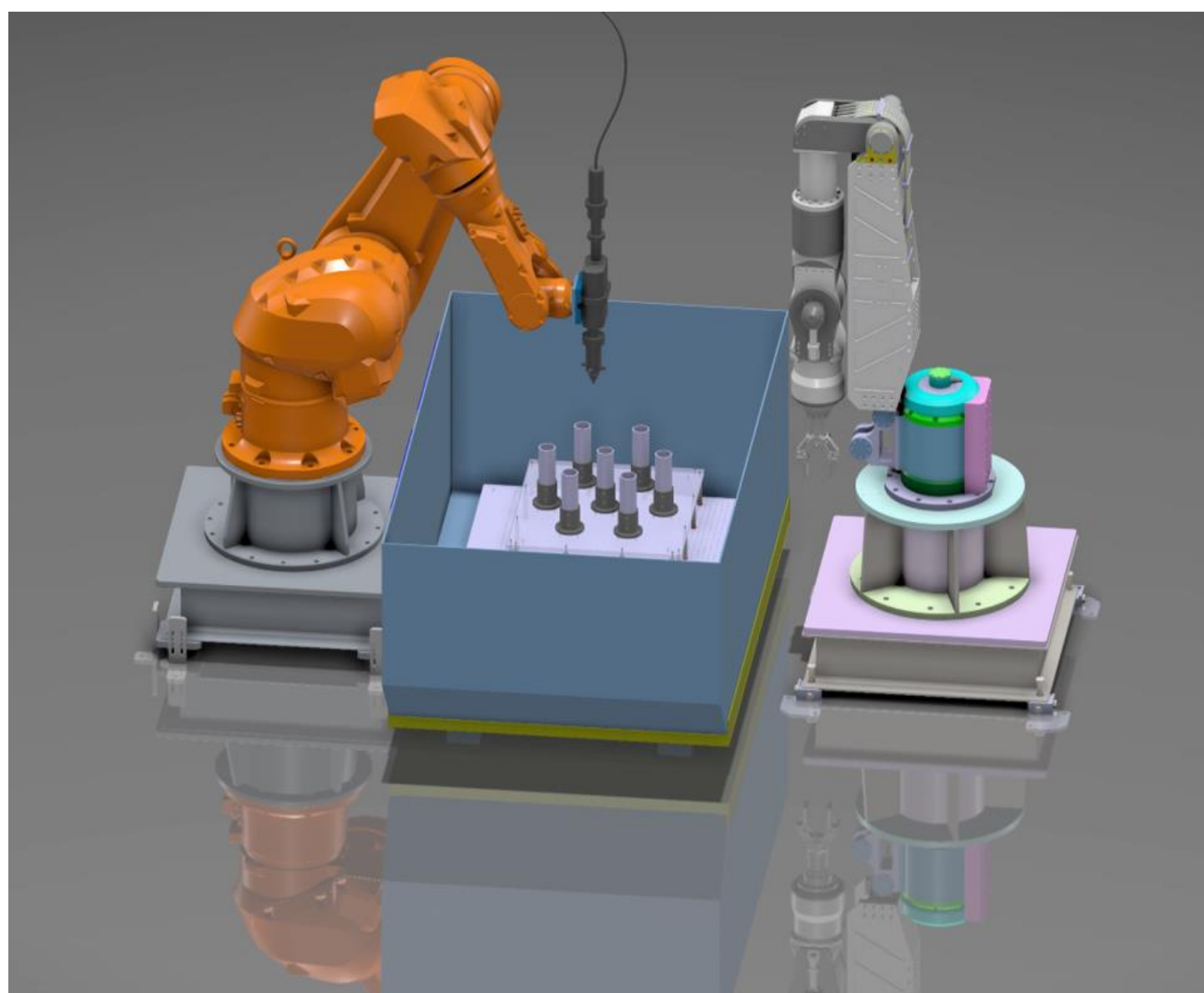


RPV Cross section



Upper support plate (blue part)

- Testbed for the cutting the upper support plate model
 - ✓ Testbed device is controlled by the digital simulation platform
 - ✓ We built the device controller as plugins of the digital simulation platform



Digital mockup config.



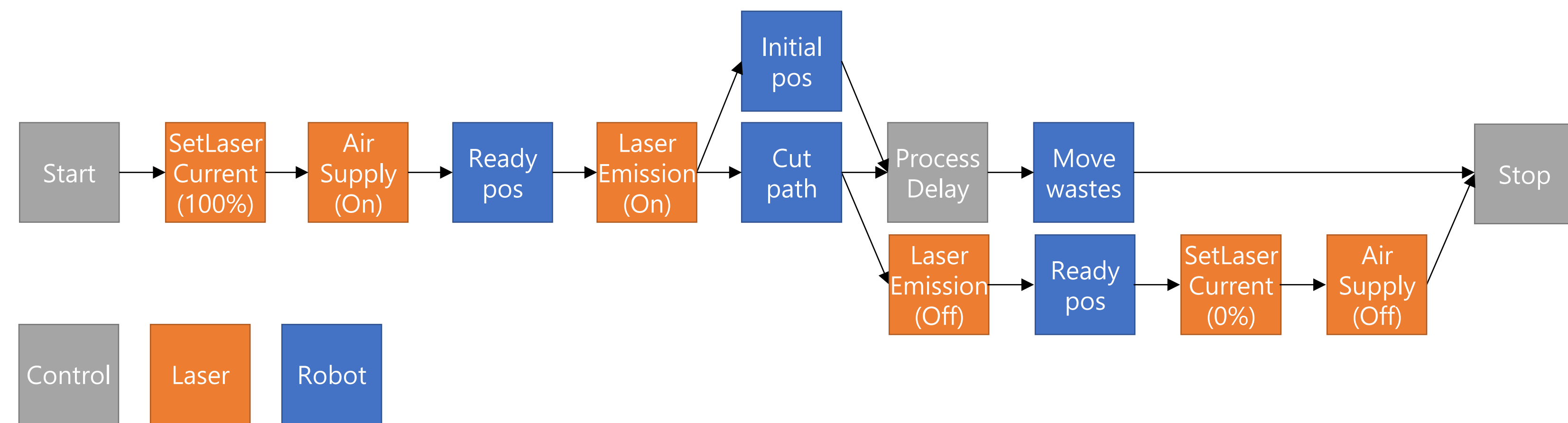
Testbed config.

- Laser cutting control
 - ✓ laser cutter is required to keep the desired standoff position between the nozzle of the laser cutter and surface of the cut part to cut properly
 - ✓ Exact time and sequence control of the air supply and the laser emission is required for the cutting quality and the process safety
 - We used the PERT chart to design and control the laser cutting process

2. PERT chart for the laser cutting

- PERT chart
 - ✓ The directed graph which is composed of nodes and edges
 - ✓ A node has information of the resource and time
 - ✓ An edge defines the sequence of the process activity using an arrow direction
- PERT chart node definition for the laser cutting
 - ✓ Control node: Start, stop or delay the process
 - ✓ Laser act. node: Set laser power, laser emission and air supply
 - ✓ Robot act. node: Move robot by input trajectory of joint or cartesian position

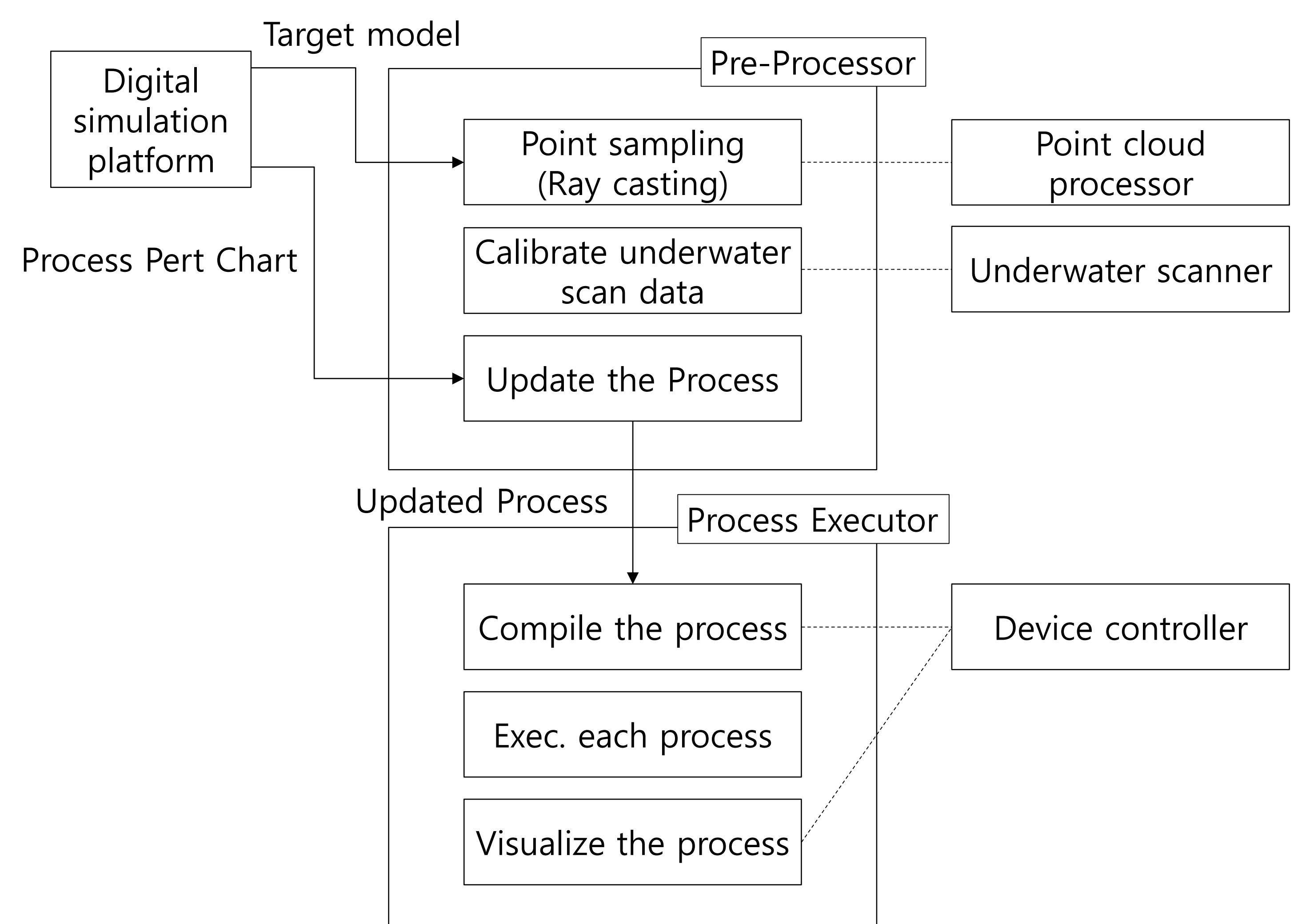
- An example of the laser cutting PERT chart
 - ✓ Parallel process of the laser cutting and the wastes pick and place is modeled by PERT chart



Laser cutting PERT chart

3. Controller structure

- Pre-Processor
 - ✓ Create the digital mockup and laser cutting PERT Chart in the digital simulation platform
 - ✓ Update the process in the PERT chart based on the scanned point cloud of the testbed geometry
 - ✓ Updated process is sent to the executor to operate the actual device in the testbed
- Process executor
 - ✓ PERT chart of the process is compiled into the machine readable form and the device controller read the message to operate the device
 - ✓ Device movement is sent back to executor to visualize the operations



Controller structure

4. Conclusion

- Works Done
 - ✓ Proposed the PERT chart based laser cutting control methodology
 - ✓ Defined the PERT chart node in the digital simulation platform to control the laser cutting process
 - ✓ Implemented the control structure as the plugin of the digital simulation platform
- PERT chart helps reducing the laser cutting process modeling time and enhancing the quality and the safety of the laser cutting operation