Met Box
Product Requirements

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Document History

Rev Number	Date	Modified By	Reason
0	29 September 2018	David Severud	Initial Release
1	8 October 2018	David Severud	Revised
2	15 October 2018	David Severud	Incorporated comments from INL

Table of Contents

1 Objective

The objective of this product is to create a remote visualization system to be used inside of the Met-Box within the Hot Fuels Examination Facility (HFEF) on the Idaho National Laboratory Site (INL).

2 Scope

The scope of the project is to create a remote visualization system for the Met Box at INL. The visualization system must be available from both operating stations of the Met Box and must be able to capture several view angles of the instruments kept inside.

3 Functional Requirements

3.1 What it should do

Display multiple images of two microscopes and a hardness tester located inside the Met-Box on two monitors located on the outside of the Met Box.

4 Mechanical Requirements

4.1 Strength Requirements

The manipulators that will be used to build the system inside the Met Box can only withstand a maximum of 10 pounds, therefore each individual part used in creating the system must not exceed this limit. It is recommended such pieces do not go past 5-6 pounds as well.

4.2 Spatial Requirements

Product can be inserted into Met Box from a Porthole which is 20 inches in diameter and is located on the top of the Met-Box for entry. Alternative entry can be accessed via an 8-inch diameter glove port hole on the backside of the Met-Box. Electrical cabling ports are located in the back-right corner of the Met-Box, where the power and signal cords for system can be fed through to the interior of the box.

4.3 Weight/Mass Requirements

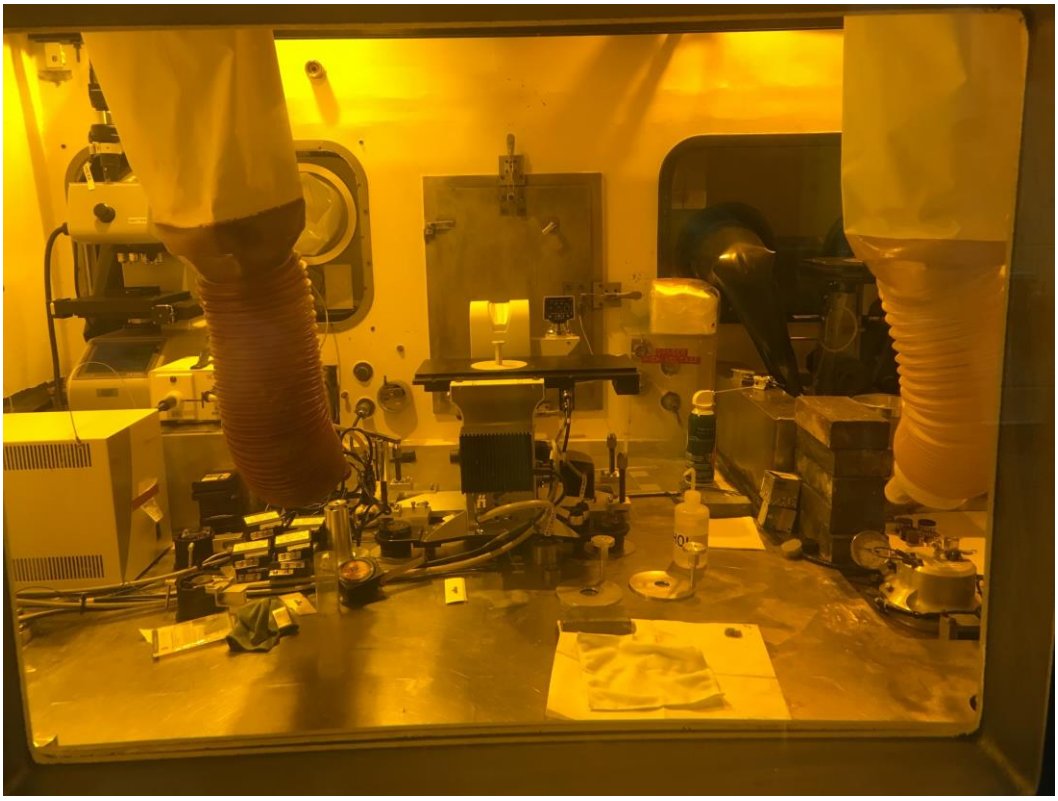
The visualization system may potentially need to be assembled by the manipulators inside the Met Box. Thus, the system is restricted to a weight of 10 pounds, with a recommended 5-6 pounds maximum. This requirement is strictly a mechanical one and driven by the manipulator capabilities.

4.4 Mounting / Interface Requirements

Product must be designed to be able to be built with manipulators within the met box. Maximum manipulator finger extension is 10 ¼ inches.

Multiple angles of viewing for the two microscopes and hardness tester must be achieved by the system. The microscopes are inverted revealing the surface easily, but the hardness tester namely, does not have an easily displayed surface.

Two solutions to mounting the cameras inside the hot-cell. Cameras sit atop tripods that can be articulated by the two manipulators inside the hot-cell. Or the cameras are mounted to wall with magnets, the height on the wall that they can be mounted at is limited by the reach of the manipulators.



4.5 Appearance Requirements

Clean cable management is required for the power and video cables coming from the cameras in the hot-cell to the monitors. The camera images will be in color with a minimum resolution of 0.5mm and a field view of 15 by 15 cm to read the two microscopes or hardness tester.

4.6 Durability Requirements

The system shall be designed to operate for 4400 hours (6 months) without any scheduled maintenance.

The life of the cameras depends on the effectiveness of the shielding built around the cameras. This shielding will be made of: Lead, Stainless Steel, Tungsten, or an additional material.

4.7 Reliability Requirements

All components shall have 90% reliability

5 Electrical Requirements

5.1 Operational Voltage

The electrical receptacle capabilities in the Met-Box are 110V, 20-30 amps. If necessary, a transformer can be implemented to step up or step down the voltage to the required value.

5.2 Operational Power Capability

During operation, the power will be constantly supplied via the receptacle.

6 User Requirements

6.1 Functionality

Color images from each of the cameras. Two monitors, mounted outside of the hot-cell, shall display all camera images on one screen.

6.2 User Interface

Cameras shall be controllable from two workstations outside of hot-cell. Ability to zoom in and out as well as rotate cameras is required.

7 Environmental Requirements

7.1 Temperature

Example - The Product is expected to have full operational capabilities in environments with ambient temperatures of (Update with temp readings inside hot cell).

7.2 Radiation

The product is expected to have full operational capabilities in a radiation environment of readings of gamma radiation upwards of 18 Rad per hour at 30cm

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8 Cost Requirements

8.1 Prototype Cost

Cost to build a POC (Proof of Concept) prototype shall not exceed $4000.

8.2 Production Requirements

Only one completed product is needed for this project, and will include a visualization system, monitors, and controls.

9 Schedule Requirements

The following are the major Project Milestones:

- Approval of Requirements — Oct. 2, 2018
- Concept Design Review — Nov. 30, 2018
- Purchase Order of long lead parts — Dec. 8, 2018
- Detailed Design Review — Feb. 9, 2019
- Engineering Release of drawing package — March 2, 2019
- Complete Prototype build — April 5, 2019
- UI Design EXPO — April 26, 2019
- Final Report / Drawings — May 4, 2019