

# INL Visual Examination Machine Periscope Upgrade

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A through-wall digital periscope has been designed and fabricated to replace a vintage unit that would be extremely costly in time and funding to refurbish. The new unit is based on a 2-meter working distance 4:1 macro zoom machine vision lens, coupled to a digital microscope camera. This combination is mounted inside a sealed shielded tube with paired mirrors to direct the optical image to the lens without being in the direct line of the radiation, which would damage both the lens and the digital image sensor.

The lens is a Keyence VW-Z2 long distance macro zoom, which has a working distance from 200 to 2000 mm with a 4x zoom. The lens is mated to a Keyence VHX-2000 microscope camera that is nominally a 2 megapixel unit that is typically used with microscope lenses.

Designed to fit into the 1.2m thick wall penetration currently occupied by a non-functional Kollmorgen periscope which was installed in the Idaho National Laboratory's Materials and Fuels Complex Hot Fuel Examination Facility Main cell in 1974, the present design is intended to allow straightforward replacement of optical and sensor components as technology progresses. Shielding is provided by steel plates that are individually removable to minimize the loads required for those installing them. To ensure that the light path is adequately shielded, a supplemental tungsten block is inserted directly above the camera component.

The periscope was initially intended for examination of individual fuel rods, since the penetration is aligned with a vertical positioning stage located 1130 mm from the inner wall of the hot cell. The stage has a primary carriage travel of 2603 mm and a supplemental extension stage that allows a rod to be moved as much as 5709 mm. At full zoom, a 40 mm length section of the rod can be inspected, while at minimum magnification, 159 mm of the rod may be seen. This is, of course, at a distance of greater than 1 m. Vertical stage movement can be controlled to within 0.07 mm allowing precise positioning of components such as fuel rods. Although the combination of stage capability, free travel space and penetration placement allows for examination of items as long as 3657 mm, for a 4267 mm rod, a set of extension mirrors has been designed, which will allow the point of view to be extended to points by 584 mm above and below the primary viewpoint center.

Due to the macro capability of the lens, it is possible to focus on a specimen placed as close as 50 mm from the front window of the feedthrough tube, resulting in a finely detailed image of small features. An X-Y-Z-phi positioning stage has been fabricated and control system is being developed.

Since the image is delivered to the display digitally, the complexity of mechanical shielding and light transmission is greatly simplified.

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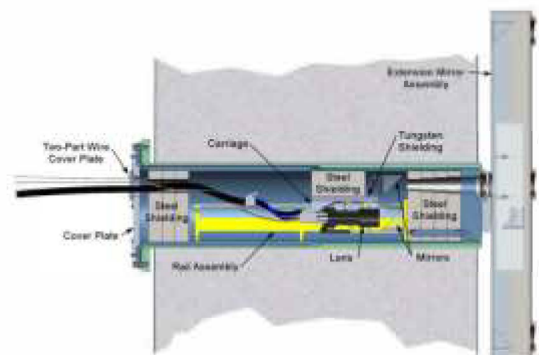


Figure 1. shown in General configuration