

# Four-faced Fuel Inspection Cavity System

## Background

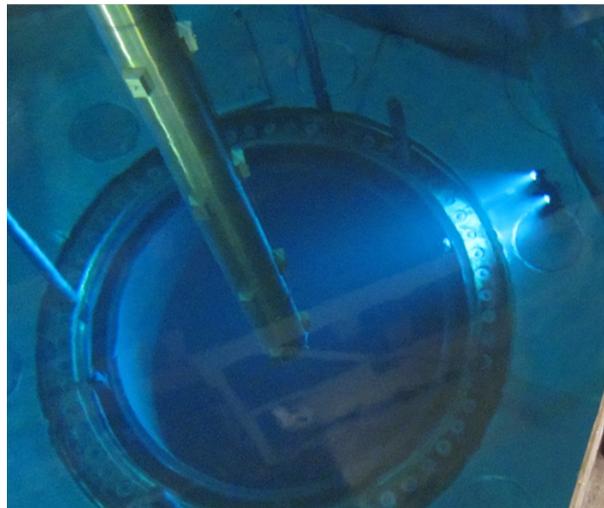
In an effort to be leak-free, sites across the industry are paying closer attention to the condition of the fuel assemblies that leave the reactors following operating cycles. Westinghouse offers the four-faced fuel inspection cavity system to help address the integrity of reloaded fuel assemblies. This system of four cameras, a control computer and a video-recording console is used to inspect off-load fuel assemblies for foreign material and gross damage.

Various four-faced systems exist in the market for recording video of the fuel as it is removed from or inserted into an up-ender basket. Westinghouse is proud to offer the first system that, with minimal user interface, will pan, tilt and zoom to a desired core location to capture four faces of the fuel as it is removed from the reactor vessel.

## Description

The four-faced fuel inspection cavity system consists of four inspection pods orthogonally positioned on the cavity floor around the reactor. Each inspection pod includes a 36:1 color underwater camera with two high-power LED lights. The camera and lights are directed by a robust pan-and-tilt with position feedback. The control of the four inspection pods is semi-automated with a touch-screen laptop computer aiming all four inspection pods at a desired location by simply touching the location as it appears on the screen. The core location and any audio from the inspector are archived with each video feed for future playback.

An upgraded version of the new Westinghouse refueling digital video recorder (DVR) is used to record video. The typical refuel DVR uses a network-enabled four-channel recorder. When connected to a network, the DVR can be accessed from any computer or table, enabling the viewer to stream live video, play back prior recordings or record locally outside of the radiologically



One inspection pod installed on cavity floor at customer site

controlled area. The upgraded four-face model uses two eight-channel DVRs for added redundancy and a quad-splitter to capture four faces in one video file. Both models allow text overlay and audio using the included microphone. The DVR can be controlled using a remote control or a USB mouse. Video is downloaded from the DVR using a USB drive on the front face of the console. Video format is generic and playable with most media players including VLC® and Windows® Media Player.

Added to the system after a refueling machine gripper was lodged onto a fuel assembly top nozzle, the system includes two guide stud cameras. These cameras look down into the core to provide video of latching the fuel assembly top nozzle.

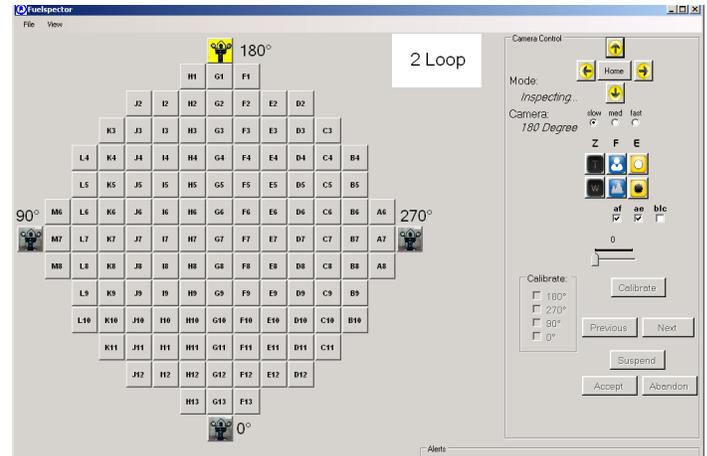
If a plant has sufficient clearance between the manipulator crane mast and cavity floor, the bottom nozzle can be seen from any or all of the inspection pods. If not, the system can be expanded to include a fifth camera that is dedicated to viewing the bottom nozzle of each fuel assembly.

## Benefits

- System includes high-resolution, 36:1 zoom, color cameras
- No impact on off-load
  - No added motion or time for each fuel move
  - Compatible with full-core off-load or core shuffle
  - Minimal setup time
  - Camera can be relocated from refuel bridge if needed
- Small, compact design
- Files are archived in off-load sequence for quick retrieval
- Audio and video overlay with time stamp, core location and face
- Remote viewing and playback via LAN from any computer
- Independent control for use with any other refueling activity
- Camera rotation: Horizontal is  $\pm 165$  degrees, vertical is up 70 degrees, down 90 degrees



Guide stud camera view



Graphical user interface screen for controlling cameras during core off-load



Sample view of fuel assembly face as top nozzle enters manipulator crane mast



One inspection pod – camera, lights, and pan and tilt on adjustable base

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