

## **N161. Remote Operated Vehicles - A Driving Force For Improved Outages**

The level of safety standards and regulations at today's nuclear power plants means that there is no effective alternative to Remote Operated Vehicles (ROVs) for carrying out required ASME inspections while observing the ALARA concept.

Remote operational inspection vehicles are neutrally buoyant, modular units with which reactor vessels, spent fuel storage pools, suppression pools, and other tank-type environments may be inspected. They are propelled by horizontal and vertical thrusters mounted in a steel crash frame with propeller guards and counterweight mounts. They are operated by a joystick, computer, or both and provide a stable platform upon which radiation tolerant cameras and other equipment may be mounted. Some of this equipment includes underwater lighting, articulating camera/light yokes, dual beam lasers for measuring, high magnification camera systems, etc.

The latest camera systems for these ROVs can operate in temperatures in excess of 185°F and in radiation fields exceeding 950,000 R/h gamma, either cumulative or acute, without auxiliary cooling equipment.

Besides inspection vehicles, many other types of ROVs have been developed. Crawling and "flying" ROVs can be used for inspection purposes and for maintenance and repair jobs. These machines may be outfitted with special tools and can reach difficult places. Their use in place of humans reduces dose to workers, shortens outage time, and reduces manpower requirements. ROVs typically perform the following tasks:

- Verifying the performance of activities such as reactor vessel disassembly, reassembly, maintenance, and repairs.
- Mapping temperatures and radiation fields.
- Locating loose and foreign objects.
- Removing foreign objects.
- Identifying and measuring defects.
- Measuring dimensional changes.
- Performing visual assessment of the condition of equipment and fuel, including spent fuel stores.
- Underwater vacuuming and related activities.

Small utility groups considering the purchase of ROV systems can gather information through the following methods:

- Canvassing utilities with functioning robotic programs.
- Searching nuclear publications.
- Accessing inter-utility on-line information systems.
- Requesting information from professional groups such as the Electric Power Research Institute (EPRI) or the Utility/Manufacturer Robot Users Group (U/M RUG).

In considering systems for purchase, the option of manufacturer support and maintenance is a good choice as experience shows that more consistent results are achieved with the support of the manufacturer than with support provided solely by utility personnel.

When actually deploying the equipment, the job should be well planned and the operators should be familiar with the equipment and with the tasks to be done. Still, problems are sure to arise. Some tips on standard problems which operators should be aware of are:

- Compensating for the effect of surface water tension on the neutrally buoyant umbilical.
- Establishing an area for control equipment out of high activity areas and away from refuel bridge wheels.