Remote Monitoring Methodology for Underwater Laser Cutting in Nuclear Facility Dismantlement

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The dismantlement of highly radioactive nuclear facilities, particularly those with complex geometries, requires advanced underwater laser cutting techniques. To ensure safety and efficiency in these critical operations, we developed a comprehensive remote monitoring methodology for underwater laser cutting processes.

Our methodology employs a multi-sensor approach to capture and analyze data from the cutting environment. We utilized hydrophones to record acoustic emissions and pressure sensors to measure hydrodynamic changes during laser cutting operations. This diverse data collection strategy enables a more robust monitoring process.

The proposed methodology includes the implementation of a time series database for efficient storage and retrieval of sensor data. We designed a specialized database interface that facilitates real-time remote access to cutting status information, allowing operators to monitor the process from a safe distance.

Our analytical approach involves spectral analysis of the acoustic data stored in the database. This technique allows us to identify and classify the states of the laser cutting process, including success and failure.

To validate our approach, we conducted a series of controlled experiments simulating various underwater laser cutting scenarios typical in nuclear facility dismantlement. Results demonstrate that our methodology can effectively distinguish between normal cutting operations and anomalous events, providing critical real-time insights into the cutting process.

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