New opportunities for laser cutting in decommissioning – both in air and underwater

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Background

Benefits of using lasers in nuclear decommissioning

Case Studies

Summary

Acknowledgements
Every nuclear decommissioning task is different with its own unique challenges. Correct selection of decommissioning technique/process is critical. The technology needs to be Safer, Cheaper and Faster. Learning from past experience is essential. Ultimately, safety and the decommissioning cost are the main drivers.
2009 – TWI Ltd wins a competition proposed by the UK’s Nuclear Decommissioning Authority (NDA) to develop a new decommissioning technology

2010 - TWI Ltd presents results of pipe cutting and concrete scabbling with lasers which generates industrial interest

2012 - TWI demonstrates laser cutting using snake-arm robot technology

2013 – TWI demonstrates underwater laser cutting
Possible applications

Estimated 200,000 m² in UK  
Estimated 88 km in UK
Possible Techniques/Processes

For concrete:
- Mechanical scabbling
- Fluid jetting
- Microwave scabbling
- Laser scabbling

For cutting:
- Reciprocating saws
- Diamond wire
- Grinders
- Heavy duty shears
- Plasma-arc cutting
- Laser cutting

One Technology for Two Processes
Lasers in Decommissioning

- Limited use to date
  - high cost
  - poor reliability
- Modern lasers
  - Compact & robust
  - Optical fibre beam delivery
  - Distances ~ 100m
  - High power
  - High beam quality
  - Lower cost ownership

Size reduction
Decontamination

Solidification
Fabrication

Repair / welding
Surfacing
Potential Benefits of Using Lasers

- Low reaction force
- Limited stand-off sensitivity
- Small & light processing head
- Minimal secondary wastes
- Laser (high value) remote from task ⇒ reusable
- Can cut variety of geometries and materials
Potential Deployment Scenario

Dedicated Chop-Shop or In-Situ decommissioning?
Size Reduction of Pipe Network
Pipe Cutting
Combination with Snake-Arm Robots

1) A Snake-arm robot integrated with 5kW fibre delivered laser to form Laser-Snake

2) The Laser-Snake system is guided through a 200mm opening into a mock-up cell with a 1m thick wall

3) The Laser-Snake system is programmed to laser cut an access hole through a 6mm thick C-Mn steel vessel

4) (left) The Laser-Snake system travels through the access hole to selectively inspect a set of tubes before cutting them to access another set of tubes

5) (right) On completion of its mission, the Laser-Snake system tracks its movement back to its home position

A complete demonstration can be viewed on TWI’s YouTube channel

http://www.youtube.com/watch?v=lJxdf13JHKU
Fuel Skip Size Reduction

In April 2012 TWI demonstrated the effectiveness of using lasers to size reduce Mgnox fuel rods storage skips.

A complete demonstration can be viewed on TWI’s YouTube channel

http://www.youtube.com/watch?v=_s_8Rsdte5s
Controlled Removal of Material

Gouge cutting (two-pass) - Steel (12mm) on concrete

Minimum damage to concrete surface
In October 2012 TWI developed hand operated laser cutting tools for decommissioning applications. Sequence of images shows hand operated laser cutting process.
Underwater Laser Cutting
Underwater Laser Cutting
Little difference in cutting speed for air and water.

Key benefits of underwater laser cutting

- Reduced fume and dross
Advantages of Laser Cutting in Decommissioning

- Single laser system addresses several applications – reduces cost
- Laser cut kerf is narrower - allowing faster cutting speed and smaller volume fumes and dross
- Light processing heads - smaller and simpler manipulation systems
- Laser source located in clean area – multiple use
- Laser cutting system – high packing density - better waste management strategy
Remote cutting technologies are necessary in most nuclear decommissioning applications.

Fibre delivered laser beams offer significant flexibility for remote cutting applications.

TWI have demonstrated the potential of using lasers for nuclear decommissioning applications, particularly related to size reduction.

The nuclear industry is now more aware of the benefits of using lasers but the ‘safety’ cases for such applications still have to be met.
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