Fibre laser cutting of thick metal sheets

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Background of the task

- Dismantling of nuclear power plants
- Cutting of different types of steel with thicknesses up to 30 mm
- Minimisation of emission of contaminated material during cutting process
- Economical efficiency of the whole dismantling process

- Tests were done for cutting of the „safety container”
- „Safety container” is a sphere made of carbon steel (t=30mm)
- The sphere has a diameter of 27 m
- Cutting in different positions

Equipment for fibre laser cutting

Mobile Base Station with laser source YLR 10.000 (manufacturer IPG)

- Mobile Base Station with laser source YLR 10.000 (manufacturer IPG)
- Chiller (63 A net connection)
- Storage cabinet
- Laser source (63 A net connection)
Testing set up at SLV M-V

Equipment for fibre laser cutting

Device for turning the plate to simulate different cutting positions

Original plates from the „safety container“ (sphere) were used

Adapted cutting head with tractor

Tractor on test plate

schematically

Original plates from the „safety container“ (sphere) were used

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Equipment for fibre laser cutting

Adapted cutting head with tractor

- Sensors for measuring the distance between tractor and plate
- Internal Si-sensors for measuring secondary radiation
- Follower roll for constant distance between cutting nozzle and plate
- Brushes around the process area
- Exhaust system for the process area

Equipment for fibre laser cutting

Safety equipment above and below the plate

- Rings and brushes around the process area
- Exhaust system for process area
Equipment for fibre laser cutting

Safety equipment above and below the plate

Beam catcher below the plate with exhaust system in different positions

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Personal for fibre laser cutting

Qualification of personal before and during the tests

- Theoretical and practical course comparable to the qualification „laser beam specialist“
- The course had a focus to cutting and manual and mechanised guided laser systems
- One day theoretical and practical lessons about laser safety during this course
- Tests were done under supervision of experienced staff

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Fibre laser cutting in different positions

Pre tests with first tractor prototype in horizontal position

Magnetic tractor GLUMAG (Servisoud) with adapted cutting head

Carbon steel, Sheet thickness 30 mm, cutting speed 0.5...1.0 m/min
Fibre laser cutting in different positions

Tests for qualification of the process with the end user

During cutting tests in horizontal position

Fibre laser cutting in different positions

Tests for qualification of the process with the end user

During cutting tests in 45° down position
Fibre laser cutting in different positions

Tests for qualification of the process with the end user

During cutting tests in vertical down position and in PB position

Some results from testing

Finished !!
The competitor: Plasma cutting

Tests for comparison of the two processes with plasma technology

Plasma cutting with exhaust system above and below the plate

Comparison between Plasma and Laser cutting

• Increasing the cutting speed about 100% with laser cutting possible
• Reduction of the emissions about 60% with laser cutting possible
• Reduction of the cutting gap about 60% with laser cutting possible
• Increasing the sheet thickness about 100% with plasma cutting possible
• Investment costs significantly lower with plasma cutting in this case
Conclusion

- Technology and equipment are applicable for cutting thick materials
- Laser cutting in different positions is possible with good results
- Mobility of the whole equipment is an essential factor for the task
- Safety issues has been fulfilled (laser safety as well as radiation)
- Minimisation of emission can be reached by using laser cutting
- Cutting speed with laser is higher compared with plasma cutting
- Mobile laser systems in dismantling offering technological benefits
- Mechanised laser equipment is usable for different tasks

Other mobile application with 10 kW fibre laser

Welding of a tool for manufacturing of airplane parts

Three dimensional seam with appr. 7 m in length
Other mobile application with 10 kW fibre laser

Welding of a tool for manufacturing of airplane parts

Tractor with laser welding head