

ARC SAW TECHNOLOGIES

Presentation

Waste Management Symposium

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Description of the Arc Saw Technology

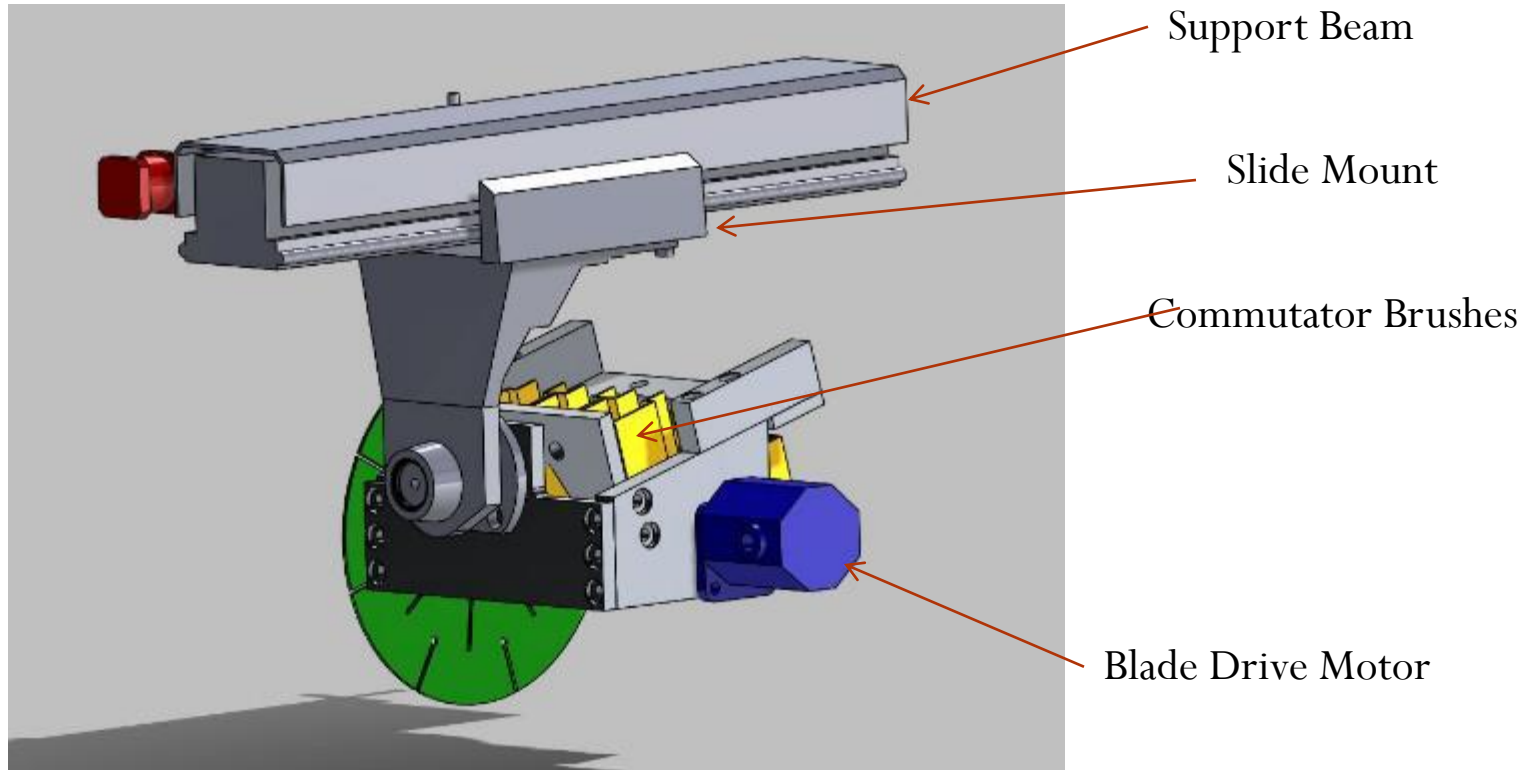
- The Arc Saw is a circular blade that cuts with an arc discharge
- Low voltage, high amperage, quick response power supply
- Blade doesn't touch work piece; no forces; no crud disturbance, no chatter
- Fastest cutting speed, lowest dross, least secondary wastes
- Computer controlled amperage feedback for cutting speed control
- Cutter shroud with air/water jets to cool blade and collect dross
- Proprietary dross separation/filter system
- Cuts any conducting metal in any configuration, thickness (up to about 20 in. thick – 50.8 cm)

Description of the Arc Saw Technology (Cont.)

- Cuts multiple thicknesses, piping, plates, weldments
- Makes plunge cuts
- Clean, through cuts – no re-cutting
- Long blade life; rapid blade change – less than 15 minutes
- Unlimited water depth of operation
- Fast cutting speed minimizes exposures to crew

Arc Saw Technologies

10-inch Diam. Demonstration Saw

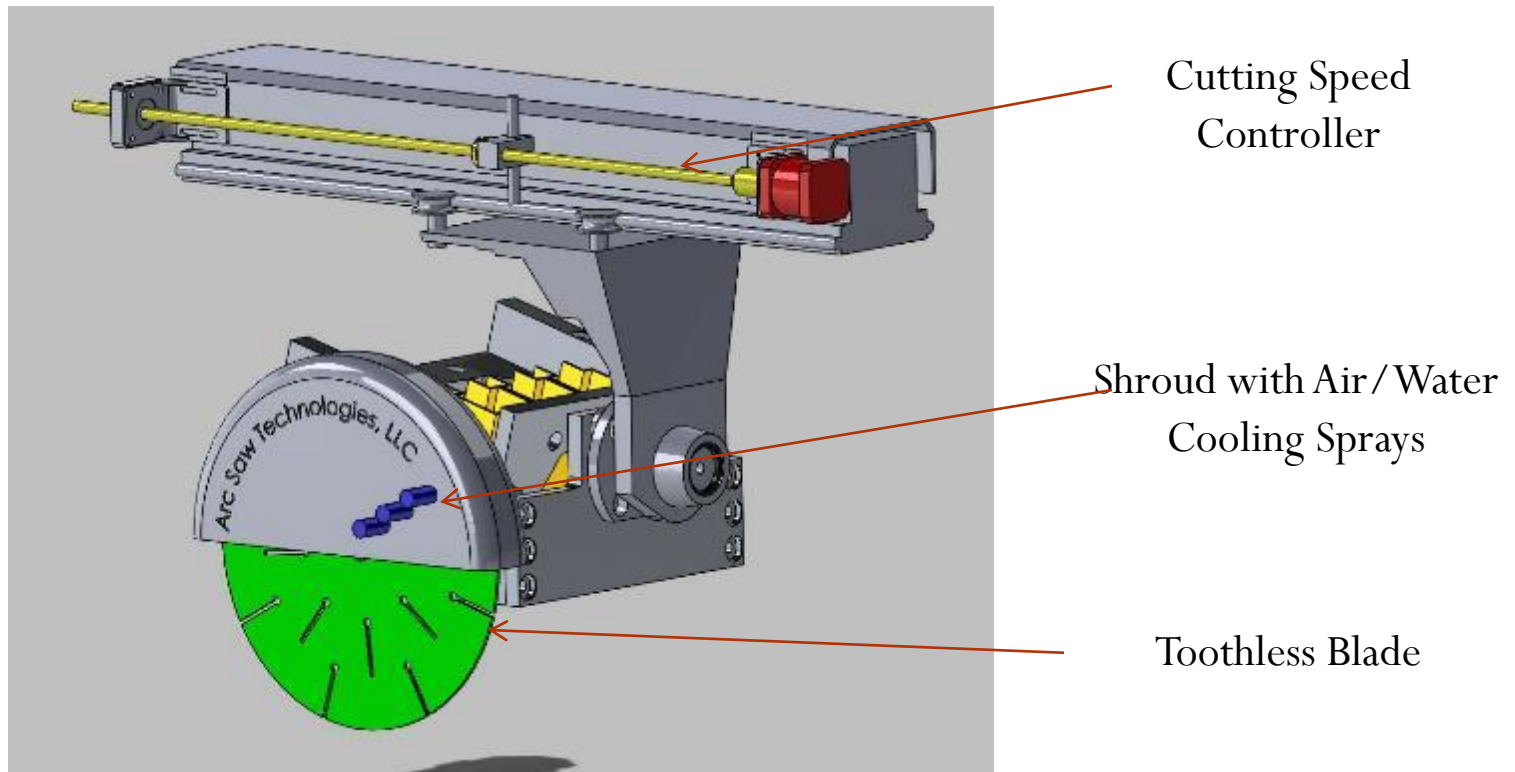


Early AST Arc Saw Demonstrations

- In 2017, AST designed and built a 10-inch diameter arc saw as a proof-of-concept demonstration
- Two sample cuts were made:
 - A piece of carbon steel 5/8" thick by 1-3/4" long
 - Seven 1" OD tubes welded together to simulate a heat exchanger bank
- Cuts were made in air (no cooling), and under water.
- Cutting duration was limited only by the power supply – six deep cycle 12 volt batteries in 2 banks of 3 to achieve 36 volts

Arc Saw Technologies

10-inch Diam. Demonstration Saw (Cont.)



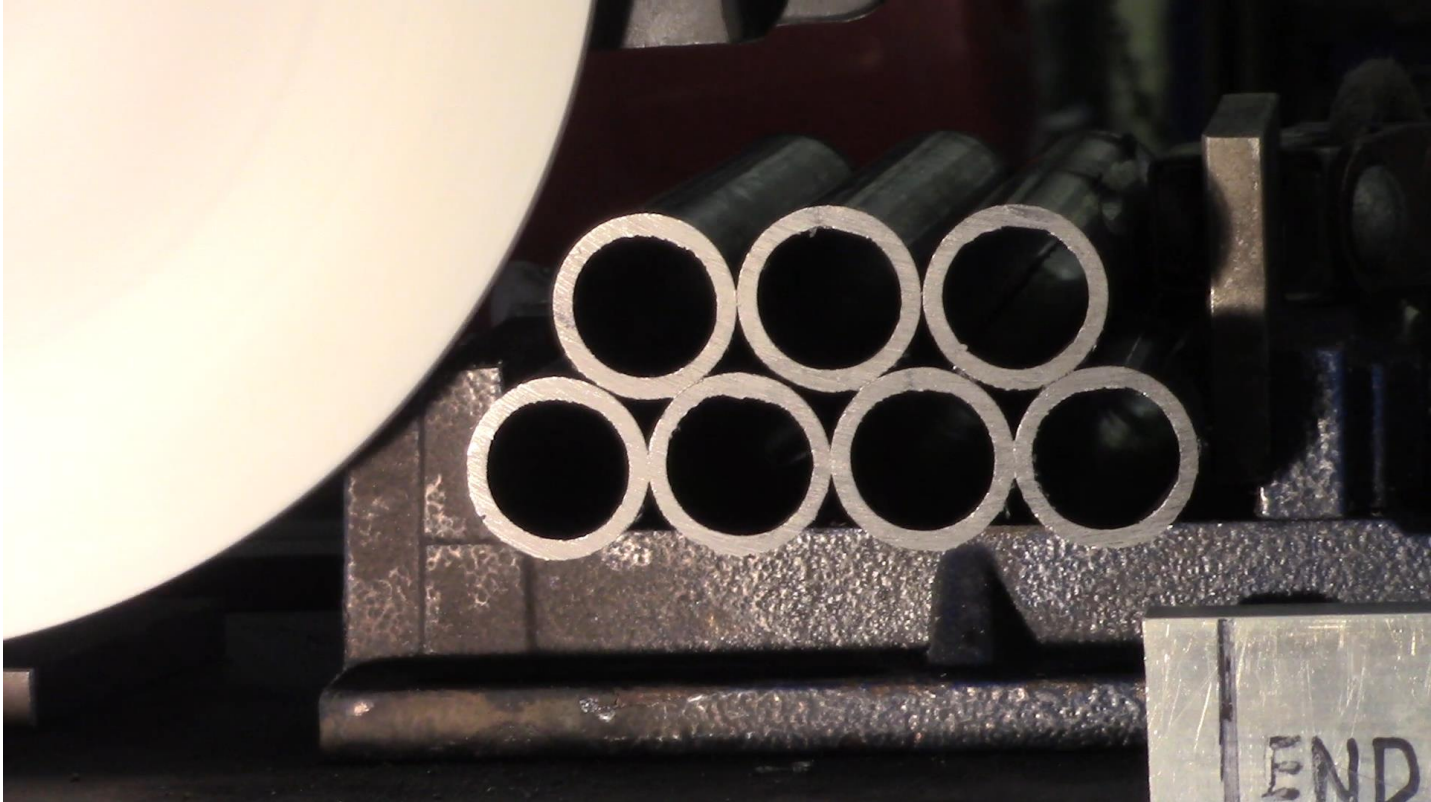
Arc Saw Technologies

Demonstration Saw (Cont.)



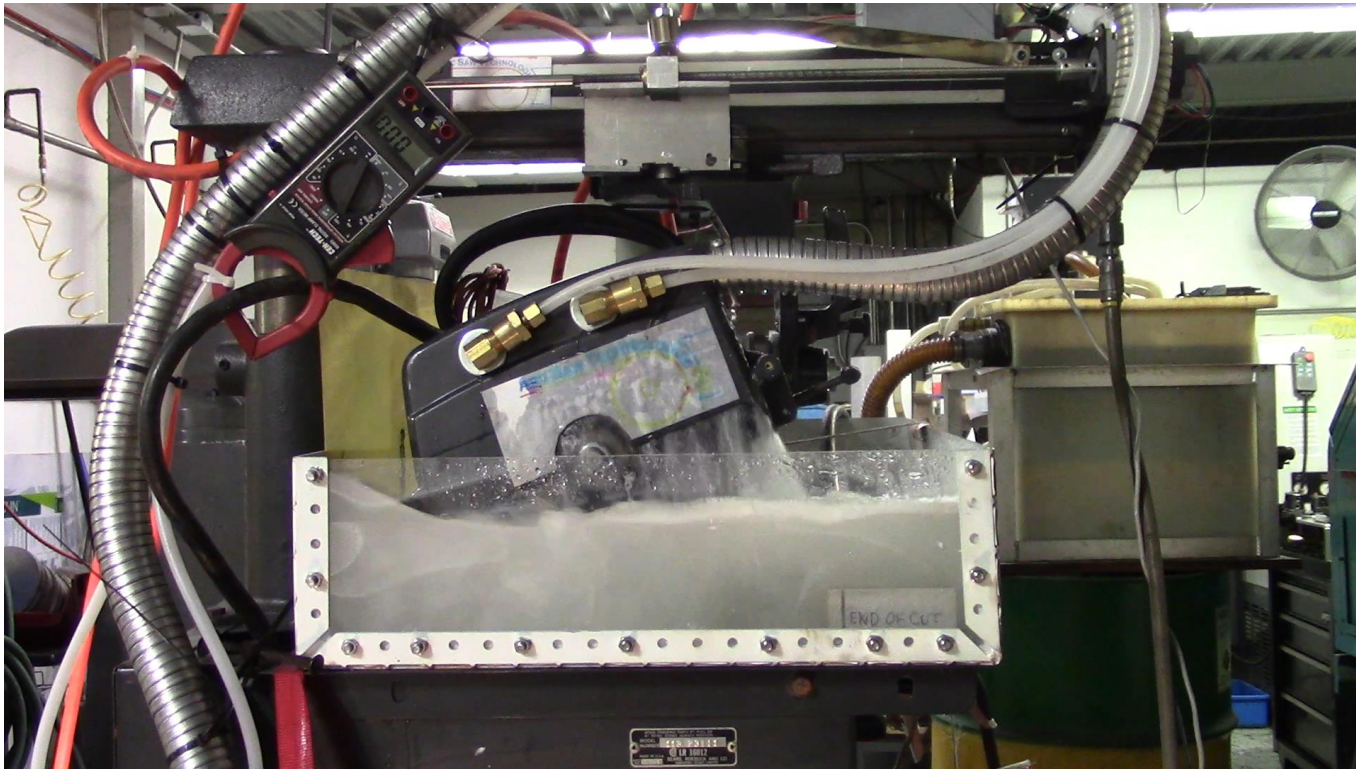
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Demonstration Saw (Cont.)

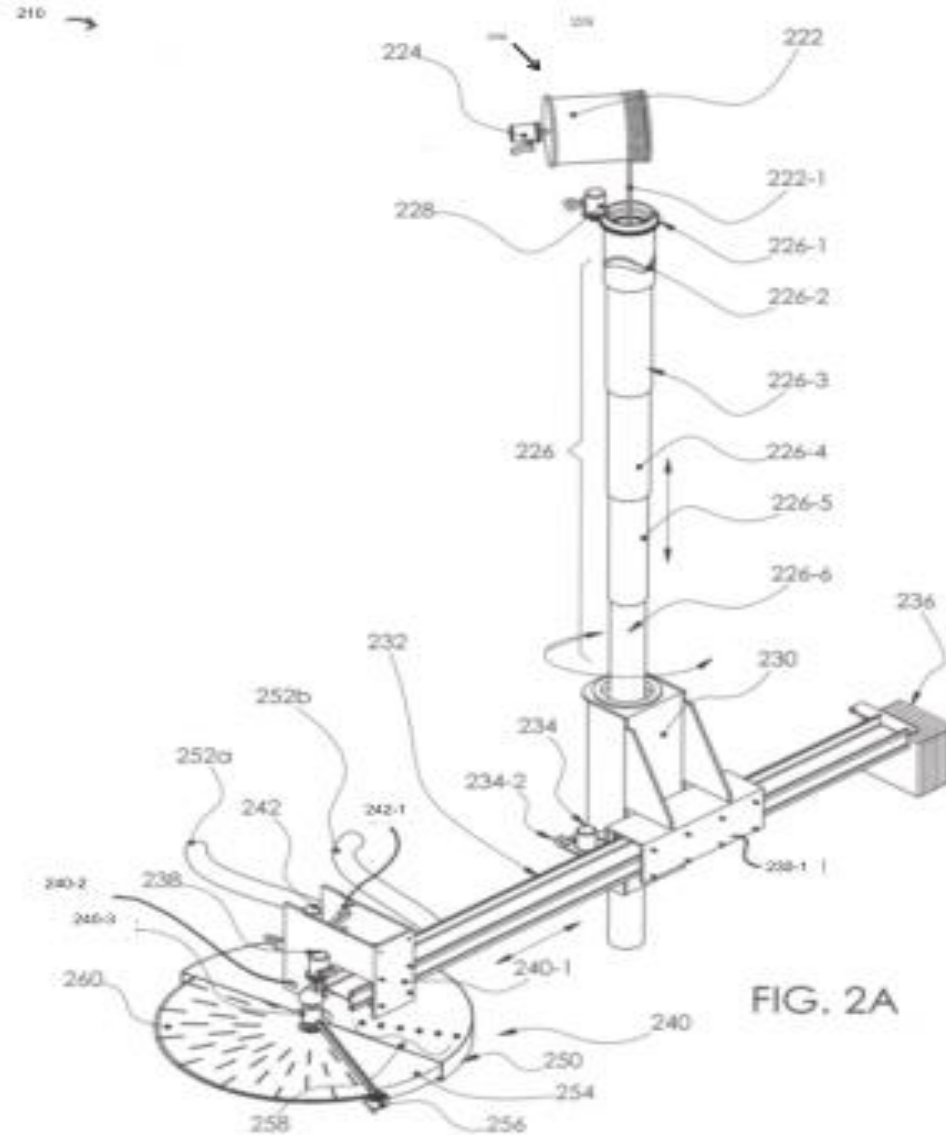


Arc Saw Technologies

Demonstration Saw (Cont.)



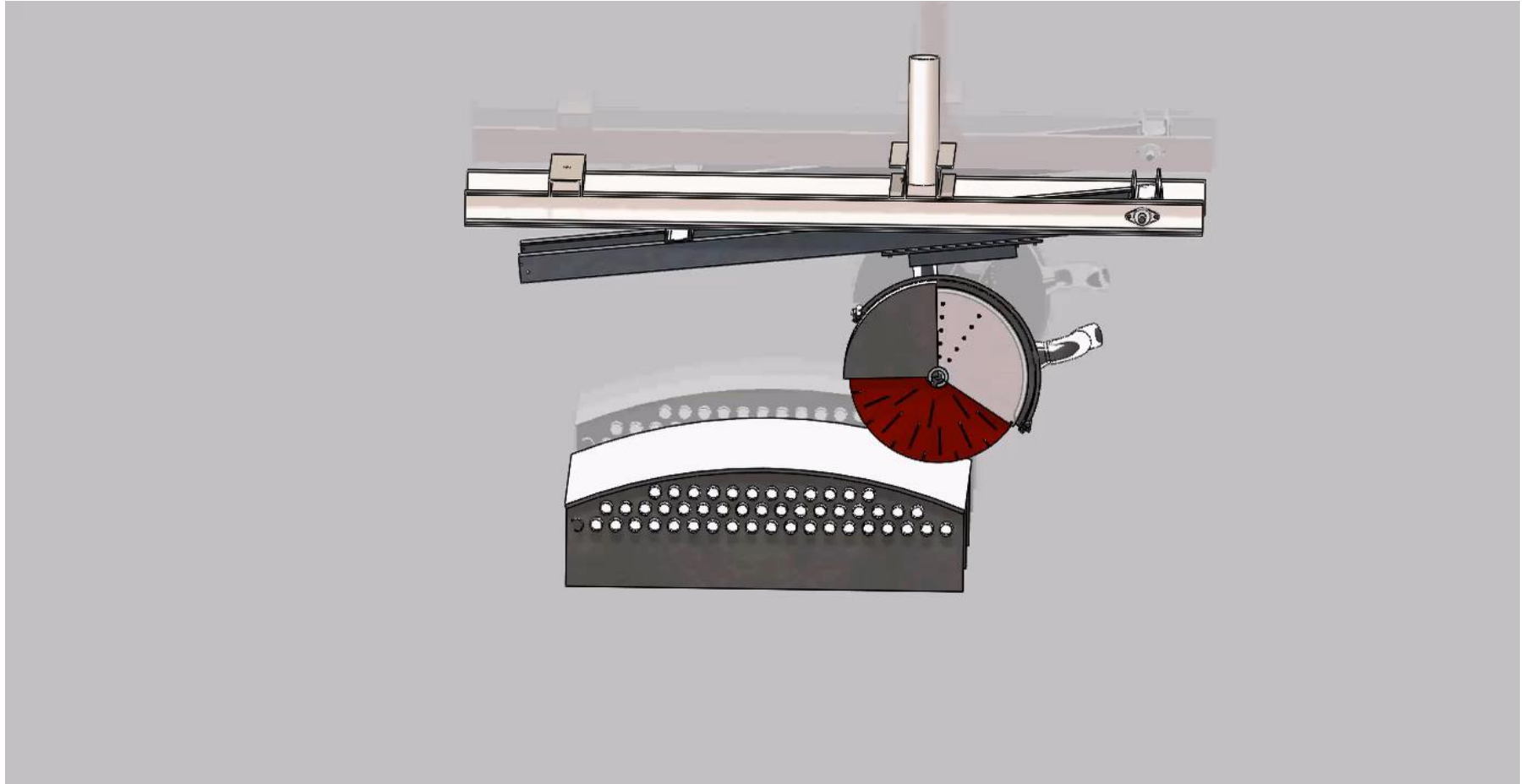
Arc Saw Technologies
Patent No. 10014084
July 2018
Design for Reactor
Vessels and Internals



AST Design for a 24-inch Blade

- In 2018, AST designed and built a 24-inch diameter blade intended to be attached to a manipulator such as a Brokk 400 or 800.
- The design incorporated a blade shroud with water cooling spray jets.
- The support arm included a drive screw to advance the blade into the workpiece.
- A computer program was written to control the speed of cut into the workpiece.
- The workpiece was a plate of AR-500 which is armor plate steel with a tensile strength of 225,000 psi & BHN=500, vs. mild steel tensile strength of 64,000 psi & BHN=130

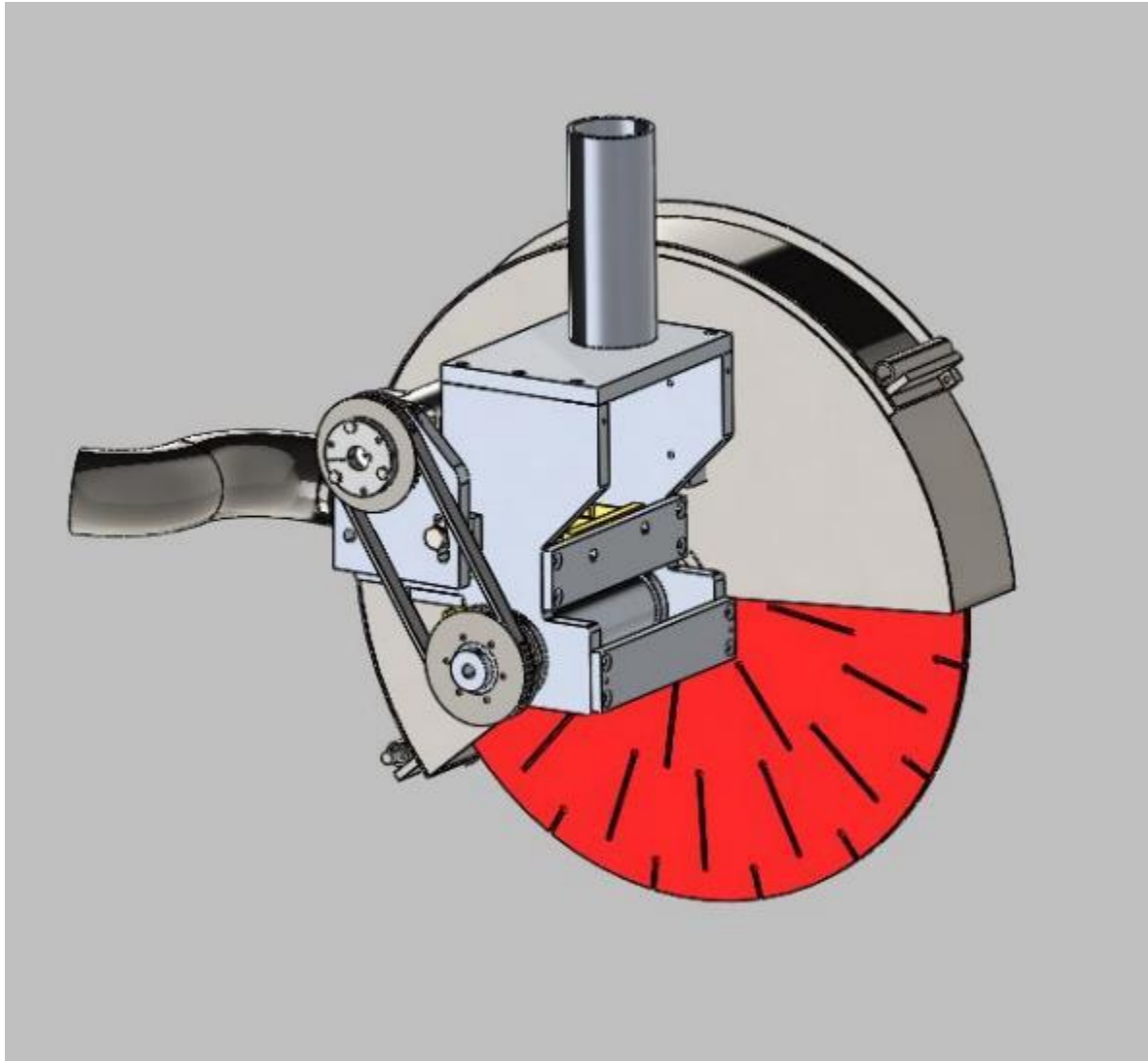
**24-inch Diameter Blade System for Segmenting Heat Exchangers or Similar Components -
Mates with Brokk 400**



24-inch OD Arc Saw for heat exchangers and similar equipment

- Designed for in-air cutting with water spray or compressed air cooling
- Power supply rate at nominal 1,200 amps at 40 volts DC (3 welding machines in parallel)
- Cutting speed used 20 inches per minute in 1/2" plate
- Capable of cutting speed of 50 inches per minute for a 5/8" thick work piece
- Can cut through heat exchanger shell and tubes continuously
- Minimal secondary wastes generated
- Videos show wet cutting and dry cutting

24-inch Diameter Blade Cutting Head, Drive, and Shroud System Details



24- inch diameter blade demonstration

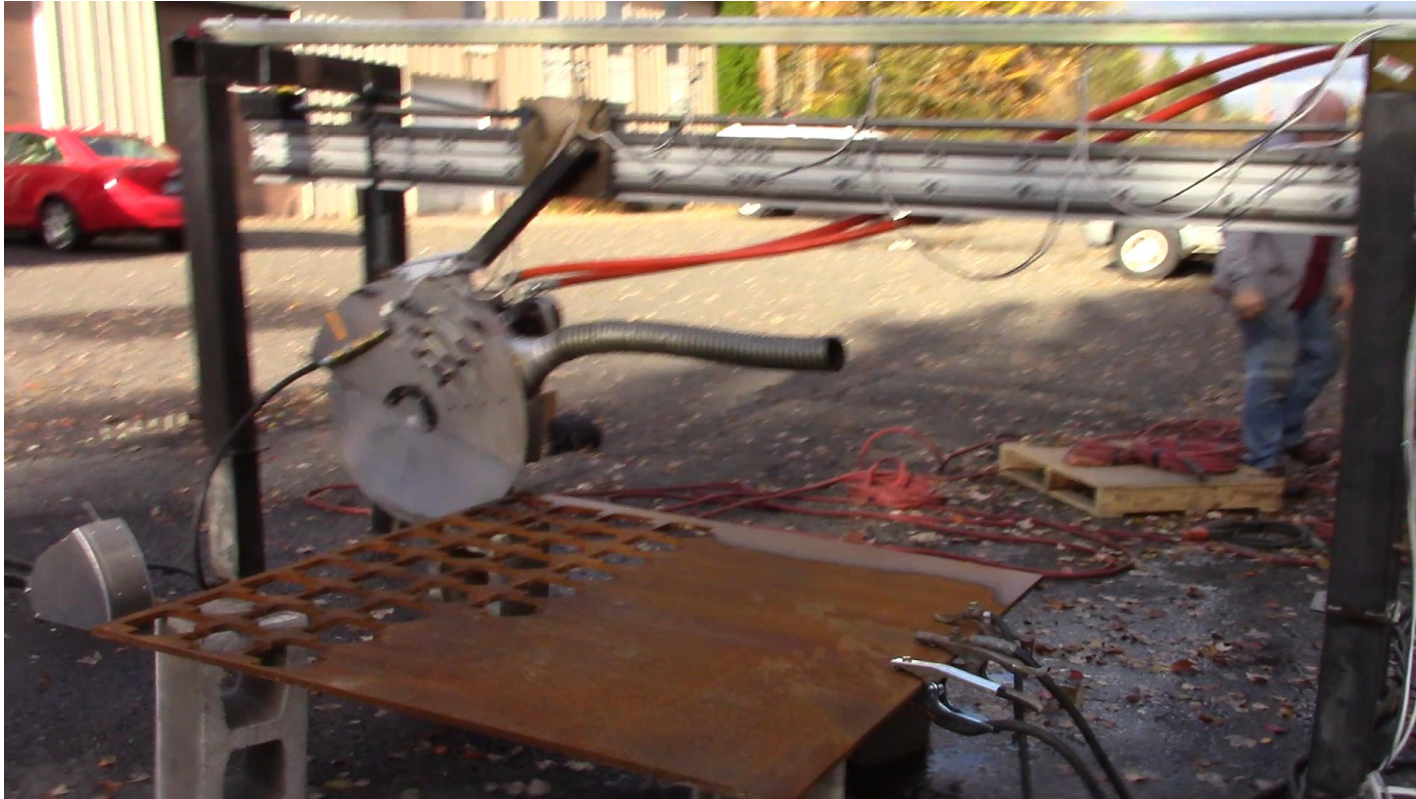


24- inch diameter blade demonstration



Arc Saw Technologies, LLC Proprietary Information **Wet cutting armor plate steel – 12 “ long**
Confidential

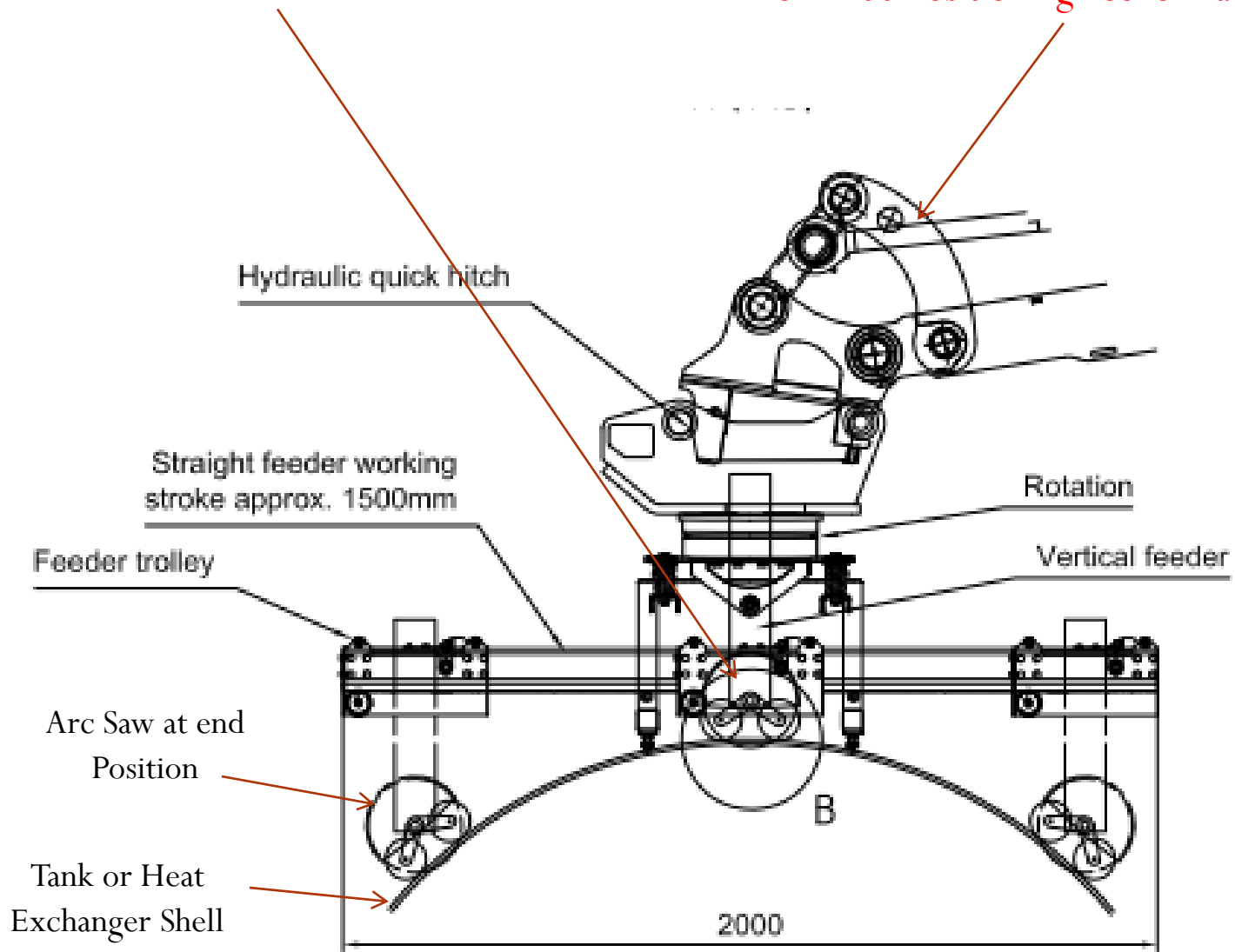
24- inch diameter blade demonstration



Dry cutting armor plate steel – 12 “ long

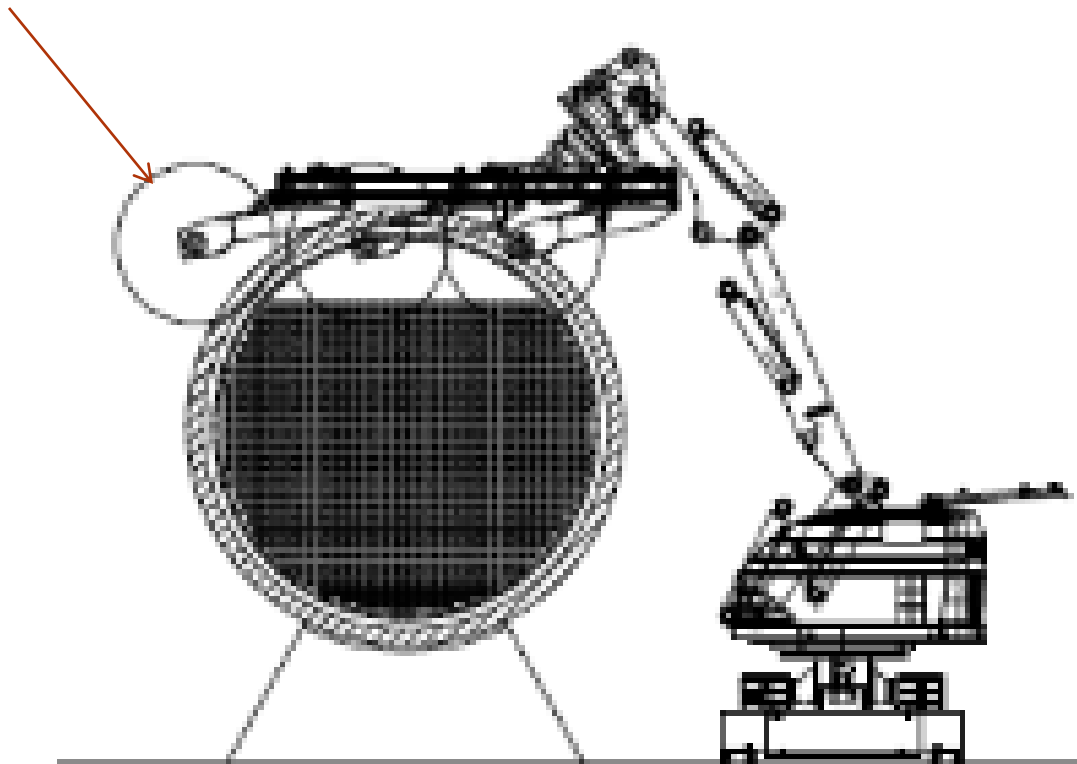
Arc Saw Supported by Feeder Bar

Brokk 400 Positioning Feeder Bar

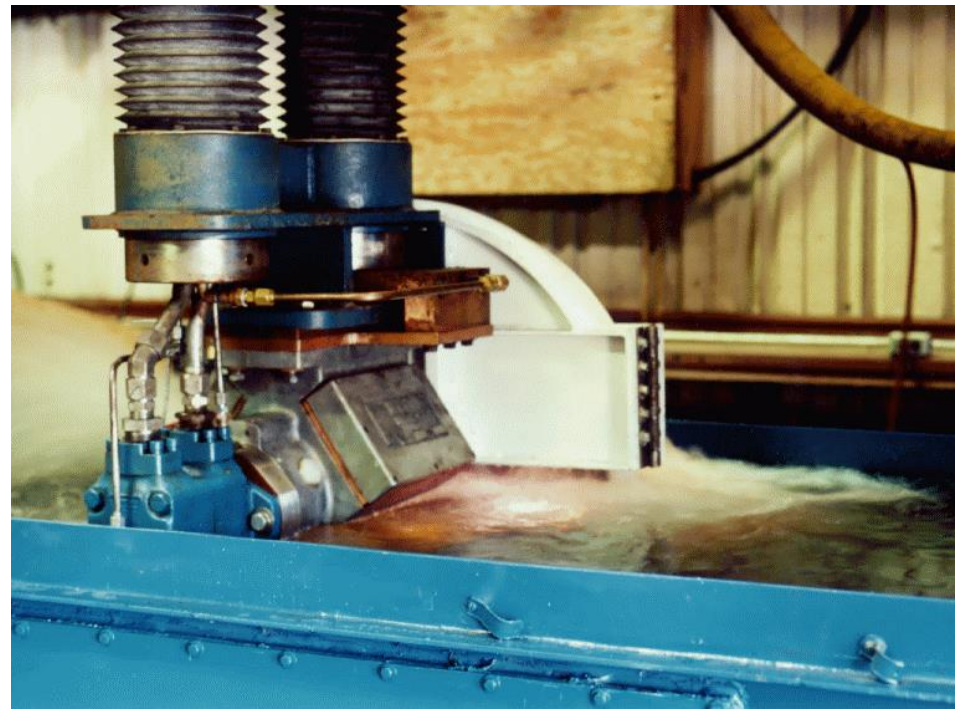
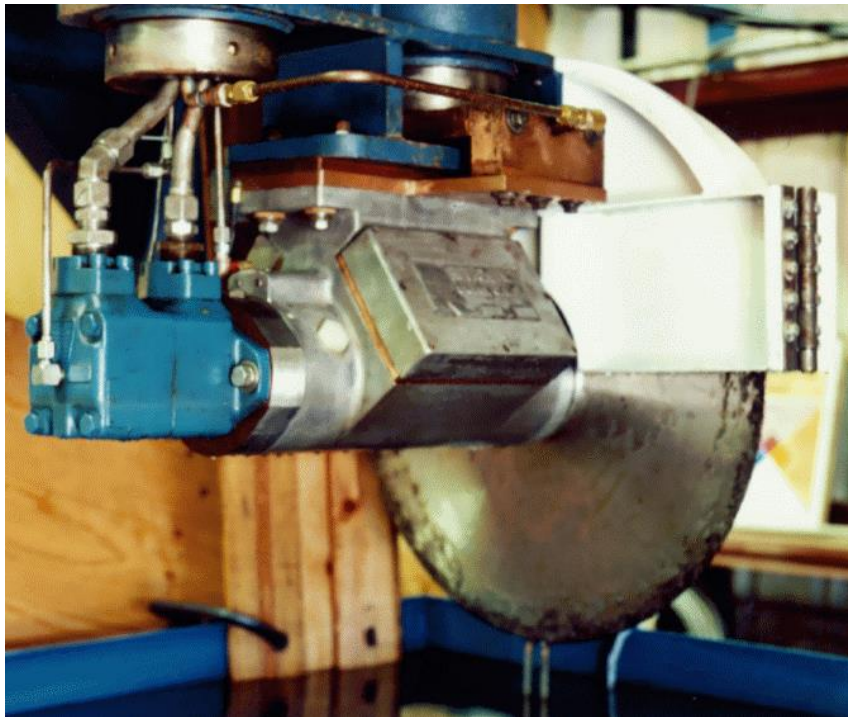


Arc Saw used for cutting heat exchanger tubes

Arc Saw Path



Original Arc Saw Prototype



Arc Saw Technology

- Operating Parameters

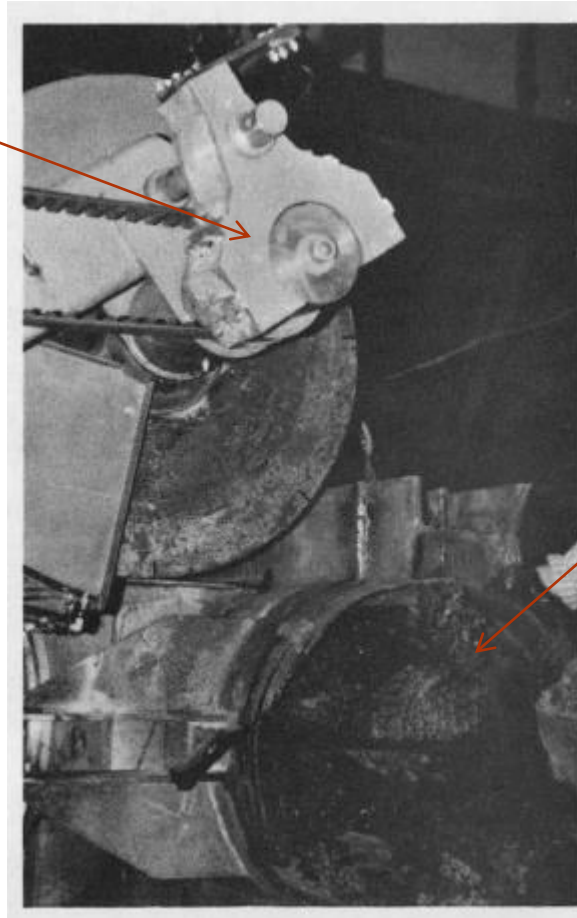
Power supply input	480 volt, 3-phase	Available at Facility
Cutting speed	200 sq. in./min (1300 sq. cm/min)	40 x Plasma Arc, 100 x Mechanical or AWJC
Cutting thickness	Up to 20 in. (50 cm)	Enough for cutting RPV flanges
Blade diameter	36 to 48 in. (90 cm to 120cm)	Extended blade use
Blade material	Carbon or Stainless Steel	Strength
Blade thickness	1/8 to 1/4 in. thk. (3 mm to 6 mm)	Minimum kerf width
Dross size – particulate/fines	0.08” for 10%; 0.008” for 40% (2 mm for 10%; 0.2 mm for 40%)	Similar to plasma arc
Dross generated – 2” SS Pl 10’ long	90 in ³ (580 cc)	Vs. 750 in ³ dross + grit for water jet cutting (4800 cc)
Gases generated	None	H ₂ recombines with a “crackle” in the kerf

Experience with Arc Saw Technology to Date

- Prototype developed and patented in 1983; patent expired
- Small 12 in. dia. Arc Saw built for ANL West; cut end fittings off fuel assemblies to fit cask; in service for more than 25 years
- Rockwell Hanford built an arc saw in 1977, and did extensive testing
- Battelle PNL built an arc saw in 1980 to cut spent fuel assemblies
- Japan Atomic Energy Research Institute (JAERI) built similar 40 in. dia. Arc Saw to segment JPDR RV underwater; performed extensive testing in 1989
- US DOE and Rockwell International, Inc., built a hand-held version, patented the design in 1986 and tested it at Hanford, WA

Atlantic Richland Hanford (1977)

Belt Driven Arc Saw



Heat Exchanger

PNL Arc Saw (1980)



Simulated BWR Fuel Bundles with Springs Shown as Cut on the PNL Arc Saw

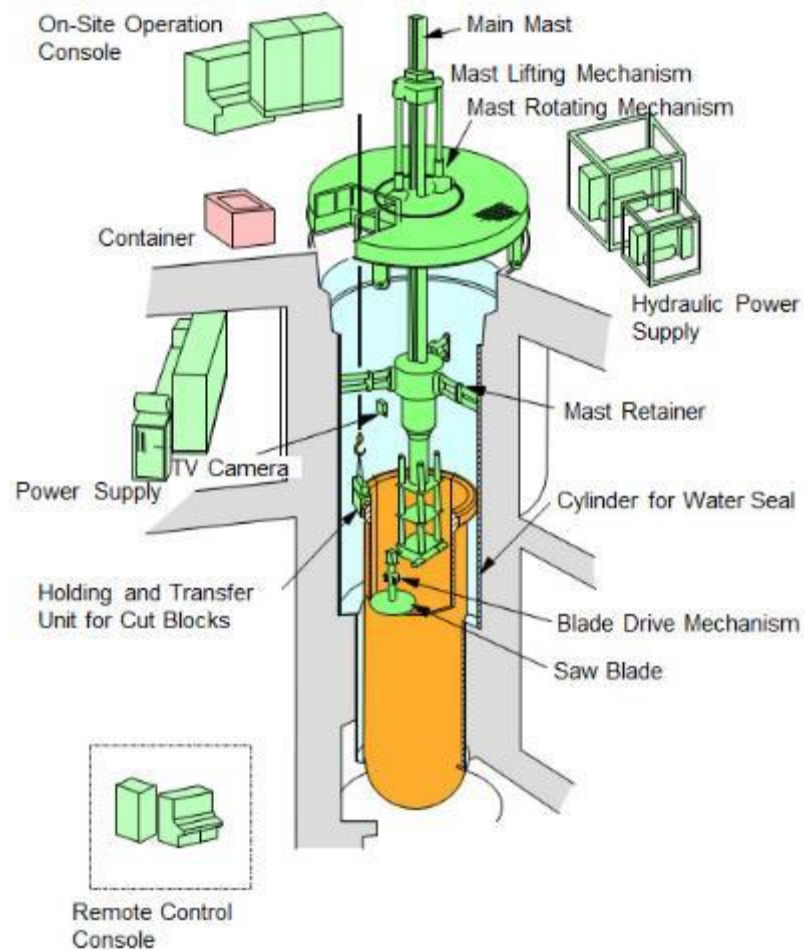
Experience to Date (Cont.)

- Japan Power Demonstration Reactor
 - 90 MWth BWR; operated 16 years
 - RV – 6.89 ft ID; 26.6 ft H; 2.25 in. thk. (210 cm x 811 cm x 5.72 cm)
 - RPV carbon steel, clad with stainless steel
 - Built tank around RV to cut under water; building the tank was the highest dose activity of project
- Extensive testing program
 - Cutting power, speed, dross size, thickness, blade life, etc.

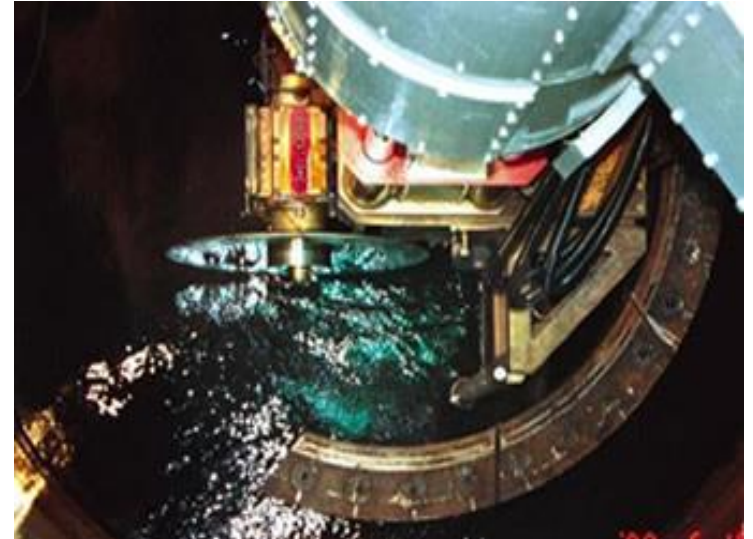
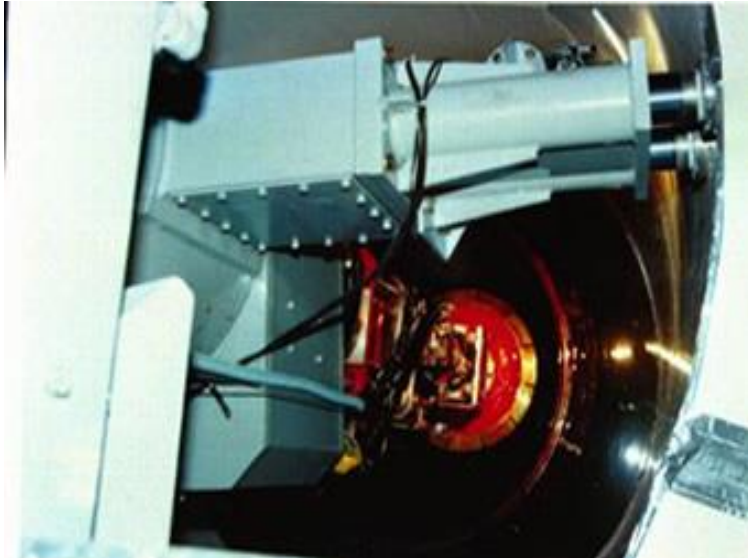
Experience to Date (Cont.)

- JPDR (cont.)
- Cutting performance
 - 41 days to cut RV; 13 days for Flange & 3 days for each row from 2nd to 8th
 - Cut all segments to fit a 1 m³ disposal container per Rokasho WAC
 - Used 24 blades for RV

JPDR RPV Vessel Segmentation



JPDR RV Segmentation (Cont.)



Improvements in Results and Certainty

- Faster cutting means greater productivity
- Complete through-cutting means no re-cutting
- Critical Path time reduced using two cutting stations – 1 in pool for RPV Internals on a turntable, and 1 in RPV for in situ cutting
- Segment handling and shipment will be the Critical Path, not the cutting time
- Proprietary dross separation and filtration system minimizes radwaste; separator dumps directly into liners of segments to fill void space
- Robotic mast and arm to position arc saw support system minimizes dose to workers

Phased Development Program

- Phase 1 – Design development
 - Assembly drawings/specifications and BOM for Arc Saw, Feeder Bar(s) & Manipulators
- Phase 2 – Development of prototype units for testing
 - Arc Saw, Feeder Bar(s) & Manipulator
 - Control Systems
- Phase 3 – Testing Program
 - Cutting parameter development, equipment demonstration, performance prediction
 - Integration with Brokk 400/800 or other manipulators
 - Mock-ups of specific facility configurations
- Phase 4 – Fabrication of Units for Field Use
 - Second Arc Saw with design modifications as determined
 - Refurbishment of prototype units for use as field units
- Phase 5 – Mobilization at facility site
- Site contractors licensed to use Arc Saw equipment at site