



**Process &
Power
Generation**

Trends and Developments in Wind Tower Fabrication

**Patrick Wahlen
Global Business Director
Lincoln Electric Holdings
May 27, 2011**



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Tower Solutions**

Wind Tower Fabrication

- Lincoln Electric Overview
- Wind Tower Design Trends
- Wind Tower Plant Overview
- Advanced Wind Tower Fabrication Solutions

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Lincoln Electric - Today

- Largest manufacturer of welding equipment and consumables in the world
- \$2.3 Billion USD in sales for 2010
- Over 9000 employees worldwide in 160 countries
 - More than 500 Technical Reps in the field
 - Over 200 Graduate Technical Reps in the field
 - Applications Engineering and R&D assets available globally
- 40 manufacturing sites in 19 countries including 5 in China
 - 5 Global Flux Manufacturing Locations
 - 11 Global Wire manufacturing Locations
- 20 worldwide distribution centers

A Truly Global Company



**40 Manufacturing Facilities
in 19 Countries**

Flux Manufacturing - 6 Plants in 5 Countries

SAW Wire Manufacturing – 11 Plants in 11 Countries



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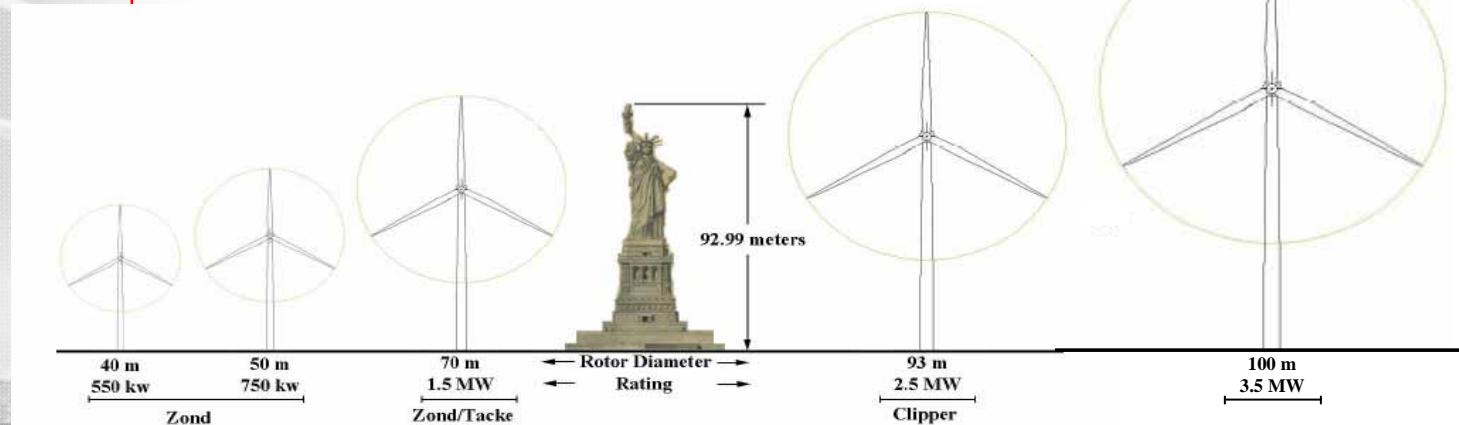
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An Evolving Industry

- As technology advances, the scale and mechanical requirements in the wind tower industry are increasing
- Nacelles are getting larger and larger
- Tower heights are trending to 80m as a standard and now even 100m or more.
- Diameters can only grow so large due to transport issues so thickness **MUST** go up.
- Potential for Higher Strength Steel Usage
- Direct Drive Nacelles



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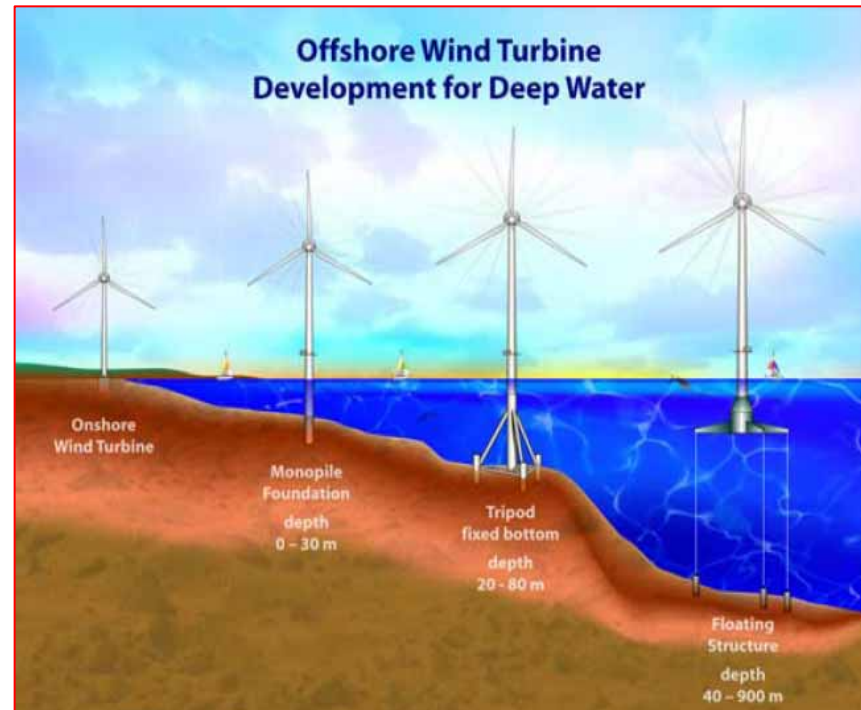
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Offshore Towers

- Offshore Wind Farm Development is Accelerating World Wide
- Nacelles Range from 2.5MW up to 6WM
- Nacelles Under Development of up to 10 MW
- Tower heights are trending to 80m or 100m to accommodate larger Blades, access better wind quality thus improving efficiency



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Offshore Solutions

- Offshore Towers are currently using Monopiles, Tripod, and Jacket Structures
- Material Thicknesses of Monopiles and other structures can easily exceed 100mm and section weights may exceed 200MT
- Floating Structures currently under development and testing
- Jacket Structures similar to petrochemical with similar requirements for low temperature weld metal toughness



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Typical Aeolic Wind Tower Plant

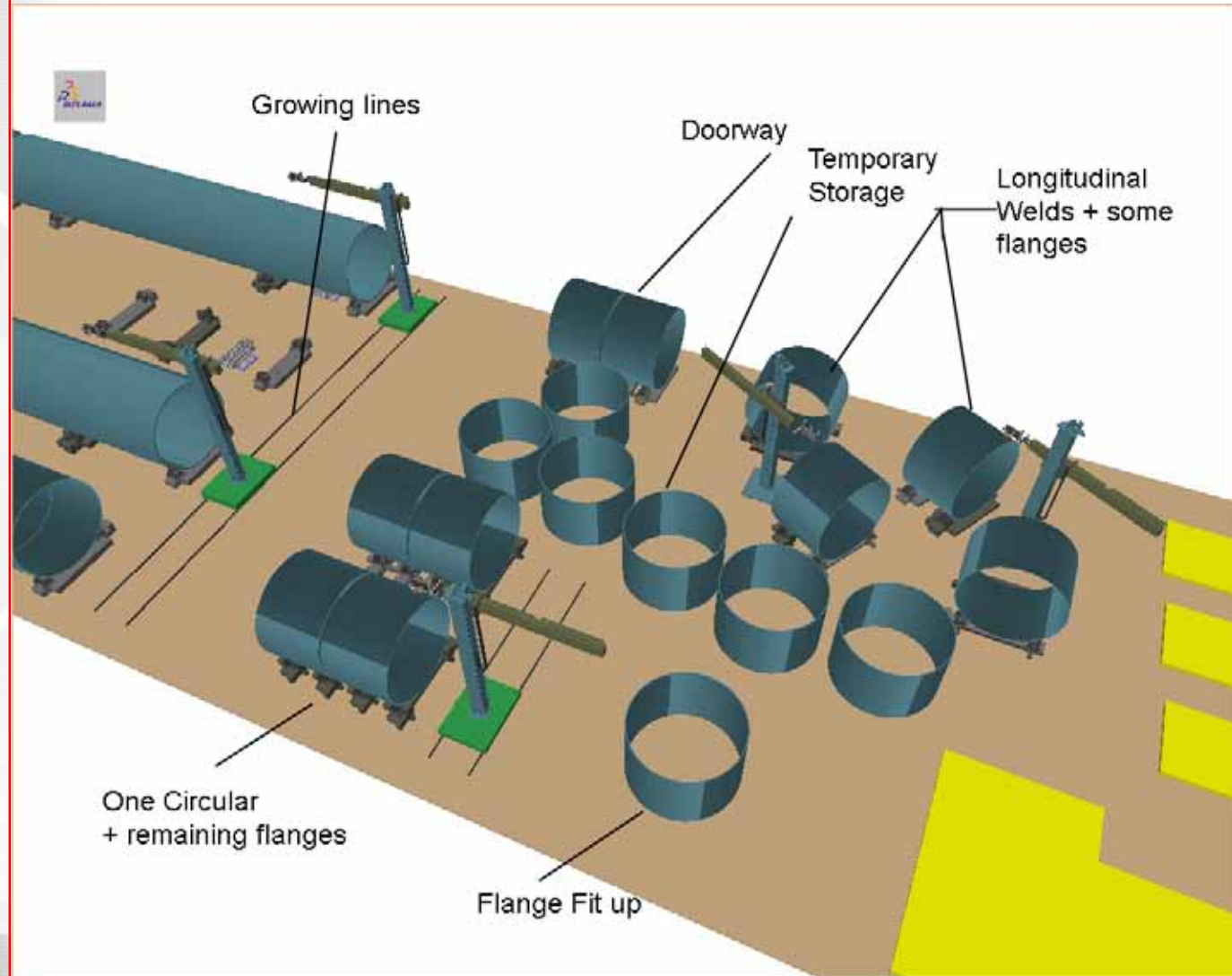


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Boxes With a Red Border Indicate Processes
Involving Welding

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Layout: 150 - 200 Towers per year



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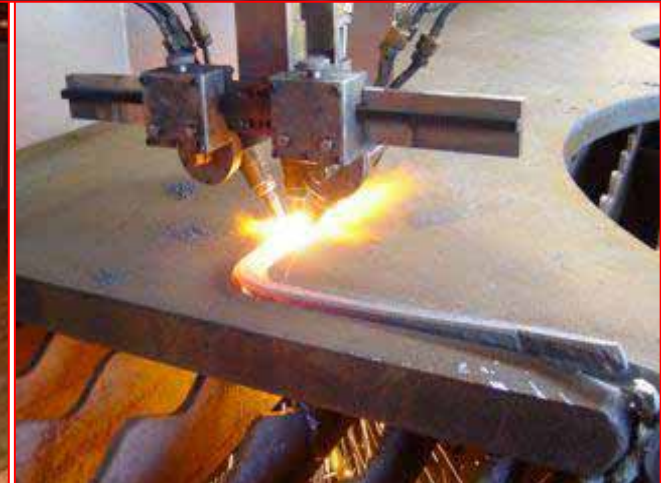
Cutting & Bevelling

Plasma Vs. Oxy Fuel



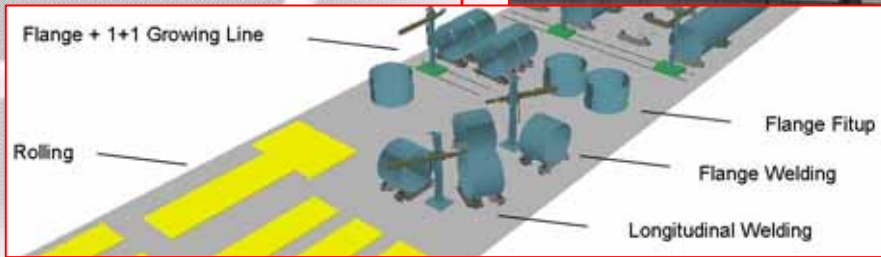
Preblast??

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Longitudinal Welding

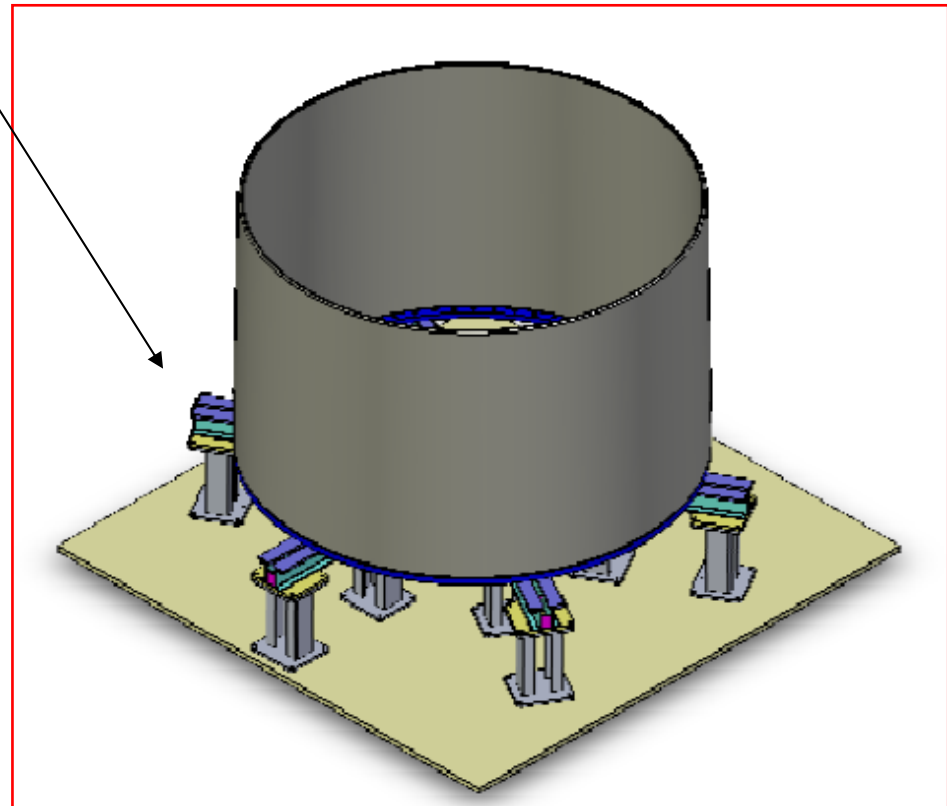
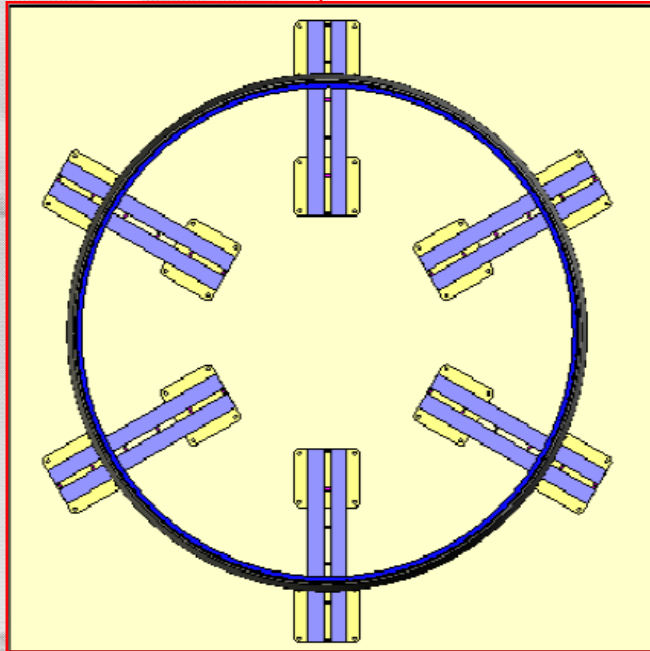
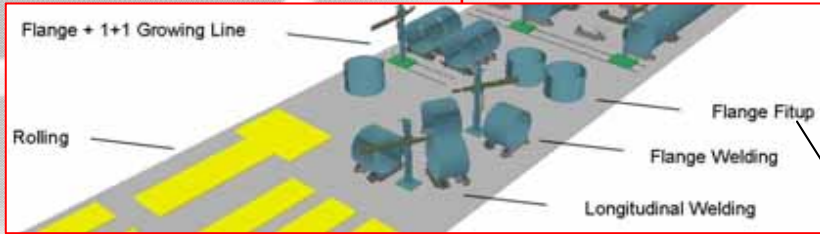


20 MT Rotator Set

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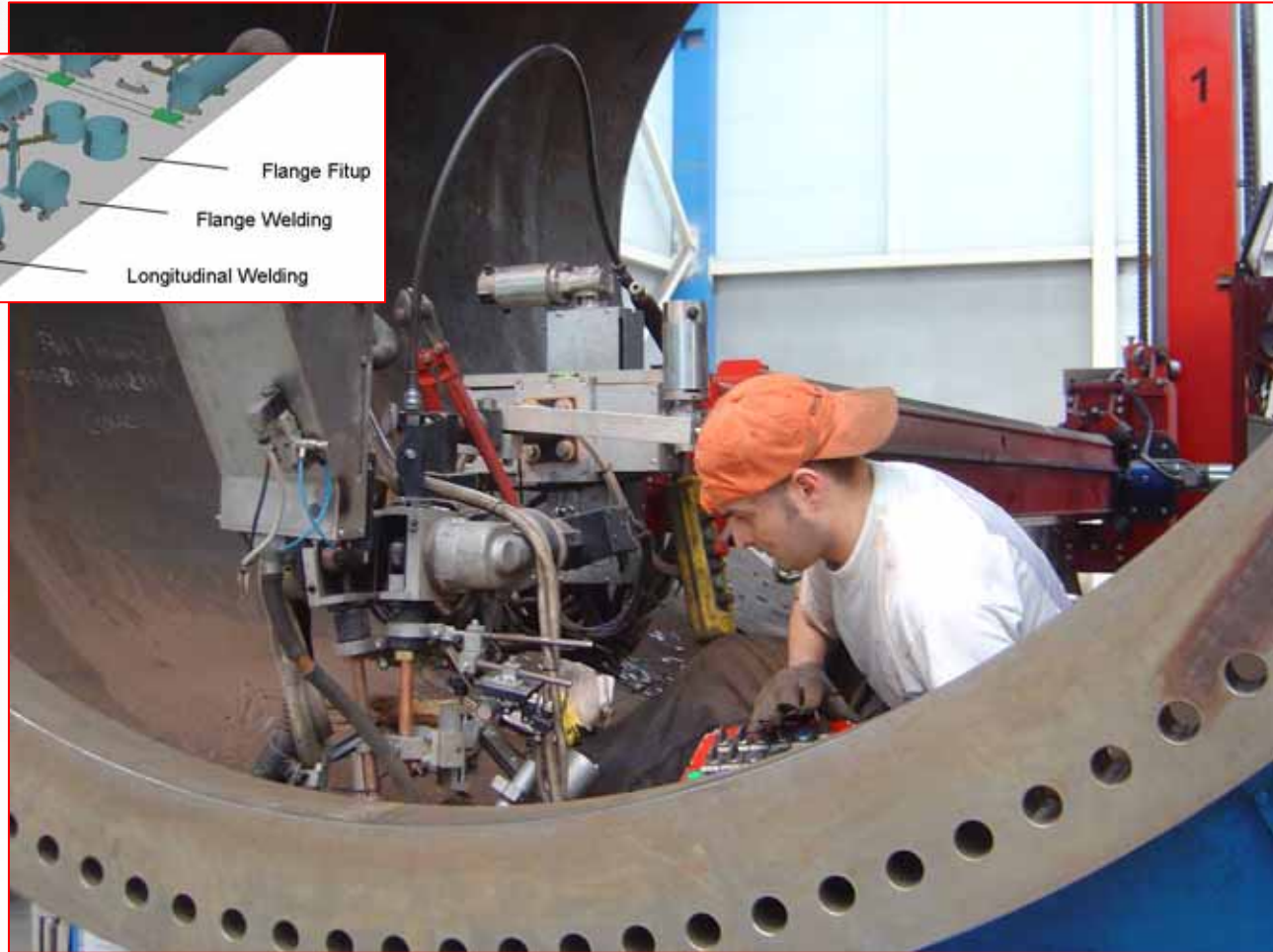
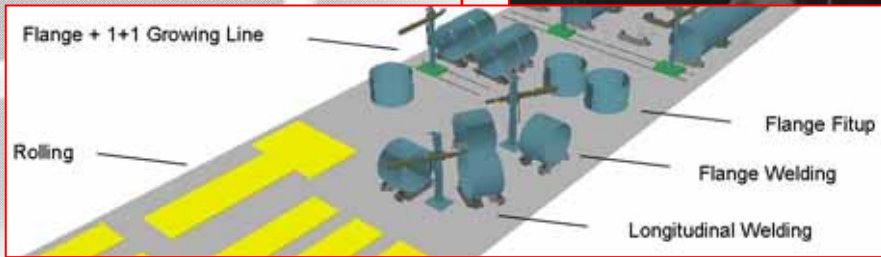
Flange Fitup Table



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Flange Welding Station



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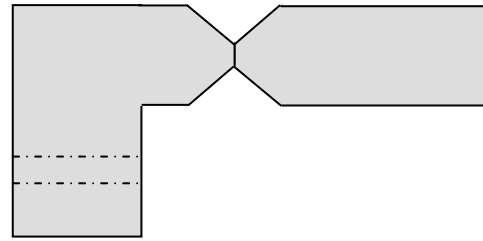


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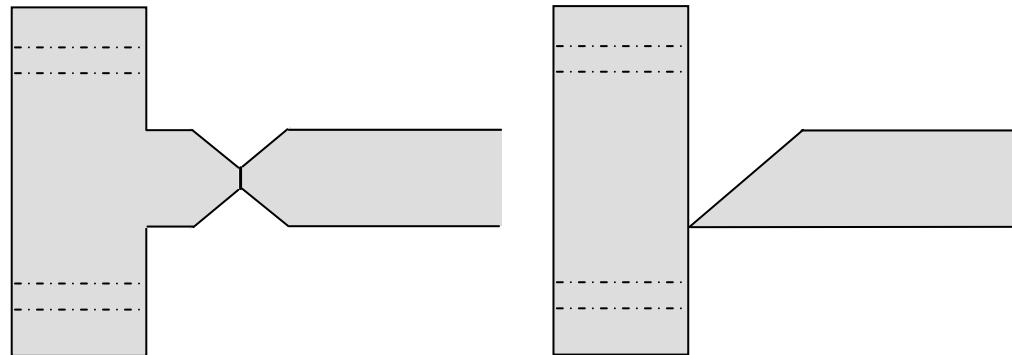
Technical drawing showing three vertical sections of a tower with dimensions. The drawing is oriented vertically and shows three distinct sections, each with a grid of dimensions. The dimensions are listed in a table format, with values ranging from 100 to 1000. The drawing is oriented vertically and shows three distinct sections, each with a grid of dimensions. The dimensions are listed in a table format, with values ranging from 100 to 1000.

Flange Welding Profiles

Typical Section Flange



Typical Bottom or Base Flange

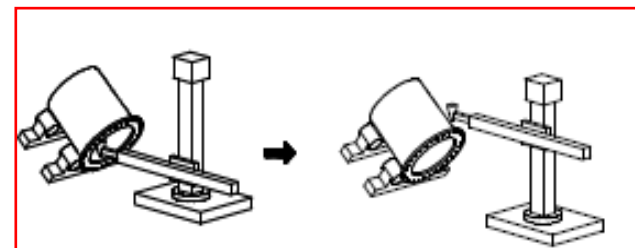
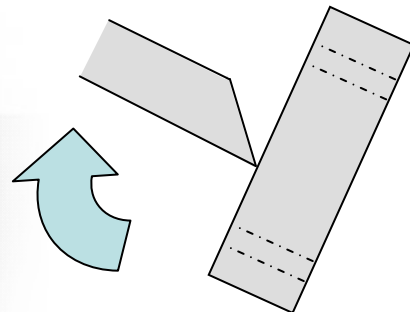


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Base Flange Welding Station - Flat Flange Welding Only

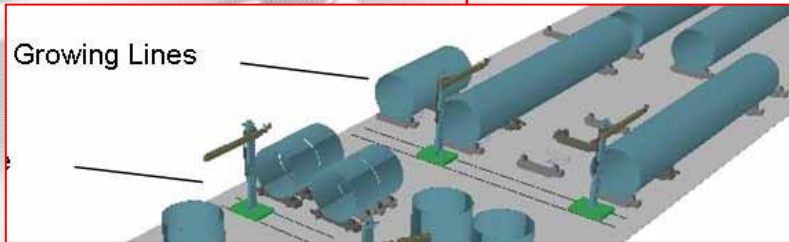


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Growing Line and Fitup Station

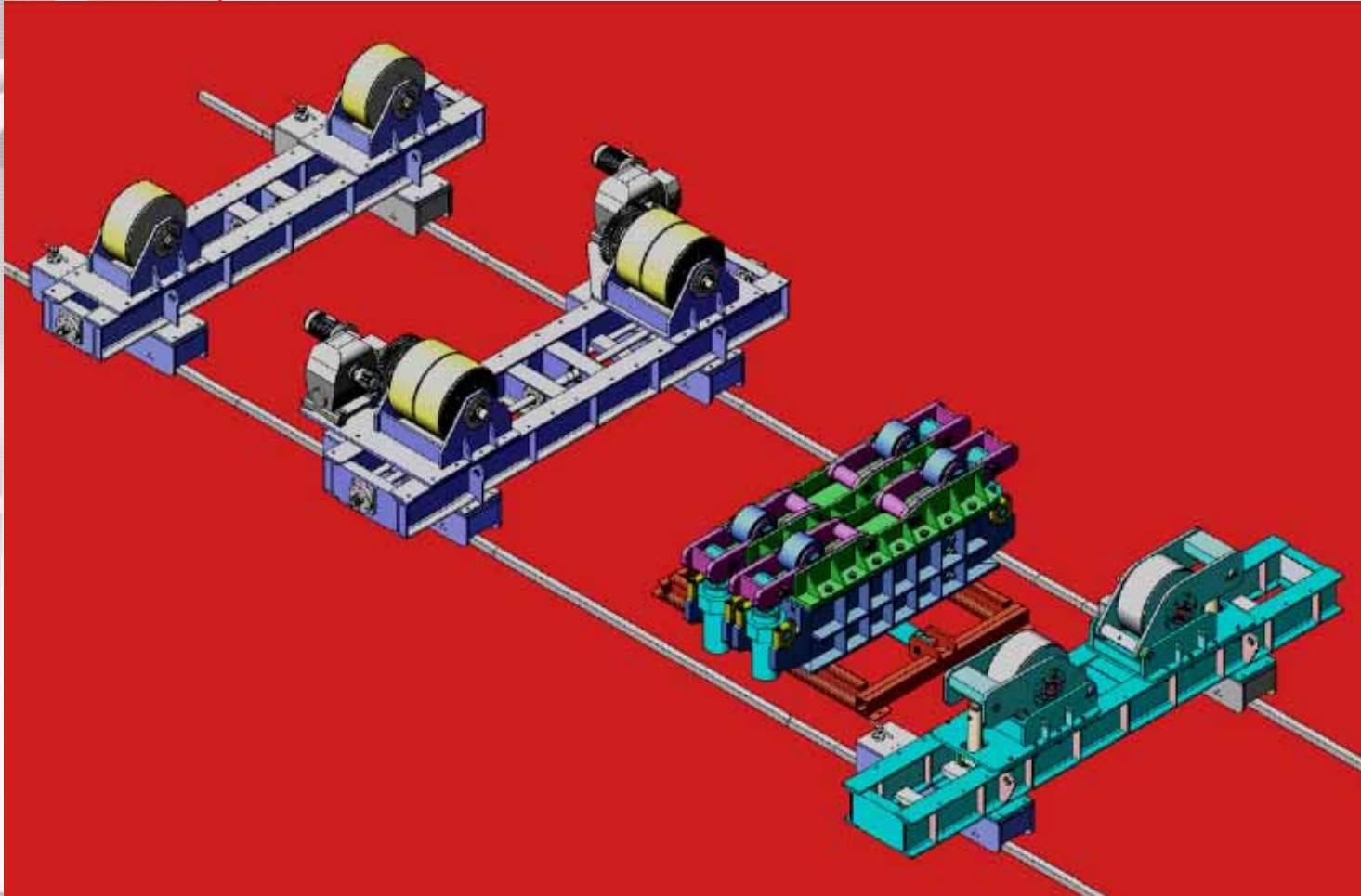
SHELL to SHELL FIT-UP and FULL WELDING INSIDE and OUTSIDE, Contd..



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Growing Line & Fitup Station



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Longitudinal & Circumferential Welding Technology Review

- Power Wave AC/DC 1000
 - Proven productivity and quality increases
 - Significant cost reduction
- Tandem, triple Tandem or Twin Tandem
- Tandem Arc single pass per side Welding
 - Significant productivity Gains
 - Decrease Included Angle to 50°
 - Increased Land
- Multipass welds for:
 - Poor fitup
 - Greater plate thickness
 - Improve weld toughness
- Tandem 3 wires for thicker sections higher productivity as well as two run welding up to 30 mm thickness may be achieved



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Lincoln Electric's Unique Solution

- Utilize the Powerwave ACDC
- Draw upon Lincoln Electric's decades long applications expertise and consumables knowledge in single pass multi arc pipe welding to optimize productivity & reduce cost
- Move from Multi pass welding to limited pass per side welding
- Utilize Growing Lines and Change Joint Geometry to reduce cost and optimize productivity
- Match consumables to procedures, steel quality and mechanical requirements to meet customer specifications while optimizing productivity

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Advanced Equipment Solutions

Powerwave AC / DC 1000 Waveform Control Technology

- Inverter Power Source
- Energy Efficient
- DC+, DC- & AC (3 Phase)
- CV and CC Modes
- AC to DC Electronic Switch
- Wave Balance Control
- Frequency Control
- Wave Shape Design
- Production Monitoring
- Weld History
- Integrated Multi Arcs



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Advanced Equipment Solutions

A Green Machine for a Green Industry



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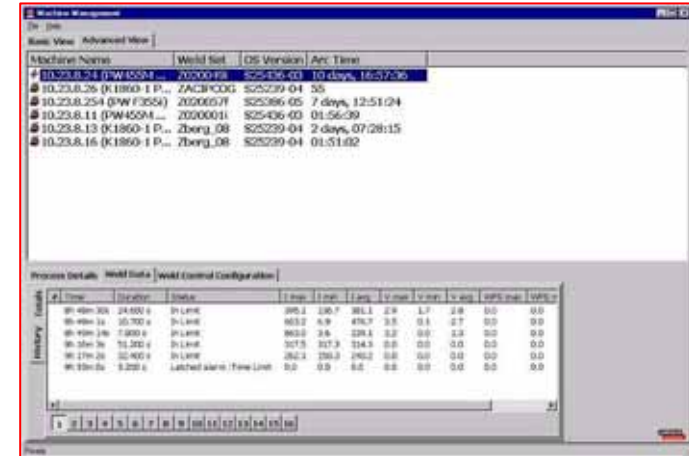
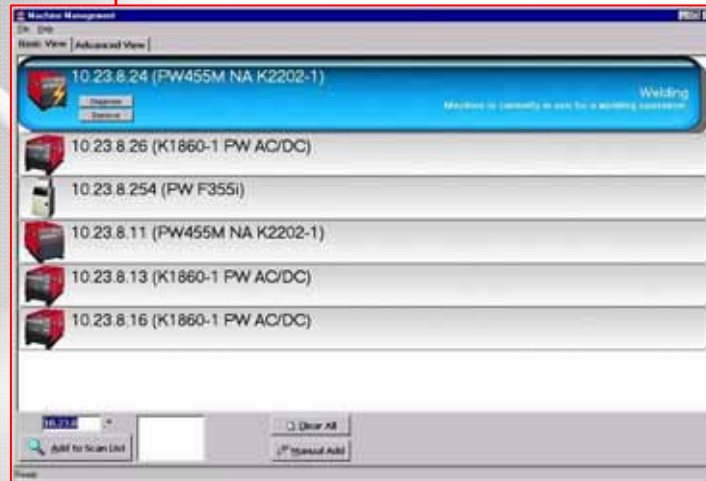
	Conventional Technology DC1000	Power Wave AC/DC 1000
Volts	44	
Amps	1000	
Efficiency	0.83	0.85
Power Factor	0.54	0.95
Input VA	98170	54489
cost / hour	\$8.64	\$4.80
cost / shift	\$69.11	\$38.36
cost /year	\$34,556	\$19,180
Annual Savings		\$15,375

Calculations are based off utility charge of \$0.11 / KVA.
Equipment is run at rated output, 2 eight hour shifts / per day,
80% Operator Factor, 5 days a week , 50 weeks per
year.(3200 Hours per year)

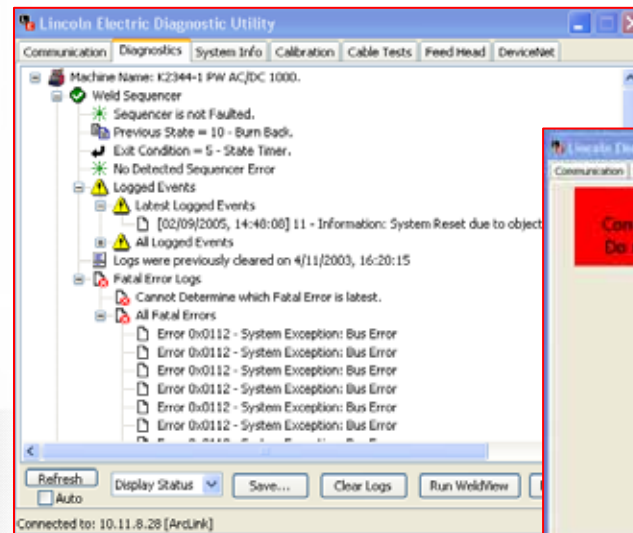
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Production Monitoring

Weld History



Diagnostics



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Advanced Equipment Solutions 2008 – 2011 (YTD)



- 66 New Wind Tower Facilities (or major expansions) Globally from 2008 - 2011
- 54 of these facilities utilized Lincoln Power Sources
- 47 Utilized Powerwave ACDC
- 488 Powerwave ACDC!!

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Lincoln Electric's Unique Solution

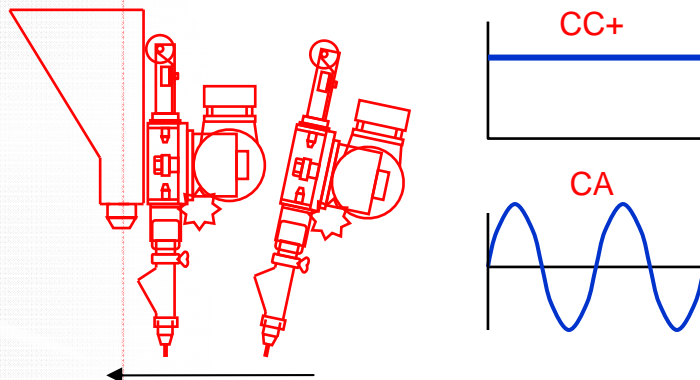
- Utilize the Powerwave ACDC
- Draw upon Lincoln Electric's decades long applications expertise and consumables knowledge in single pass multi arc pipe welding to optimize productivity & reduce cost
- Move from Multi pass welding to limited pass per side welding where possible
- Utilize Growing Lines and Change Joint Geometry to reduce cost and optimize productivity
- Match consumables to procedures, steel quality and mechanical requirements to meet customer specifications while optimizing productivity

New Tow Run Weld Procedure

- One Pass Per Side

Tandem Arc, Impacts: 27J @ -20°C

Travel Speed = 530 mm/min.



Lead Arc (DC+)

- ▣ 4.0 mm
- ▣ 950 A
- ▣ 30 V

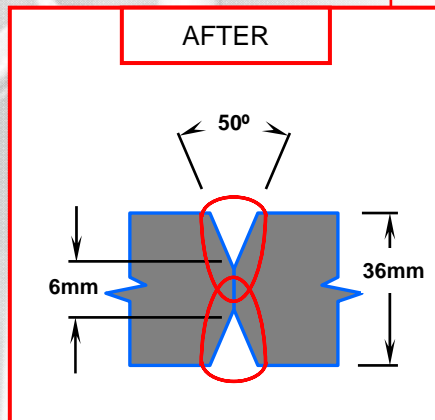
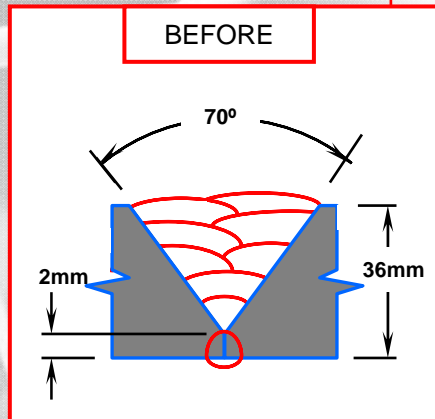
Trail Arc (CA)

- ▣ 4.0 mm
- ▣ 700 A
- ▣ 34 V

Deposition Rate = 21,5 Kg/hr



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Customer Success

- Transferring technologies developed for the pipeline industry, in 2002 Lincoln Electric developed a new procedure for Apoyos Metalicos
- The new procedure replaced a 9 pass single arc approach with a 2 pass tandem arc one
- Switched from CV to CC
- Consumable recommendation for Impacts at -20°C ; P230, P223, or WTX with L-61
- Consumable recommendation for Impacts at -40°C ; WTX with L-61 or other
- **Cost Savings – greater than 50% reduction in weld time and consumable savings**



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Triple Arc Tandem Head Lower Cost High Productivity



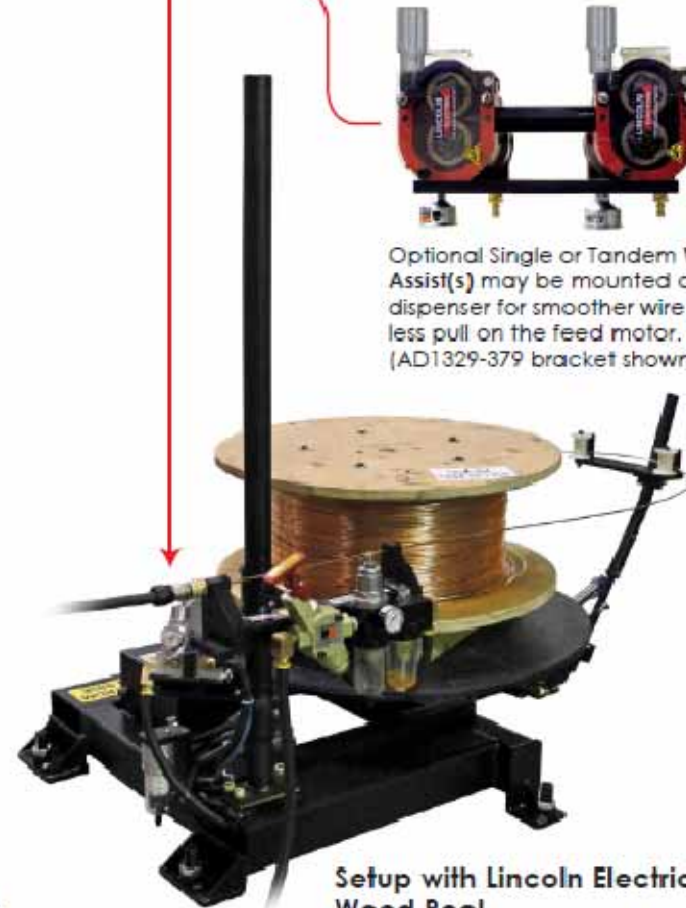
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20mm Thick Plate and up

New Bulk Dereeling Systems



AD1329-577
Setup with Lincoln Electric Stem Pack



Optional Single or Tandem Wire Feed Assist(s) may be mounted on the dispenser for smoother wire feed with less pull on the feed motor. (AD1329-379 bracket shown)

Setup with Lincoln Electric
Wood Reel

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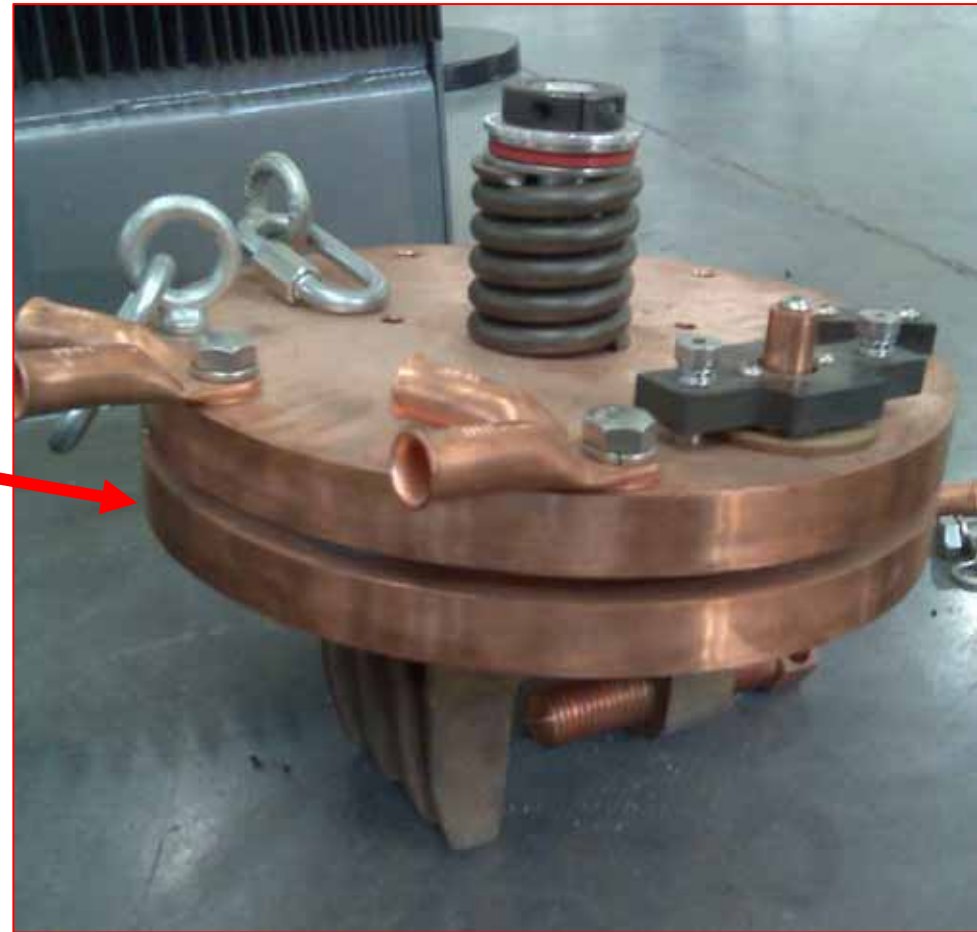
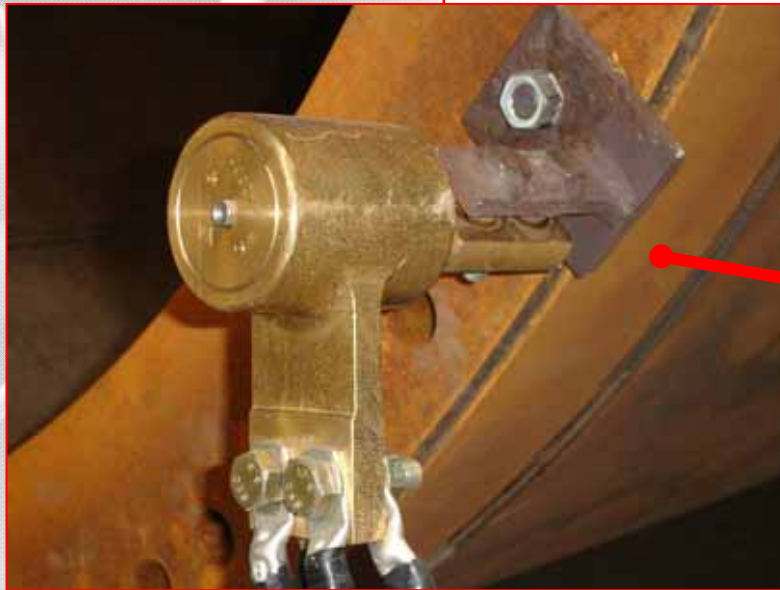
New 250Lb Slim Reel Wire Package



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Special Design Ground

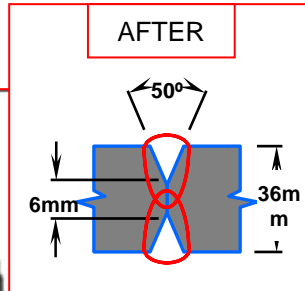


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New Design Ground
2000A or 4000A Capacity

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SAW Cost Reduction Savings Potential In Summary



36mm Plate



- Change Joint Configuration
- Decrease Joint Angle
- Increase Joint Land
- Increase Weld Amperage
- AC to Increase Deposition
- Eliminate Back Gouging
- PWV ACDC Technology Improves Energy Efficiency
- Triple Arc Tandem
- Bulk Packaging

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Doorway Welding



Can be done as a subassembly before the growing line or after fabrication of the section

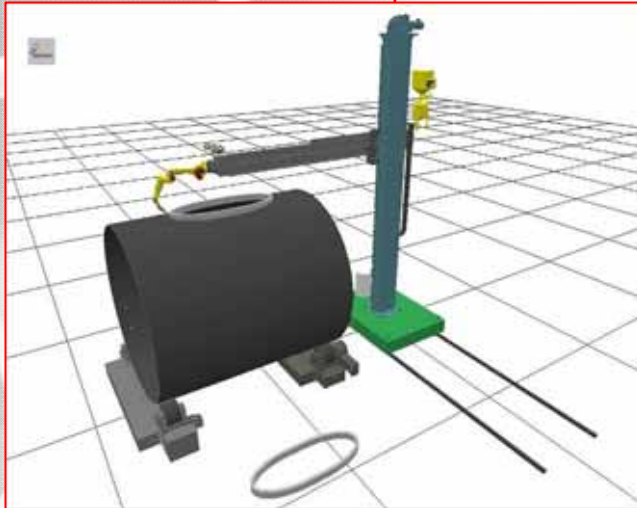
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1.6mm T12 – 3Kg/Hr, 2.0mm T5 – 4.5Kg/Hr, 2.4MM SAW – 6Kg/Hr

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Automated Door Frame Welding



- Measurement of the door
- Cut and Bevel
- SAW Robotic Welding



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Lincoln Electric's 2.5MW Turbine

The screenshot displays a web-based camera interface. At the top, there are two tabs labeled "Camera 1" and "Camera 2". The main video feed shows a night-time construction site with a large crane in the center, illuminated by site lights. The interface includes a control panel on the left with a circular navigation pad, a "Reset" button, "Time-Lapse Movie" and "Save/Email Image" buttons, a calendar for May 2011, and a small map showing the location. The video player at the bottom has a timestamp of "May 27, 2011 3:15am" and standard playback controls.

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Thank You !!

Questions...??