## **MMS:** an advanced SA fabricator

Metallurgical and Manufacturing Services is a proudly South African fabrication specialist born out of South Africa's nuclear facility at Pelindaba. The company is therefore noted for its expertise in the fabrication of critical, high value components from exotic materials. Dion Greyling: a metallurgical engineer and an International Welding Technologist outlines the company's niche capabilities.

66 ur story began in February 1998 following downscaling of the Nuclear Energy Corporation of South Africa (NECSA), which led to the formation of MMS as a specialist welder and fabricator of critical plant components manufactured using special and exotic materials," says Dion Greyling, the company's International Welding Specialist.

"Our experience gained at NECSA included manufacturing in special alloys, the development of advanced manufacturing processes, serving as the metallurgical arm of the department responsible for the design, manufacture and maintenance of all rotational equipment, as well as considerable experience from the previously established and operated uranium enrichment plant at NECSA.

The company's nuclear heritage puts safety and product quality at the heart



A KUKA robot arm is used with Fronius' Cold Metal Transfer (CMT) welding process for 3D printing/additive remanufacturing of high-value replacement components and rapid prototyping of products in the development phase.

of MMS's core values, with sustainability and integrity as guiding values for the environmental and business ethics aspects of the company's offering. "We take pride in the world-class quality we produce. All projects are done to client specifications. If no specifications yet exist and these are required, we will do the qualification (WPQR) according to the requirements of ASME IX or BS EN ISO 15614, and all our welders are qualified to BS EN ISO 9606 to do work according to these codes," he adds.

MMS specialises in components manufactured in sophisticated engineering alloys. Typical materials that can be accommodated include aluminium; nickelbased and copper-based alloys; titanium and titanium alloys; wear-resistant alloys such as Stellite; as well as cast iron, carbon steels, high-strength low-alloy (HSLA) and high-alloy steels; austenitic,

> precipitation-hardened, super/duplex, martensitic and ferritic stainless steels: and corrosion-resistant overlay materials such as Monel. "We are also specialists in joining dissimilar alloys such as copper to stainless steel, for example," Greyling adds.

Welding experience gained in South Africa's former uranium enrichment programme is now used by MMS to service the power generation, chemical, petrochemical and plastics industries, as well for defence, mining and general manufacturing.

## Facilities and capabilities

The company's 2 200 m<sup>2</sup> of workspace is made up of five integrated business units: the CNC machine shop; the manual machine shop; our welding and heat treatment



The Plasma Transferred Arc Welding (PTA) process is a versatile powder-based method of depositing high-quality metallurgically fused deposits onto relatively low-cost surfaces.

facility; the specialised equipment and R&D facility with Electron Beam, Plasma Transferred Arc and Robotic WAAM/3D-printing machines; and a receiving, dispatch, storage and assembly shop," says Greyling.

In terms of welding capability, MMS has specialist welders for delivering Gas Tungsten Arc Welding (GTAW/TIG); Gas Metal Arc Welding (GMAW/MIG), Submerged Arc Welding (SAW) and Shielded Metal Arc Welding (SMAW/STICK).

In addition, however, the company offers several of the advanced modern processes, including Electron Beam Welding (EBW), Plasma Transferred Arc (PTA), and Cold Metal Transfer (CMT) welding, the latter being used for 3D printing/additive remanufacturing of high-value replacement components and rapid prototyping of products in the development phase.

"We are one of few fabricators in South Africa with an Electron Beam Welding station, which enables us to join ferrous, light and precious metals and alloys to themselves or to each other. EBW is a fusion process that uses a high-velocity electron stream to supply the fusion energy between two parts. The process, which has to be done in a vacuum chamber, does not require any filler material, with the joint being achieved by melting material from each side of the joint as the kinetic energy of the electrons is transformed into heat upon impact," Greyling explains.

It is a fully automated process that delivers very high depth-to-width ratios, with penetration depths of up to 35 mm in

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carbon steel and joint widths as narrow as 3.0 mm. Distortion is minimal and weld strength exceptional. EBW is ideal for thick section welding, particularly of exotic and difficult to weld materials. It is typically used at MMS to weld flanges onto turbine shafts, for example.

Plasma Transferred Arc Welding (PTA) is another advanced process being offered by MMS. "PTA is a versatile powder-based method of depositing high-quality metallurgically fused deposits onto relatively low-cost surfaces. Alloys consisting of various hardnesses or sought-after properties, including carbide composites, can be deposited on a variety of base materials to achieve diverse surface properties, which include: mechanical strength, wear and corrosion resistance and creep resistance," he explains.

PTA advantages include: a constant and low heat input that delivers minimal dilution of the base materials (<5%) – most other processes for this application have a dilution of more than 20 to 30%; low crack risks; good surface protection properties; and several more, making it an ideal process for surfacing valve seats, for example.

Another MMS speciality is the reverse engineering and/or remanufacture of valve wedges or seats from previously damaged components. "We can generate the engineering drawings, apply hardfacing using an

appropriate alloy such as Stellite 6 onto a blank billet, and then remanufacture or refurbish valve seats to original OEM specifications," notes Greyling, adding that this service can significantly reduce lead times and costs from overseas OEMs, and/or the need to replace an entire high value component because replacement parts are no longer available.

In support of the company's reverse engineering offering, MMS has also recently set up a Cold Metal Transfer Welding station to enable wire-arc additive manufacturing (WAAM) or 3D printing using the CMT welding process. "We have a CMT welding station with a KUKA robot arm that delivers the very low heat inputs needed for perfect 3D printing.

"This is ideal for wear rings, for example, that need to be manufactured from specialised alloys. These niche components can take months to import, but we can use our CMT-based 3D printer to build and then machine them to the precise size within three days. We can also do the heat treatment, where applicable, and provide all of the procedural qualifications, mechanical testing, material certificates and the NDT – and internationally, the use of this WAAM/3D-printing process is rapidly expanding," Greyling informs African Fusion.



A new and complete turbine rotor reversed engineered and manufactured based on the data extracted from a damaged component.



A fully refurbished Pelton wheel for a water-turbine re-engineered and refurbished in 316 stainless steel from the damaged original (inset).

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In support of the welding side, MMS' machine shops house horizontal and vertical boring mills; CNC and manual lathes and 4- and 5-axis milling machines; as well as drill presses, wire cutters, spark eroders and more.

"We specialise in weld constructed manufacturing and refurbishment of products such as pumps and pump heads; Pelton wheels in 316 stainless steel for water-turbines; and turbine impellers and blades for all types of rotating equipment. We also have a service centre, where we service equipment such as compressors, expansion turbines and valves, which involves disassembly, diagnostics, re-engineering, servicing and assembly.

"In addition, we offer onsite field services; metallurgical and mechanical engineering; design, CAD modelling and reverse engineering; material sourcing; heat treatment; brazing and much more.

"We at MMS apply our rich experience to deliver exceptional services to our clients through cutting-edge technology and a talented, dedicated team of highly qualified and well-trained employees. We strive to maintain the highest quality standards while adhering to industry requirements via full compliance to ISO 9001 and ISO 3834-2 standards," concludes Dion Greyling.





A remanufactured pump head.