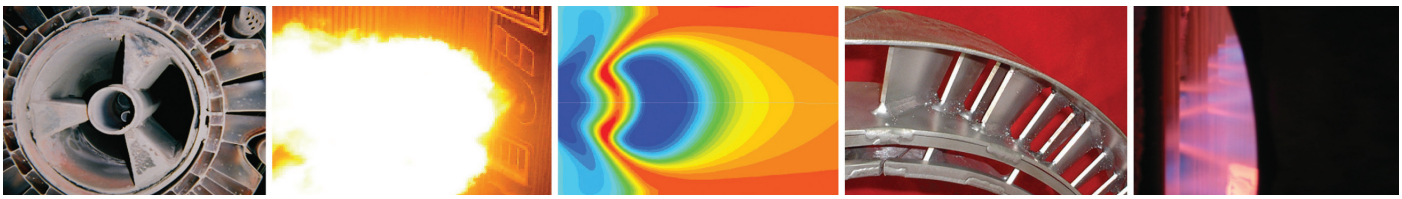
INNOVATIVE ENERGY SOLUTIONS

RJM

INTERNATIONAL



RESOLVING COMPLEX EMISSIONS CHALLENGES FOR COAL, OIL, GAS AND BIOMASS-FIRED PLANT THROUGH THE APPLICATION OF INNOVATIVE COST-EFFECTIVE SOLUTIONS

BURNERS

COAL : OIL : GAS : BIOMASS : CO-FIRING

ANALYSIS DESIGN SUPPLY INSTALLATION
COMMISSIONING SPARES MAINTENANCE

RJM INTERNATIONAL IS ONE OF THE WORLD'S LEADING EMISSIONS REDUCTION SPECIALISTS, PROVIDING HARDWARE AND ANALYTICAL SERVICES TO POWER GENERATORS AND LARGE COMBUSTION PLANT.

In response to growing demand from its utility clients seeking a single provider capable of delivering everything from CFD analysis to specification, design, and installation of new components, RJM is now able to offer a new range of cost-effective, Ultra-Low NOx burners suitable for all retrofit applications.

These new Ultra-Low NOx burners are capable of delivering emissions reductions of between 50% – 70% on both coal and oil, and up to 80% on gas. Consequently, they offer boiler operators a viable retrofit alternative to SCR or SNCR emission reduction systems.

RJM's new Ultra-Low NOx burners are also ideally suited for plants that are introducing some element of biomass to their fuel mix, or converting 100% to biomass combustion.

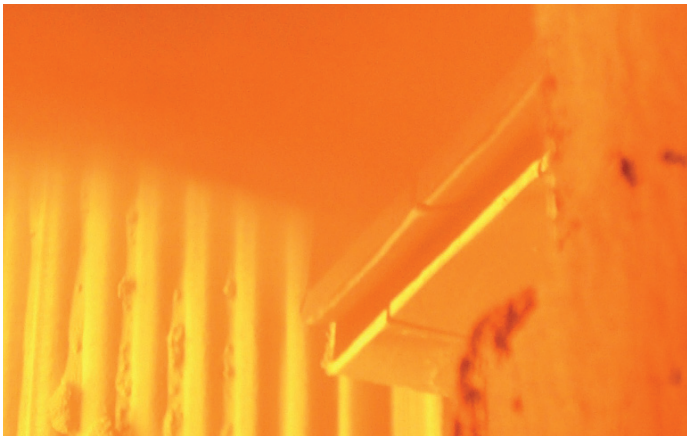
COAL

Many industrialised countries still rely on coal for base-load generation capacity and are increasingly using coal-fired stations as peaking units. Set against this backdrop of increased operational challenges can be added further ones relating to power stations now sourcing their coal globally, meaning different combustion procedures and properties, as well as ever-tightening legislation relating to emissions (NOx, SOx and particulates) and carbon.

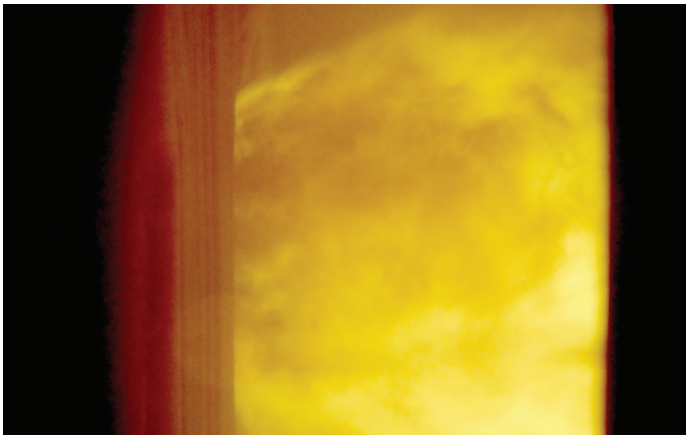
Wholesale replacement of major parts on the combustion side of the power station is typically not an option for plant operators due to financial constraints and the restricted extension of the life of the plant.

That's why the innovative, cost-effective engineering solutions of the type that RJM specialises in are helping power stations maintain operational flexibility and meet the new emissions regulations without having to commit to massive capex programmes to keep generating.

RJM's new Ultra-Low NOx burner can now achieve NOx levels as low as 250mg/m_0^3 on coal, without compromising plant efficiency or flexibility. When combined with optimised fuel & air balancing and over-fire air, they provide the lowest possible emissions without after treatment, such as SCR or SNCR. When combined with co-firing of biomass and / or an in-duct SCR system, the lowest worldwide legislative NOx limits can be achieved.



With a combination of measures including staged combustion, fuel / air mixing and firing through new Ultra-Low Nox burners, RJM achieved a NOx reduction of greater than 50% at this T-fired 440MW coal / oil power station.



Excellent flame shape characteristics can be seen on this RJM Ultra-Low NOx burner firing coal.

RJM's Ultra-Low NOx burners have reduced NOx emissions by 50%, down from 500mg/m_0^3 to 250mg/m_0^3, at a state-of-the-art, 2,000MWe plant commissioned in November 2011. The plant burns a wide range of internationally-sourced coal and a number of other issues relating to emissions and plant reliability have also been resolved.

Whilst the installation of RJM's Ultra-Low NOx burners is often the core element of an emissions reduction project, a significant amount of detailed analysis work is always carried out in the early stages.

Typically, this will involve a combination of detailed on-site measurement of actual components (and verifying back to plant technical drawings); CFD analysis using RJM's in-house developed software and the fabrication of accurate, physical scale models to re-create fuel and air flows through critical sections of the plant.

BIOMASS AND CO-FIRING

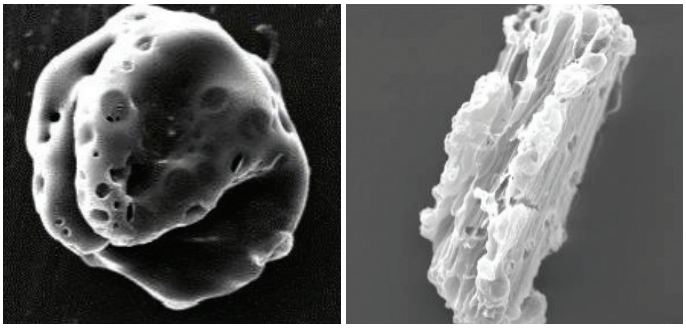
With governments across the developed world seeking to decarbonise their economies, fossil-fuelled power stations are now being incentivised to introduce an element of co-firing or convert 100% to biomass combustion.

RJM is at the forefront of this new 'biomass revolution' and has developed a new burner, ideally suited for biomass combustion. This new biomass burner is a development of RJM's field-proven Ultra-Low NOx coal burner and has been re-engineered, through design and operational changes, to handle the different shape, size and fuel chemical properties of biomass fuel.

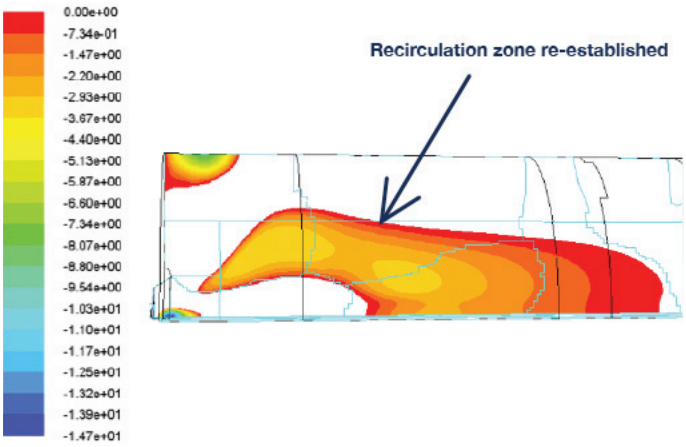
As NOx formation is different on biomass as opposed to coal, RJM has developed its own biomass CFD model that can predict a number of critical variables, including flue gas emissions, the extent of slagging and fouling and boiler efficiency levels.

This data is now informing the design process, enabling RJM to retro-fit its Ultra-Low NOx biomass-optimised burners into existing coal-fired units and deliver optimum performance.

Currently, RJM is working with a number of global power generators, helping them evaluate the opportunities presented by biomass, to enable them to convert to full biomass combustion or co-firing.



The different physical properties of coal (l) and biomass (r) are clearly visible. Coal particles are also smaller than biomass, typically by a factor of 100. Both shape and size impact on burner performance.



CFD image shows the biomass particles penetrating the internal re-circulation zone of the RJM burner, giving excellent flame stability and controlled combustion.

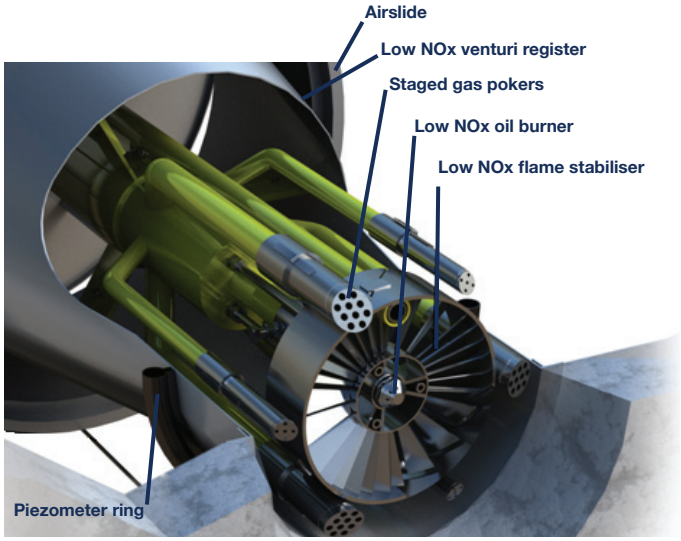
OIL AND GAS

RJM's Ultra-Low NOx burners are also capable of delivering impressive results on oil and gas-fired plants.

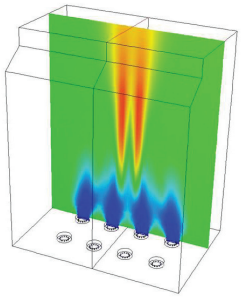
For example, at a European oil-fired power station, NOx emissions of 850 mg/m_0^3 were reduced to 240 mg/m_0^3 through a combination of detailed CFD analysis work and sophisticated design, manufacture and installation work carried out by RJM.

RJM's ultra low NOx oil burner on a test rig showing fuel rich and fuel-lean regions.

Gas is the cleanest of the fossil fuels but again, complete RJM ultra-low NOx burners or RJM-modified burners can still deliver significant operational improvements and reduced emissions. For example, at one customer plant, NOx emissions when firing gas were reduced from 1100 mg/m_0^3 to 100 mg/m_0^3.



RJM's Ultra-Low NOx oil and gas burner.

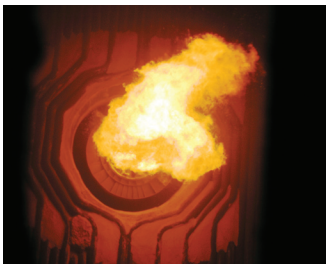


CFD analysis of this gas-fired unit confirmed that high NOx levels existed because there was a large region of high peak flame temperature.

OTHER PRODUCTS

RJM is also able to offer a new range of replacement oil burner injectors, oil burner components, gas igniters and light-up equipment to cope with extremely harsh operating regimes. These products have also been specifically designed to handle repeated plant start-ups and frequent load changes, whilst offering improved reliability and much greater consistency of performance.

An RJM oil injector tip valve.



An RJM Ultra-Low NOx oil burner under full load.

PARTNERSHIP IN ACTION

SAS, Inc. is RJM's partner operation in the USA and enables RJM to offer its full range of products and services throughout North America.

RJM International

- Founded 1977
- Proven track record in burner design, manufacture and installation
- 50,000MWe of NOx compliance experience in the USA
- >4,000MWe of NOx compliance experience in rest of world
- 300+ utility and industrial customers worldwide
- HQ in Winchester, UK and agents across Europe
- Partnering with SAS, Inc. since 2010

SAS, Inc.

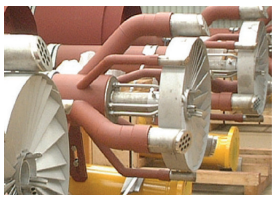
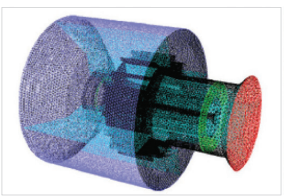
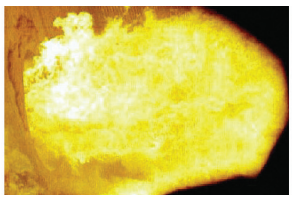
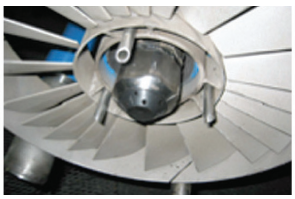
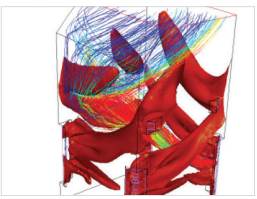
- Founded 2005
- World-class CFD and process modeling capability
- Industry-leading combustion analysis and design skills
- Custom hardware systems design and installation capabilities
- 25+ utility, petrochemical, and refining customers in the US
- Offices in Tulsa, OK, Houston, TX and Chicago, IL
- Partnering with RJM International since 2010

WHAT OUR CLIENTS SAY

"RJM is definitely a great company to work with. The work RJM did here was also very good value for money, so we are completely satisfied."
Jos Peeters, Senior Asset Engineer
Essent Energie, the Netherlands

"We are very satisfied with RJM and we would definitely recommend the company to other plants as experienced providers of low NOx expertise and an organisation that can solve any low NOx or combustion problem."
Peter Kiss, Engineering Leader
Aes Tisza, Hungary

"This was a very challenging project technically and in terms of schedule but the results have exceeded expectations, with emissions well below the required limits. We will definitely use RJM in future projects."
Lyle Woodard, Director of Construction
Global Engineering and Construction Group
AES Corporation, USA

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