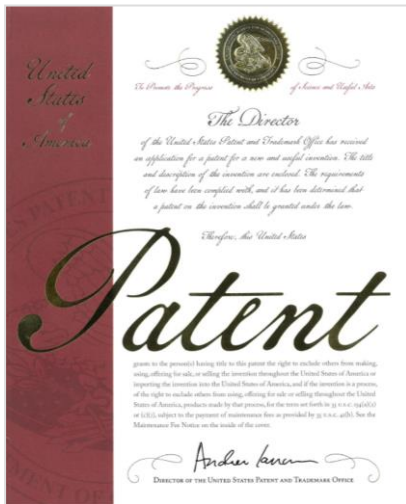


## Patent Issued to R.F. MacDonald Co. for Safest NOx Emissions Reduction Technology with SCR

With the help of Michael MacDonald and the Boiler Special Projects Group, R.F. MacDonald Co. has invented and now patented the safest NOx emissions reduction process for boilers and fired vessels using direct urea injection with SCR.



On Tuesday, Nov. 24, 2020, the U.S. Patent and Trademark Office granted a patent to R.F. MacDonald Co. for inventing a “process for direct urea injection with selective catalytic reduction (SCR) for NOx reduction in hot gas streams and related systems and assemblies.”

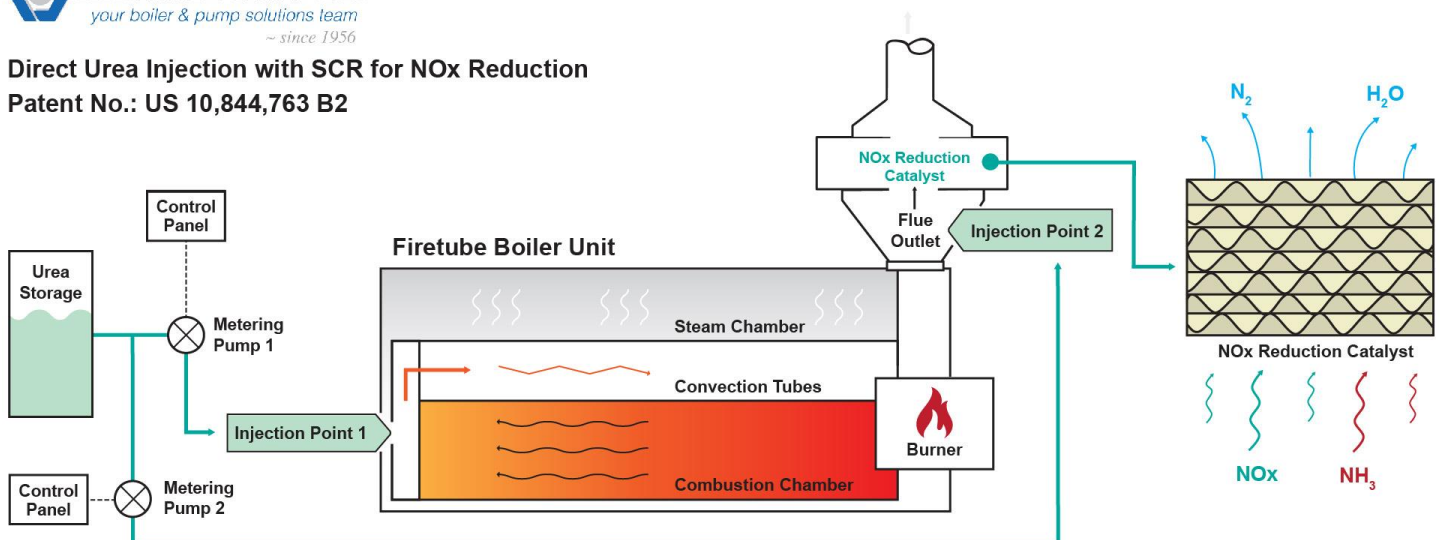
SCR requires the use and storage of ammonia-based reagents, which range from high risk to low risk. The R.F. MacDonald Co. patent specifies urea, which is the lowest risk ammonia-based reagent. The only health hazard associated with urea is “possible irritation” as indicated by the Hazardous Materials Identification System (HMIS).

The urea solution is identical to Diesel Exhaust Fluid (DEF), which is sold worldwide in automotive retail stores for use in diesel motor vehicles.





As shown in the graphic below, urea is injected at each Injection Point into the boiler. As NOx and urea pass through the NOx Reduction Catalyst, NOx is separated into two non-harmful elements Nitrogen (N<sub>2</sub>) and water (H<sub>2</sub>O).



### Direct Urea Injection with SCR for NOx Reduction Patent No.: US 10,844,763 B2



There are three types of ammonia-based reagents: anhydrous, aqueous and urea. Both anhydrous and aqueous ammonia carry higher risk and regulatory issues compared to urea as shown in the chart below. R.F. MacDonald Co. provides SCR installation and service for each type of ammonia-based reagent. However, direct urea injection with SCR is recommended for institutions housing people, such as hospitals and universities, because urea is classified as non-hazardous. Hospitals use boilers to produce steam for sanitation and universities use boilers to produce hot water for amenities.

|  |  |  |   |
|---|--|--|---|
| Ammonia-Based Reagents  | <br>ANHYDROUS | <br>AQUEOUS | <br>UREA |
| Hazard Rating (Level of Toxicity):<br>3 = Extreme 2 = Moderate 1 = Low            | <b>3</b>   | <b>2</b>   | <b>1</b>  |
| Level of Usage Risk:  | Highest Risk   | Moderate Risk  | Lowest Risk   |
| Ease of Use / Operational Readiness:  | Ready to Operate   | Vaporized before Use   | Needs Vaporization & Conversion   |
| Compliance Requirements:  | See AQMD & APCD Rules & Regulations  |  |   |
| Safety Requirements:  | Training, Emergency Planning, Fire Dept. Audit   | Training, Emergency Planning, Fire Dept. Audit   | Training  |
| Most Common Applications:   | Power Plants, Industrial Facilities  | Food Processing, Agriculture, Utilities  | Hospitals, Schools, Universities, Prisons   |
| R.F. MacDonald Co. Offers:  | Full Installation Support & Service  |  |   |

As restrictions on NOx emissions and air pollutants increase, industrial and institutional facilities are investing in SCR technology for their boiler systems because SCR has been proven to reach the lowest NOx emissions levels while maintaining boiler efficiency.

R.F. MacDonald Co.'s newly patented SCR technology complies with every emissions limit in California, including the strictest district in the nation: The San Joaquin Valley Air Pollution Control District.

### Local Air District Emissions Rules & Regulations

- Bay Area Air Quality Management District (BAAQMD)  
<https://www.baaqmd.gov/rules-and-compliance/current-rules>
- Sacramento Metropolitan Air Quality Management District (SacMetro AQMD)  
<http://www.airquality.org/Businesses/Rules-Regulations>
- San Diego Air Pollution Control District (SDAPCD)  
[https://www.sdapcd.org/content/sdc/apcd/en/Rule\\_Development/Rules\\_and\\_Regulations.html](https://www.sdapcd.org/content/sdc/apcd/en/Rule_Development/Rules_and_Regulations.html)
- San Joaquin Valley Air Pollution Control District (SJVAPCD)  
<https://www.valleyair.org/rules/1ruleslist.htm>
- Southern California Air Quality Management District (SCAQMD)  
<http://www.aqmd.gov/home/rules-compliance/rules/scaqmd-rule-book/regulation-xi>

R.F. MacDonald Co.'s history with Low NOx began in the late 1970s after the California Air Resources Board (CARB) began mandating new Low NOx rules and compliance deadlines. At that time, R.F. MacDonald Co. poised itself to be the Low NOx solutions provider in California and began retrofitting and installing flue gas recirculation and Ultra-Low NOx burners.

Since 2006, R.F. MacDonald Co. has installed multiple SCR systems each year for the various industries within California and Nevada, including hospitals, universities, manufacturing facilities, power plants, food processors and more.

Selection of the appropriate emissions control system requires a detailed evaluation of environmental, technical, safety and economic factors. Solutions currently available to meet emissions regulations include burner installation, burner retrofit and SCR installation. Contact us to help guide you through the process.

### **U.S. Patent Details**

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Application: R.F. MacDonald Co., Modesto, CA

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PDF: [Patent Abstract](#)

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