fives

PROCESS TECHNOLOGIES

ENERGY | COMBUSTION

Pillard NOVAFLAM® evolution

Still a step ahead of the crowd

- High momentum flame with lower NOx emission
- Exceptional fuel flexibility
- The best clinker quality with increased ASF rates
- User friendly with easily repeatable flame settings
- Reduced CO_2 impact
- Improved service lifetime and tip durability
- Strong adaptability to changing running conditions
- Industry 4.0 ready

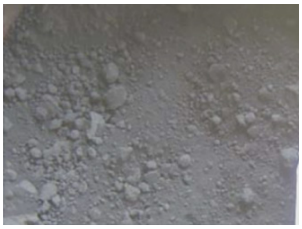
Pillard NOVAFLAM® evolution: Increased benefits for clients

Fives Pillard initiated a revolutionary burner design 10 years ago, with the introduction of impulse efficiency concept, using a specific burner tip configuration where axial air nozzles are grouped together in a specific way so as to maximize secondary air entrainment. Since then, this trend has been followed by many burner manufacturers.
In less than a decade and with the strength of 600 references worldwide, the natural evolution of the Pillard NOVAFLAM® burner is now ready, delivering unparalleled performances to levels unseen before.

LOWER SPECIFIC FUEL CONSUMPTION AND BETTER CLINKER QUALITY

With an ideal and controllable thermal profile, Pillard NOVAFLAM® evolution enables the highest clinker quality with an excellent hydraulic activity, a controlled size of Alite crystals and a homogeneous clinker granulometry distribution with a lower fines rate. Kiln thermal efficiency is increased with a lower specific fuel consumption by avoiding "overheating" issues, optimizing radiation and improving heat recuperation from the cooler thanks to the favourable granulometry distribution mentioned previously.
e.g: In a North American plant kiln specific consumption was decreased by 3.7% with lower cooler losses and lower dust recirculation between cooler, kiln and calciner.

Before



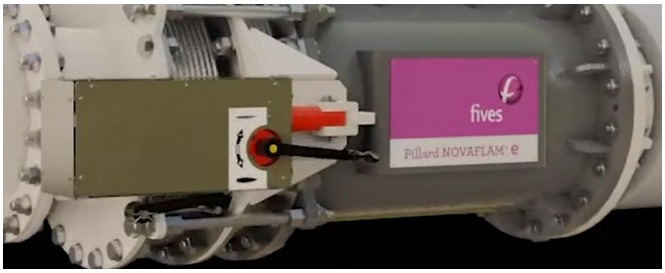
Dusty clinker

After

Normal clinker

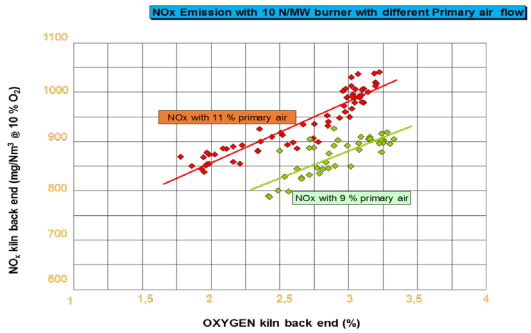
REDUCED CO_2 IMPACT AND COST SAVINGS THANKS TO ENHANCED ALTERNATIVE FUELS SUBSTITUTION RATE

Fives has defined a series of injectors with a design adapted to the high diversity of alternative fuel availability: biomass, plastics, domestic waste, etc. enabling enhanced ASF substitution rates. Pillard NOVAFLAM® evolution allows the firing of large quantities of alternative fuels, thus saving fossil fuel consumption and reducing CO_2 emissions.



A MORE FLEXIBLE BURNER WITH AN EASY FLAME SHAPING AND MOMENTUM ADJUSTMENT

The Pillard NOVAFLAM® evolution burner remains easily adjustable: once momentum is adjusted, a simple handle makes it possible to modify both the swirl and the flame shape whilst the kiln is in operation without impacting radial/axial air flows or the burner's overall momentum.

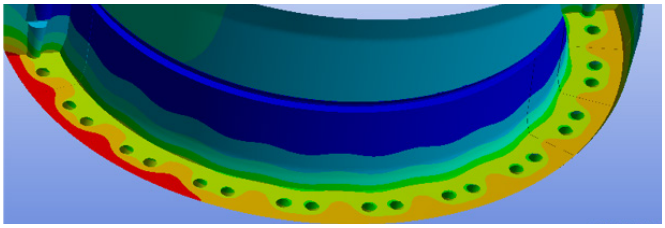


LOWER PRIMARY AIR FLOW AND NOx EMISSIONS

Thanks to succesful innovation, the Pillard NOVAFLAM® evolution burners reduce both primary air flow and NOx emissions whatever the fuel mix. This reduction is achieved without compromising on momentum or on the thermal profile of the flame.

INCREASED BURNER LIFETIME AND REDUCED KILN DOWNTIME

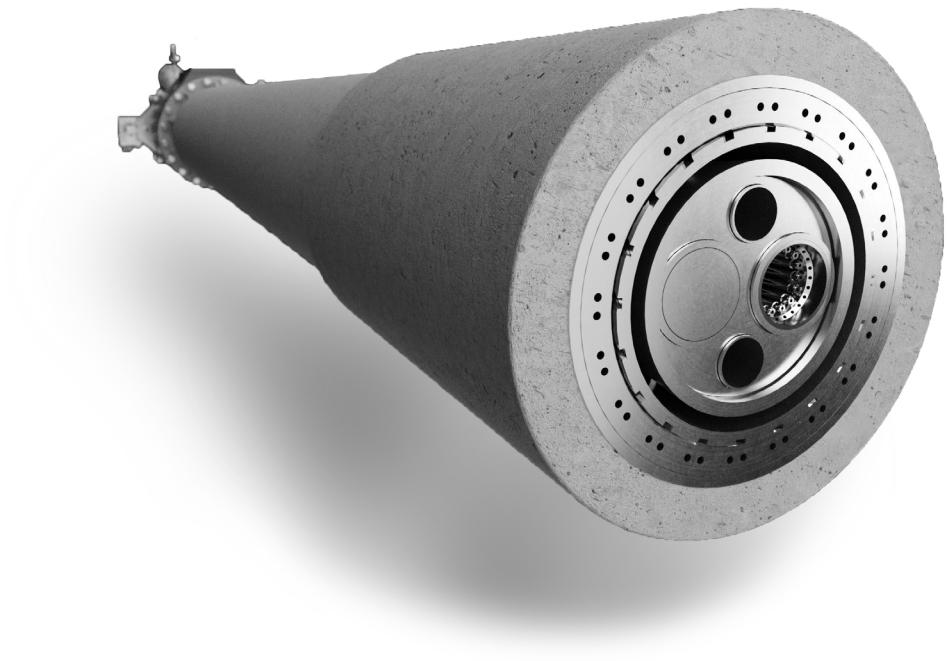
Pillard NOVAFLAM® evolution is easy to dismantle and is equipped with a new Cooled Heavy Duty axial tip design, enabling a strong sustainability to heat expansion in case of refractory failure. In addition, thanks to the SMART technology package, the Pillard NOVAFLAM® evolution can be failure predictive.

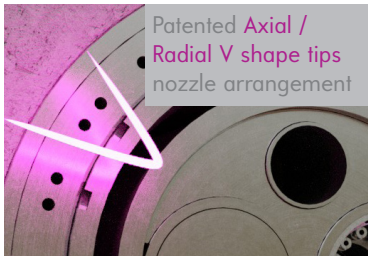
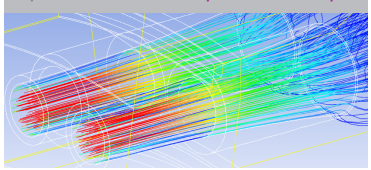


Pillard NOVAFLAM® evolution: What's new?

#1 A NEW BURNER TIP FOR A MAXIMIZED MOMENTUM EFFICIENCY

The Pillard NOVAFLAM® evolution's new axial tip design combines 3 major improvements:



Improvement	Effects	Benefits
 Patented Axial / Radial V shape tips nozzle arrangement	Maximized impulse efficiency for an optimal thermal profile and a maximum secondary air entrainment using minimal kinetic energy	Lower primary air flow for a better thermal efficiency With a 9 N/MW momentum, the burner produces a better mix than a 11 N/MW conventional one for increased energy savings
 Replaceable inserts for axial air injectors	Possibility to replace the axial air injector in case of changing operation mode	Reduced OPEX by avoiding the entire burner's tip replacement
Aerodynamically shaped axial air injectors for lowest pressure drop 	All static pressure is converted in dynamic pressure and momentum with a very limited energy loss	Reduction of both the primary air flow and the electrical consumption of the blower

Pillard NOVAFLAM® evolution: What's new?

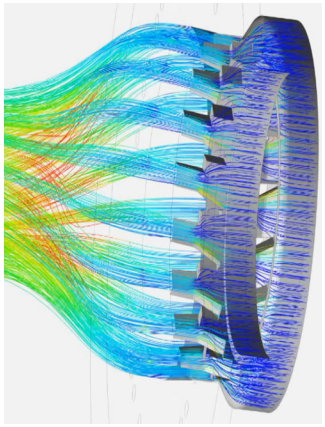
#2 A NEW BURNER SWIRLER

The Pillard NOVAFLAM® evolution is fitted with a new Pillard RST™ swirler for fuel mix flexibility and better flame shaping.

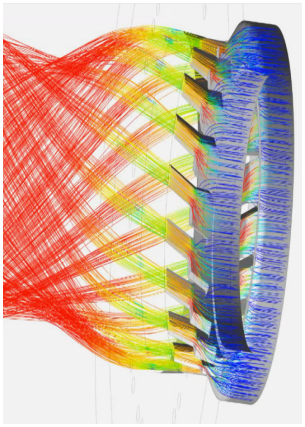
IMPROVED FLAME AND KILN STABILITY

Pillard RST™ swirler generates a stronger internal reverse flow zone in the flame core, recirculating hot combustion gases with a low O_2 concentration. The Pillard RST™ swirler makes it possible to:

— Optimize ignition distance
— Improve flame and kiln stabilty
— Increase flame radiation
— Reduce O_2 content in flame core, and generate NH3 and HCN radicals which decrease NOx emissions



Swirl angle of 5°



Swirl angle of 25°

BETTER FLAME SHAPING WITH A CONSTANT FLAME MOMENTUM

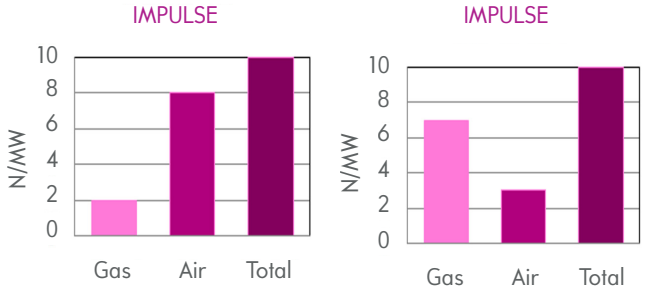
The Pillard RST™ swirl angle can be smoothly adjusted from 0 to 45°. This Fives innovation breakthrough currently allows the widest range of flame adjustment possibilities.

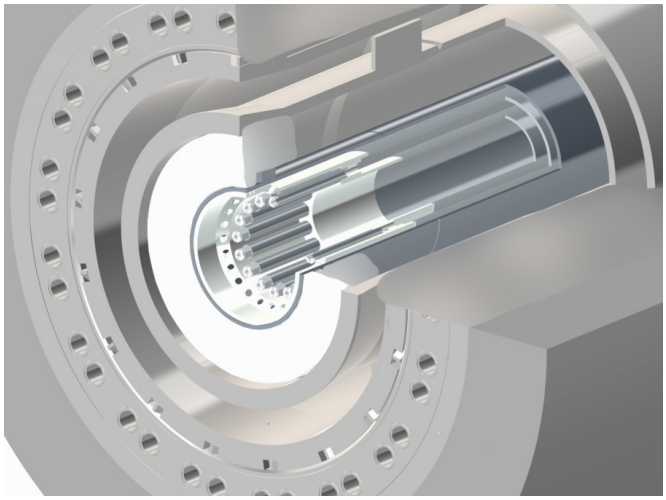
Operators can therefore easily adapt the flame shape to any changing kiln operating conditions without impacting the air flow or momentum whilst the kiln is in operation.

For example, the swirl air angle can be effortlessly reduced when switching from coal to high sulfur petcoke, making the flame thinner in order to reduce sulfur volatilization without impacting the burner's momentum or the secondary air entrainment efficiency.

OPTIMIZED GAS MOMENTUM WHATEVER THE FLOW RATE

Gas firing burners are fitted with a unique adjustable cross section device which can be remotely controlled whilst the burner is in operation. The advantage of such a unique Fives design is to maintain an optimized gas jet velocity whatever the gas flow.





#3 NEW OPTIONAL DEVICES TO REDUCE NOx EMISSIONS EVEN MORE

Reduced air injection for improved efficiency and lower NOx emissions:

The Pillard NOVAFLAM® evolution can be consolidated with a Pillard Airless Stabilizer™ and Pillard PGZ™ gas nozzle device.

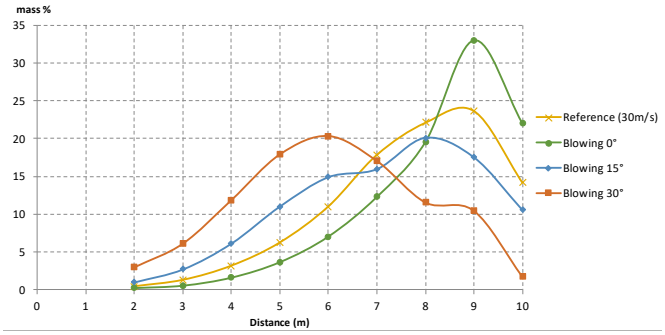
The Pillard Airless Stabilizer™ reduces the cooling air in the burner's center to practically zero, creating a local lean O_2 zone which favours low NOx emissions and increases the kiln's thermal efficiency.

Pillard PGZ™ natural gas nozzle, using Pillard BLUEMIX™ technology, reduces NOx emissions by up to 20% compared to a standard burner, whether operating on 100% natural gas or in dual fuel firing conditions (gas + any other fuel).

Pillard NOVAFLAM® Evolution: What's new?

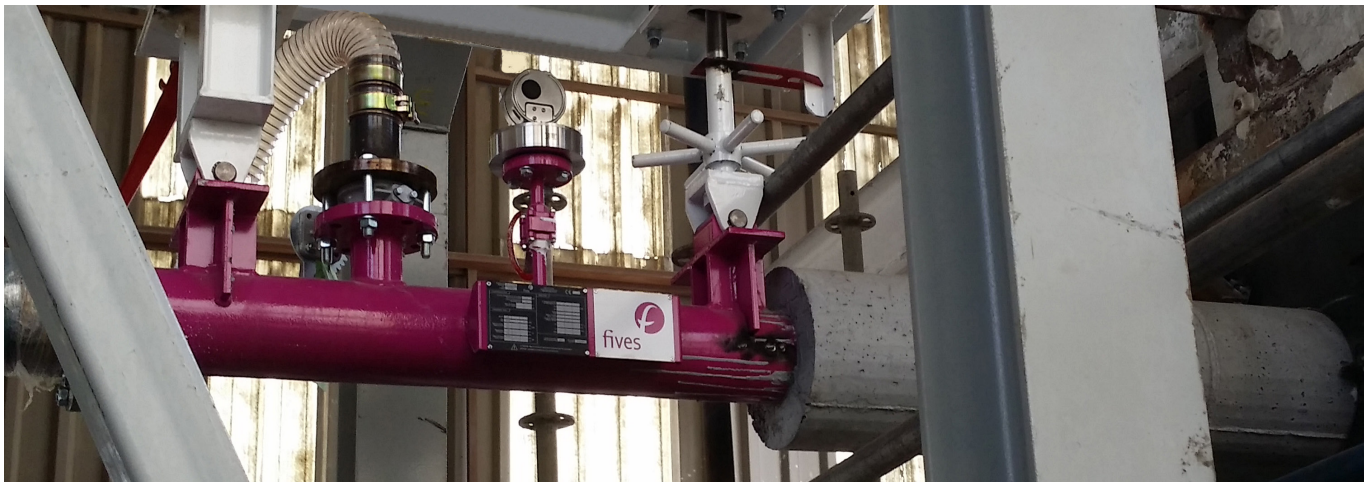
#4 NEW ASF INJECTORS TO ACHIEVE A MAXIMUM SUBSTITUTION RATE OF ALTERNATIVE SOLID FUELS

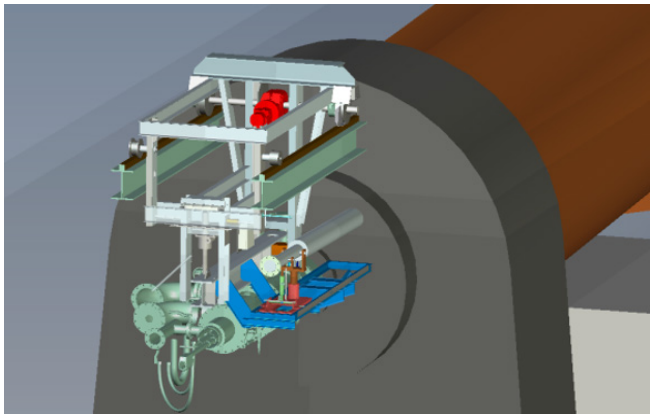
ASF injection experiments were carried out at the Fives European Combustion Centre (FECC) to understand the ballistic behaviour of the particles for various types of ASF.
Fives defined a series of design criteria adapted to the high diversity of alternative fuels available: biomass, plastics, domestic waste etc...

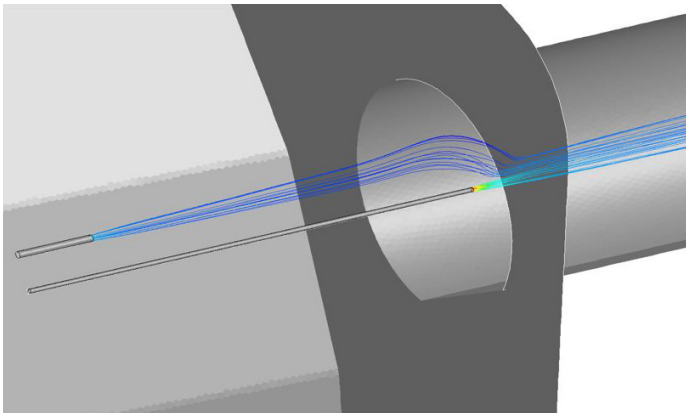


The Pillard NOVAFLAM® Evolution burner enables the central injection of ASF by means of dedicated injectors, specially engineered to avoid the 'double flame' effect. The injection method is adapted according to the various ASF criteria such as density, moisture, size, combustion kinetics...
Various arrangements of ASF injection are possible to achieve the best combustion and thermal efficiency.

Dedicated satellite injection systems can also be proposed with the Pillard NOVAFLAM® Evolution burner package.





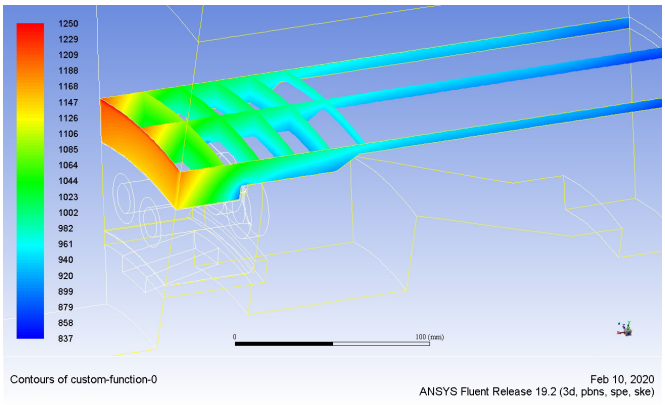


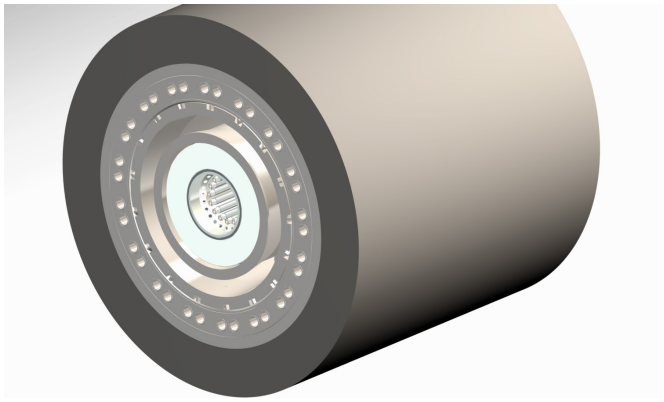
Pillard NOVAFLAM® evolution: What's new?

#5 NEW BURNER TIPS WITH A STURDIER DESIGN

COOLED HEAVY DUTY TIPS

The new Pillard NOVAFLAM® evolution burner tips are made of a specific refractory alloy which can withstand the harshest of kiln operating conditions. The new design of Cooled Heavy Duty axial tips guarantees a strong sustainability during heat expansion in the case of a refractory failure. These new tips ensure improved durability and an increased service lifetime.



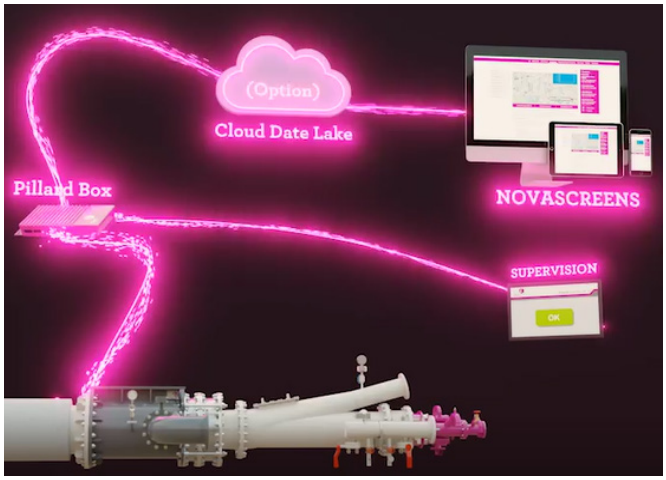


WEAR REDUCTION

The new Pillard NOVAFLAM® evolution tips have no moving parts in front of the flame. The burner tips are arranged in a specific manner to avoid internal recirculation of pulverized coal and clinker dust, thereby preventing any wear or build up on the burner's front face. Wear resistant materials and ceramic parts can be used at specific locations inside the burner so as to prevent wear due to the firing of solid and pulverized fuels.

REDUCED DOWNTIME

The burner tips are designed for easy dismantling in order to reduce the maintenance time and kiln un-availability. Patented innovative axial air injectors can be replaced so as to adapt the burner to a different operating mode, thereby avoiding a full axial burner tip replacement.



SMART TECHNOLOGY

To properly control kiln operation, the process parameters and the burner's geometric features must be mastered. The Pillard NOVAFLAM® evolution can be fitted with an optional Pillard NOVASMART® service, which enables a real-time and continuous follow-up with 4 smart functions for maintenance or performance purposes.

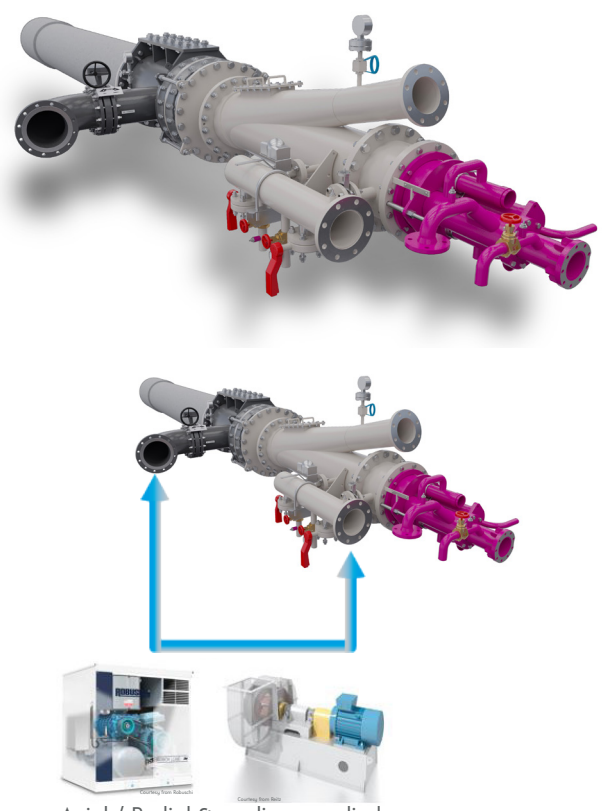
- Survey: with appropriate sensors, the burner's operational status is continuously monitored
- Detection: for each parameter monitored (sensor), alarm and safety thresholds are set-up to detect any deviation
- Diagnostic: analysis of each burner operating fault/drift with associated recommendations
- Action: manual or automatic modification of the burner's settings according to a previous diagnostic, in order to return to an optimized burner operation

Pillard NOVAFLAM® Evolution: General features and overview

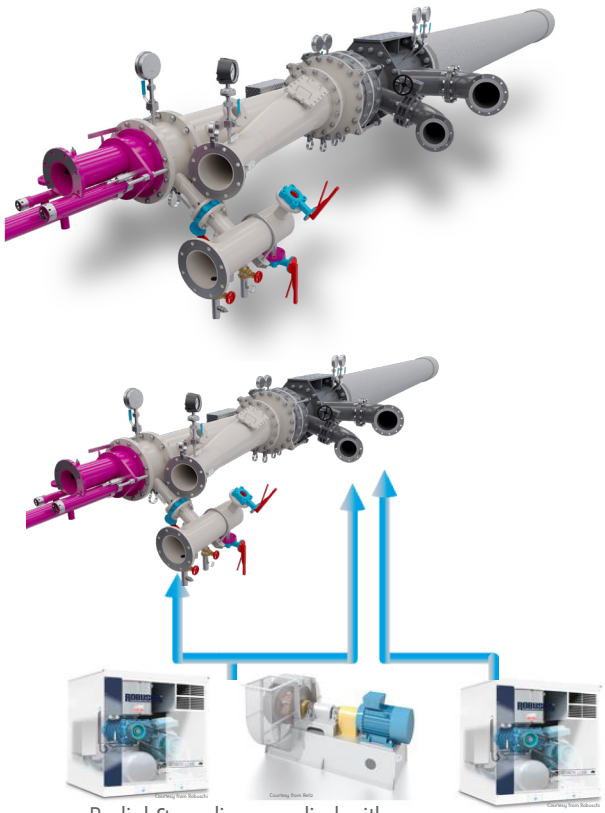
Pillard NOVAFLAM® Evolution is available in the following configurations:

Mono-channel Pillard NOVAFLAM® Evolution version
- Common primary air channel
- Only one primary air device (fan or blower)
- Easy flame settings / user friendly
- No compromise on performance
- Smart ready

Bi-channel Pillard NOVAFLAM® Evolution+ version
- Separate axial and swirl air channels
- Two primary air devices (high pressure axial blower and low pressure swirl air fan)
- Extremely fine adjustment possibilities
- No compromise on performance
- Smart ready



Axial / Radial & cooling supplied with common fan or blower



Radial & cooling supplied with common fan or blower

Axial blower

Key features	
Fuels	Natural Gas, Coal, Petcoke, Anthracite, Lignite, HFO, DO, ASF, ALF, LCV gas and other gaseous fuels...
Output range	from 10MW to 200MW
Primary air pressure	from 100 mb to 800 mb
Gas pressure	from 300 mb to 800 mb
% Primary air	4% to 10% depending on fuel and process

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