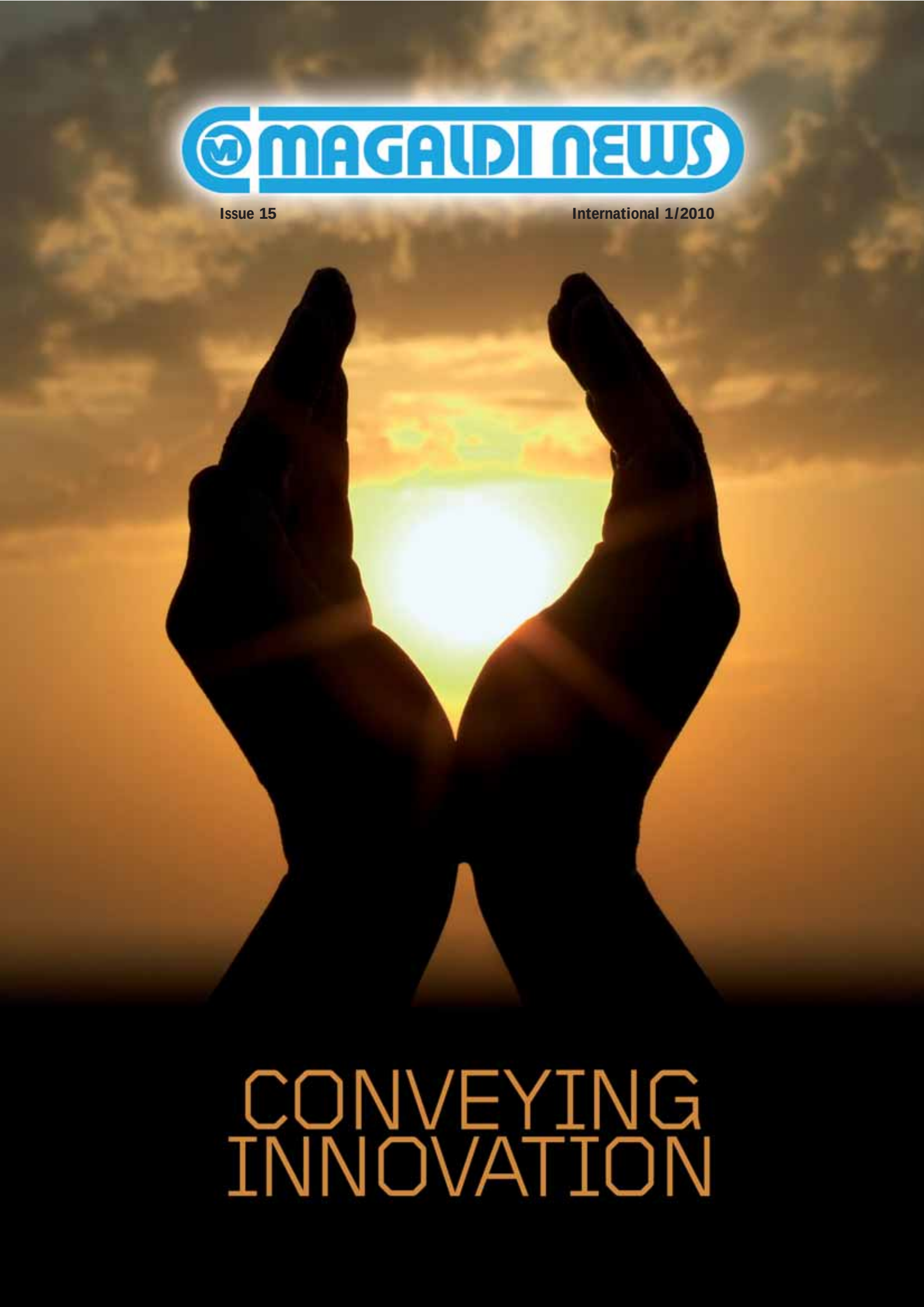
MAGALDI NEWS

Issue 15 International 1/2010



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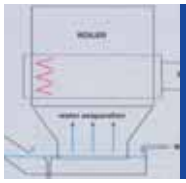

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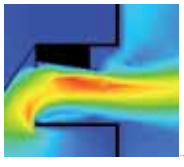

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5 GENERATIONS OF INVENTORS, ENTREPRENEURS SINCE 1929.

The Magaldi Group, founded in Southern Italy in 1929, maintains its unaltered mission to create innovative and dependable products and distributing them worldwide.
Our confidence in the necessity for innovations has led us to obtain hundreds of international patents from which many successful technologies have been generated.
From the "Supercinghia Magaldi", a transmission belt patented in 1901, so dependable that it guaranteed 5-year continuous operation, to the first patent of the "Superbelt" obtained in 1972 for a steel belt conveyor used for the transport of hot and abrasive materials, which was sold in 40 countries all over the world.
From the patent of the "Superbelt" ideas were taken for the development of the "MAC" system used for the dry extraction of hot ashes from boilers fed with solid fossil fuels, as well as for the "ECOBELT" designed for the dependable handling of dusty, abrasive or hot materials.
From dependable machines to dependable plants, designed for the integrated and economic processing of all solid residuals coming from the combustion of coal, lignites and waste, we have maintained a constant commitment to excellence, thus procuring the award for the "Best Available Technology".
Serving boilers totalling about 50,000 MWe of power generation all over the world, the MAC technology has allowed us to save hundreds of billions of liters of water, by eliminating the pollution caused by effluents and by reducing the emissions of CO_2.
Over the last years our Research Group has collaborated with many prestigious universities as well as public and private research centres, in order to develop new technologies in the field of the power generation from renewable sources.
We are sure we will contribute to a sustainable progress in this sector, too.

Mario Magaldi
President & CEO
MAGALDI GROUP
mario.magaldi@magaldi.com

India

Ratnagiri: a modern Power Station in Maharashtra

by **Debasish Chakraberty** *General Manager – Magaldi Power India Pvt Ltd.* chakraberty.debasish@magaldi.com

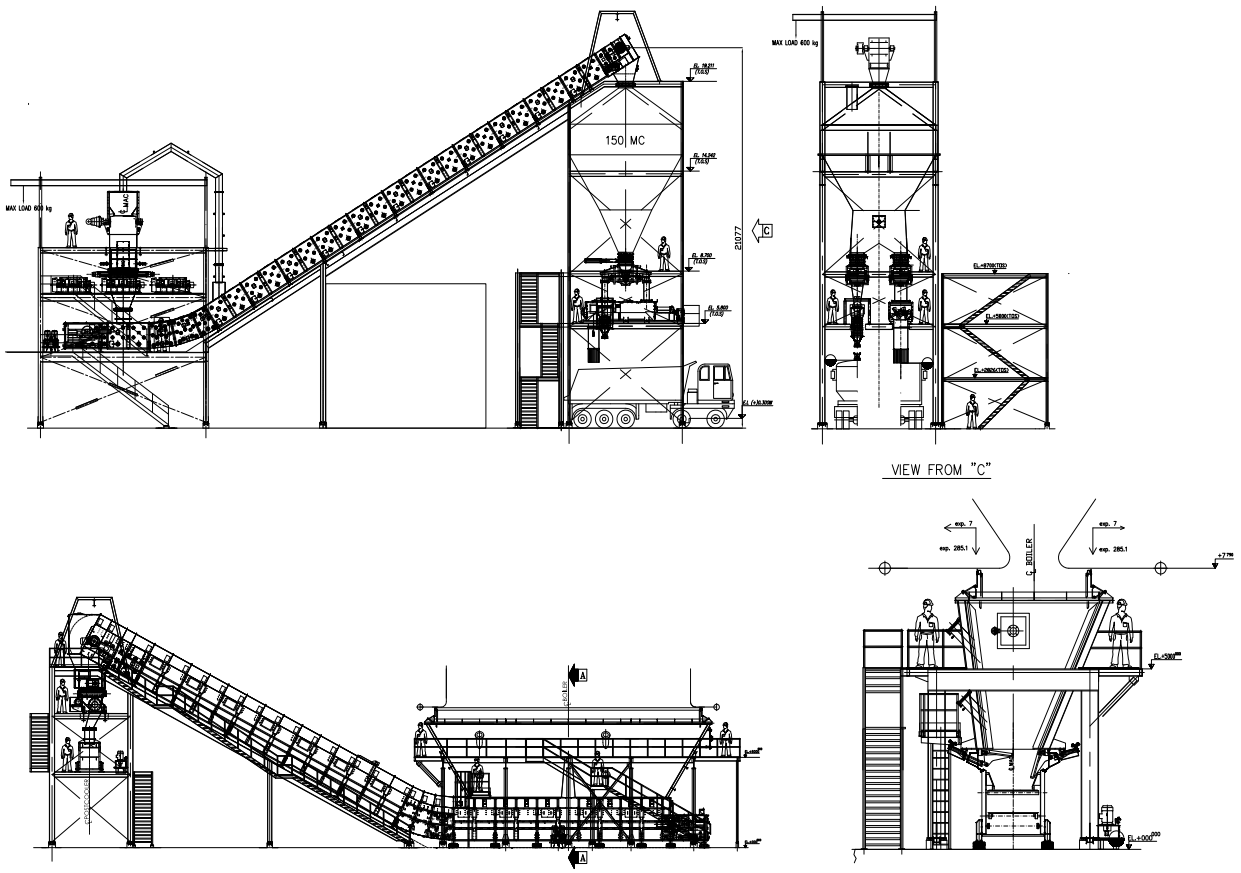
JSW Energy (Ratnagiri) Ltd, (JSWERL), a subsidiary of JSW Energy Ltd, a leading business group in India with a presence in high growth sector like Steel, Energy, Aluminium, Cement, Infrastructure and Logistics, is setting up the 4 x 300 MWe Coal Based Power Plant, at Jaigad, about 40 km from Ratnagiri in Maharashtra.

The Project is being implemented in approximately 450 acres of land. Out of the Project cost, about Rs 150 Crores (approx. 25 mio Euro) is being invested in Environment protection measures, for a total compliance with environmental laws and regulations. JSW has therefore chosen the most modern environmental technologies, and, among them, the dry extraction and removal of bottom ash from their four coal fired boilers.

The contract has been therefore awarded to Magaldi, for the supply of the MAC® system, the most reliable and experienced dry bottom ash removal system in the world.

The installation of the MAC® in Ratnagiri power station will of course contribute to the main goal of JSWERL, which are:

• To generate electric power in the



Ratnagiri Layout.

most environmental friendly manner.

- To develop Green belt of approx 100 acres, in first phase itself.
- To adopt international standards for Environmental Management as well as in Occupational Health & Safety Management systems, since the inception of the project (ISO 14001 & OHSAS standards).
- To ensure no impact on nearby water bodies since the envisaged effluent management system will ensure zero discharge from the plant boundary. The effluents shall be suitably treated to meet the standards stipulated by Pollution boards and it will be utilized for Plantation / Green belt within the premises.
- 100% utilization of ashes.

The erection of the MAC® systems for Units # 1 & 2 are underway; Units # 3 & 4 shall follow shortly. All the four units are expected to be commissioned within 2010, starting June 2010. Magaldi Power is providing supervisory services for erection which is being done by client through their erection subcontractor EDAC. The system would be commissioned by Magaldi Technicians.

	RATNAGIRI POWER STATION
Owner	JSW Energy (Ratnagiri) Ltd
Units	#1, #2, #3, #4 (4 x 300 MWe)
Location	Ratnagiri (Maharashtra - India)
Fuel	Imported coal
Bottom ash rate	7 - 14 t/h

India

Gummidipoondi Power Station got dry

by **Debasish Chakraberty** *General Manager - Magaldi Power India Pvt Ltd.* chakraberty.debasish@magaldi.com

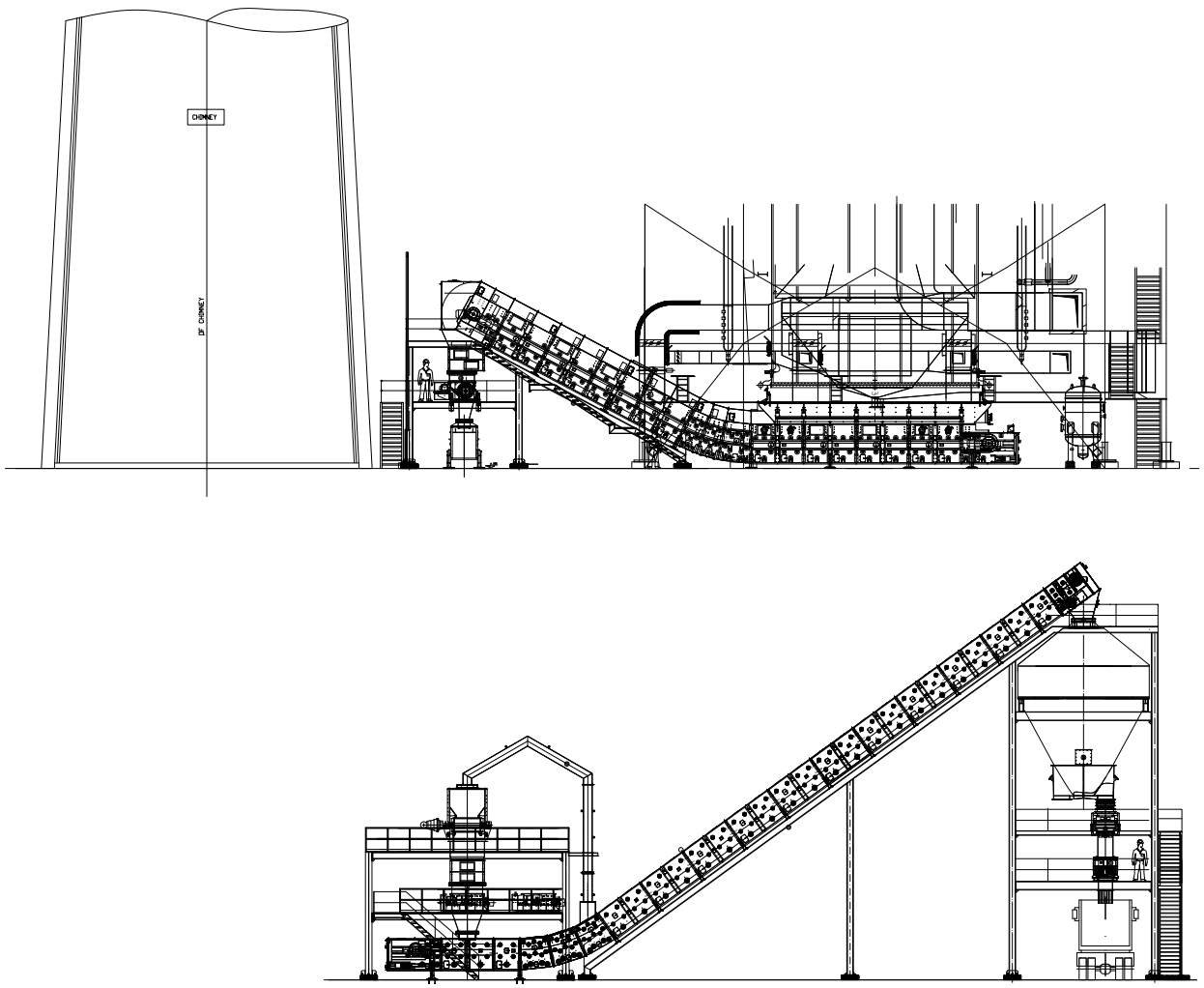
The Indian federal government has launched in the past years actions for enlargement and modernization of all Indian Infrastructures, with a particular eye to the energy production and distribution facilities, as main factor of a rapid growth of country economy. The OPG Power Group was established in 2004 with the goal of providing reliable and cost effective power to Industry and has consolidated its position in these years as a private producer of power serving industry in the state of Tamil Nadu.

The 2 x 80 MWe facility is coming up at Gummidipoondi about 55 km from Chennai city and is configured to use both Indonesian and Indian coal and thus able to use coals of a wide range of moisture and calorific value.

BHEL are the suppliers of the turbines and Ansaldo Caldaie for the boilers.

Single minded devotion, toil and belief in the MAC® system have been the key elements in realization of this order, which took after a deep evaluation and analysis of the MAC® characteristics

Postcooler view.



Gummidipoondi layout.

and beneficial effects on the operation and maintenance of the unit.
Client had some issues about capital costs and were initially considering submerged scraper chain systems from Chinese and also possibly from Indian vendors. Sourcing, maintenance issues and life of the critical elements (i.e. chains and sprockets) raised however several piquant issues. This made the client rethink about their choice. Ultimately the vastly superior MAC® dry system was chosen by client from the point of view of lifetime costs and also because:

- Client wanted the state of art system.
- It conserves water.
- Being Zero discharge it is extremely environmental friendly.
- It increases the efficiency of the furnace.
- It produces a saleable product.

There were competitors but to quote client - “they only offered Glorified Submerged Scrapper Chain Systems”.
The first Unit has been commissioned in the last week of April 10 and has attained full load. Client is extremely pleased with the Magaldi equipment and the its performance, making a lot of PR work for us.
This is another instance of one more “Happy Customer” very willing to place repeated orders on Magaldi.

	GUMMIDIPOONDI POWER STATION
Owner	OPG Power Generation
Units	#1, #2 (2 x 80 MWe)
Location	Gummidipoondi (Tamil Nadu - India)
Fuel	Imported coal
Bottom ash rate	1,5 - 5 t/h

Brazil

Brazilian coal projects

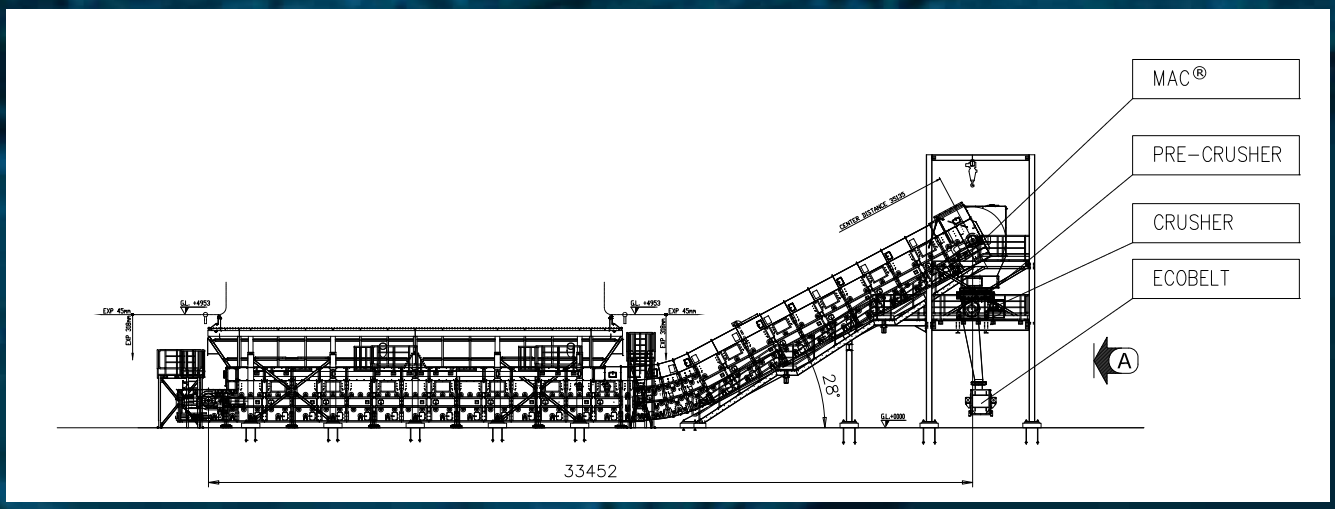
by **Vincenzo Quattrucci** *Marketing Manager* vincenzo.quattrucci@magaldi.com

Brazil will soon add 1,080 megawatts (MW) of electric power in the North-eastern states of Ceará and Maranhão when the two coal-fired power stations built by a consortium led by the Italian group Tecnimont Maire will be completed. The two stations, Pecém I – II and Itaqui, are respectively own, the first, by a consortium of Energias do Brasil S.A. and MPX Energia S.A., while the second by MPX Energia.

As part of the Brazilian Government's Growth Acceleration Program (PAC), Pecém I, Pecem II and Itaqui will add 720 MWe, 360 MWe and 360 MWe, respectively, to the national grid by 2012.

These new plants, made of 4 units rated 360 MWe each, will sell energy to 32 distribution companies that have a combined client base of more than 158 million people.

Fossil fuels make up a comparatively small part of Brazil's energy matrix, thanks to a system of hydroelectric facilities that supplies 84 percent of



MAC® lateral view

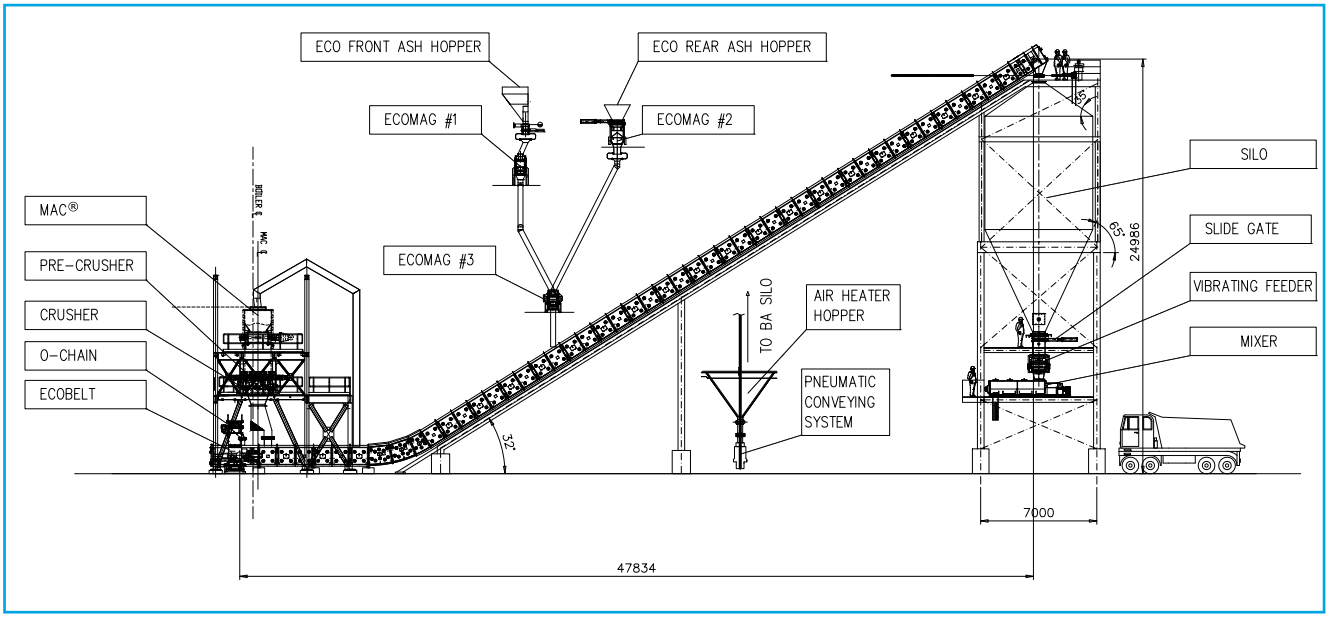
the country's electricity and an ethanol industry that produces around 40 percent of its transportation fuel needs. However, these renewable sources make Brazil vulnerable to drought, so the government has been working to diversify its energy matrix to guarantee security, reliability and affordability to the supply of electricity.

Magaldi Power S.p.A. has been awarded of 4 MAC® systems to be fitted underneath the units by MABE, a Tecnimont company, in charge of contract executions for the construction of two coal stations. Key to our success is the expected savings in terms of fresh water consumption, the elimination of problems associated with waste water, and a recovery of energy associated to the ash, which will consent an increase of the boiler efficiency and consequently, less coal burned and less CO_2 emissions.

The arrangement of the four similar systems, for each boiler, includes a MAC® extractor beneath the boiler throat, a large size primary crusher, the post-cooler, a 320-cubic-meter storage silo and truck discharging equipment; the extraction and transportation of ECO ash is made with Magaldi specialized equipment, the ECOMAG conveyor. Finally the dust collected in the Air Heaters, will be transported with a dedicated pneumatic system. All the extracted ash will be then conveyed and stored in the silo, since its discharge onto trucks.

	PECEM POWER STATION	ITAQUI POWER STATION
Owner	Cons. EDB and MPX Energia	MPX Energia
Units	#1, #2 and Pecem 2 #1 (3 x 360 MWe)	# 1 (1 x 360 MWe)
Location	Pecem (Ceara - Brazil)	Port of Itaqui (Maranhão -Brazil)
Fuel	Imported coal	Imported coal
Bottom ash rate	4 - 8 t/h	4 - 8 t/h

Pecem view.



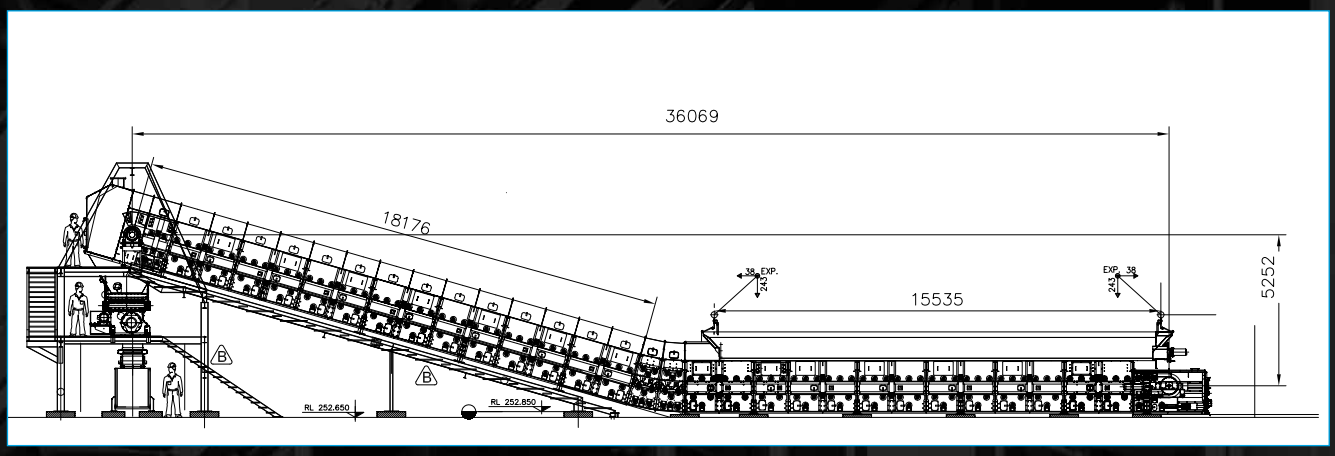
Australia

Bluewaters Power Station

by **Carmine Di Martino** *Project Manager* carmine.dimartino@magaldi.com

In March 2009 the Unit # 1 boiler at the Bluewaters Power Station was fired on coal and Western Australia got its first MAC® dry bottom ash handling system.
A few months later, in November 2009, the second boiler Unit # 2, also equipped with the MAC® system, started its operation.

The Bluewaters Power Station is located in Collie in the South West region of Western Australia, 213 kilometres south of Perth. The plant is a base load power station with a capacity of 416 Megawatts, using the sub critical technology to generate electricity.
When designing the power station, the IHI and Aurecon - the former being one of the world most experienced boiler makers, the latter one the largest Australian consulting company - choose the advanced technologies to protect environment by preserving water, a scarce and precious resource in Australia, and keeping the emissions at levels that are the lowest for the coal power stations currently operating in Australia. To achieve that, they choose the most efficient emissions control systems and the MAC® technology, that was selected over the alternative solutions in view of the guarantees offered in terms of the boiler energy efficiency and the system life cycle operational costs, in addition to the environmental protection.
Each of the Magaldi systems installed at Bluewaters Power Station consists of a MAC® extractor connected to a boiler through a mechanical seal and ash transition chute. The collected bottom ash is discharged from the extractor through a pre-crusher and a primary crusher onto a postcooler conveyor and from here to a silo to which grits from economizers are also loaded via an auxiliary pneumatic conveying

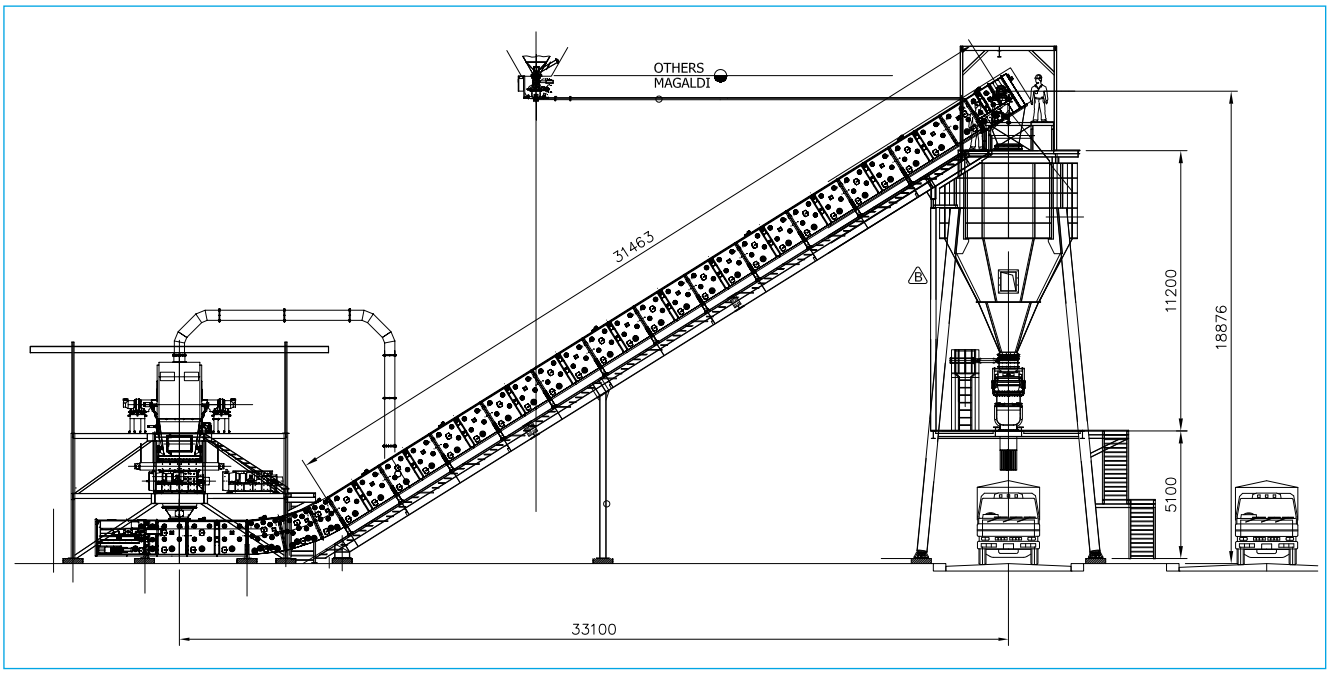


Bluewaters MAC® view.

Overview of Bluewaters Unit #1.

system - all this equipment being part of the Magaldi supplied plant.
The MAC® systems delivered to the Bluewaters Power Station have a significant distinctive feature compared with other MAC® installations: these are the first MAC® systems installed and commissioned in Australia by the Magaldi personnel only, without use of the erection subcontractors. The installation was carried out with the locally employed labour, coordinated by the Magaldi project/site manager and supervisor with support from Italian engineers: it has been a great and exciting challenge for all involved in this project. From a professional viewpoint the Australian Magaldi team members have been given an opportunity to work on one of the best products of the Italian technology; the Italians have been exposed to a new and different business environment. In addition we all have had to learn and appreciate working together in a mixture of different cultures and work ethics in a highly demanding site environment.
The MAC® system installed on Unit 1 boiler is in service by March 2009; few months later, in November 2009, the MAC® system on Unit 2 boiler started its operation as well: both of them are working satisfactorily, confirming the expected performances and the benefits of MAC® system technology.

Client	**IHI Engineering Australia Pty Ltd**
Power plant name	Bluewaters Power Plant
Power plant owner	The Griffin Group
Unit #	1 and 2
Capacity	2 x 208 MWe
Bottom ash rate (design)	4 t/h
Bottom ash rate (max normal)	9 t/h
Bottom ash temperature at final discharge	150 °C
Contract awarded to Magaldi	March 2007
Erection activity start up	September 2008
Erection activity completion	November 2009



Bluewaters Postcooler and Silo view.

Czech Republic

Plzeň heating plant: small project, big benefits results

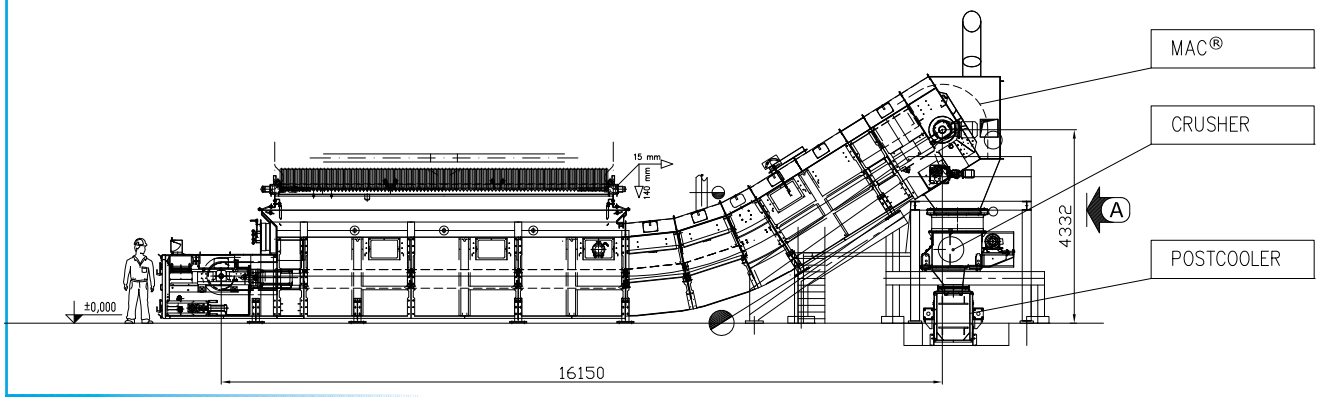
by **Jozef Cmarko** *Alstom s.r.o.* jozef.cmarko@power.alstom.com
by **Daniele Coppola** *Magaldi Power S.p.A.* daniele.coppola@magaldi.com

A bottom ash handling system reconstruction project in Plzeňská Teplárenská illustrates the benefits of applying dry technology to a relatively small project.

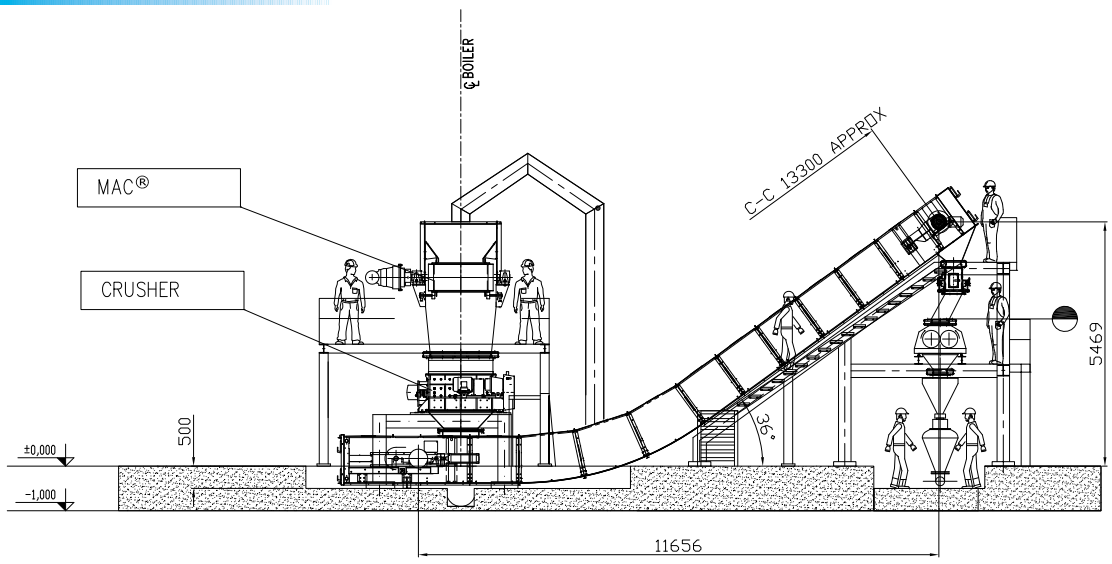
Plzeň is a peaceful town located in a green and hill area in west Bohemia, Czech Republic. Plzeň has the biggest brewery (Pilsner Urquell) in the country which has given a name to an entire beer style (specifically, a pale lager), the Pilsener, arguably the world's most popular style.

In the industrial area is located a Heat and Power Station, Plzeňská Teplárenská, which in the past year has been subject to a deep reconstruction to improve the efficiency of the production and at the same time rise the quality of the environment, with a drastic reduction of the gas and liquid emissions. One of the steps of this renewed course is the revamping of the coal boiler with modern equipment able to guarantee more efficient methods of generating heat and electrical power. In particular, the main step taken by the Power Station is the decision to eliminate the water as process fluid in the extraction and cooling of bottom ash from unit k5.
This unit will also be subject to other important retrofit jobs in order to test

Plzen Heat and Power Station.



MAC® lateral view.



Postcooler lateral view.

	PLZEN HEAT AND POWER STATION
Owner	Plzeňská Teplárenská
Unit	#1 (60 MWe)
Location	Plzen (Czech Republic)
Fuel	Coal, coal + RDF
Bottom ash rate	1 - 2 t/h

a possible co-combustion of Refused Derived Fuel with coal.
The elimination of water in the extraction of bottom ash has been made possible by the use of a Magaldi MAC® system, the dry bottom ash system designed and manufactured by Magaldi Power.
The hot ashes, falling from a boiler having a steam production of 185 t/h@136,3 bar@540°C, will be transported at a rate of approx. 1 t/h and cooled down by the MAC® extractor.
After a first crushing stage, furnace ashes will then be milled by a secondary crusher and finally transported to the existing fly ash silo by means of positive pressure pneumatic conveying system.
The main contract for the reconstruction of the boiler has been awarded by Plzeňská Teplárenská.

Alstom s.r.o. headquarters in Brno.

Germany

The dry bottom ash extraction system - introduced by Magaldi in 1985 - is becoming the standard for newly built bituminous fired power plants

by **Günter Baur** *Magaldi Power GmbH General Manager* guenter.baur@magaldi.com

After an interruption of more than 10 years new bituminous fired power plants are built again in Germany. After their completion these power plants disposing of heat rates of more than 45 percent will belong to the most advanced ones of their kind throughout the world.

The modernisation of the power plant park may contribute considerably to the protection of the climate. The dry bottom ash handling of Magaldi is made without utilising cooling water, instead the hot ash is cooled with a small partial stream of the combustion air thus recovering the lost heat of the ash. By this means the boiler efficiency is increased, while coal consumption and emissions are reduced accordingly. Our reference list includes 126 plants all over the world and we guarantee maximum plant availability utilising our

Wilhelmshaven 800 MWe, current photo from site.

MAC® systems.
Magaldi will equip **seven newly built plants** in Germany and the Netherlands with the MAC® system.
Unit #10, 750 MW being built in the power plant Walsum (Evonik Industries AG and EVN AG) will start operation still in 2010 as the first newly built unit in Germany. In this plant the dry and cooled bottom ash will be converted entirely into fly ash of higher quality by recirculation into the furnace.
RWE Power will have equipped the units **Westfalen D&E and Eemshaven A&B (4 x 800 MWe**) with a dry bottom ash handling system. The steam generators will be supplied by Alstom Power. At the request of RWE the ash handling systems arranged below the boiler hopper are designed movable.
The two newly built 800 MWe units of GDF Suez **in Wilhelmshaven and Rotterdam** will equally be equipped with the Magaldi ash handling systems. We will supply to Hitachi Power Europe.

Dry bottom ash handling system at Walsum #10 (Photos: HPE)

Westfalen #D, E new bituminous fired plants (Illustration RWE Power).

Australia

The Magaldi ECOBELT conveyor at Millmerran Power Station

by **Celestino Agresta** *Sales Manager* celestino.agresta@magaldi.com

Dependable and reliable handling of bulk materials is important to ensure the highest productivity in many industries. Traditional conveyors are not designed to withstand high temperatures, heavy weights, abrasiveness or sharp edges of different bulk materials. Conventional conveyors can often cause production losses due to unforeseen failures, they require excessive maintenance and are noisy and dusty.

During the last 40 years, hundreds of successful installations confirm that the Magaldi Superbelt® conveyor (in its different configurations) is the dependable and environmental friendly solution to address and definitely solve all these problems.

The Magaldi Superbelt® differs from competing technologies by:

- Unchallenged dependability
- High temperature operating ability
- Impact resistance
- Low wear, long life
- Low operational & maintenance costs
- Safe and clean working environment
- Cost-effective retrofitting.

The dependability of the equipment in material handling systems is essential to guarantee the productivity of industrial plants, especially for continuous production processes such as coal fired power plants, steel mills and cement factories.

Conventional belt conveyors, drag chain conveyors and steel plate conveyors are normally designed with the aim to guarantee a continuous operation, allowing it to perform maintenance operations during scheduled plant outages.

In case of transportations of hot and highly abrasive materials and unpredictable material size distributions; the mechanical and thermal resistance of traditional conveyors can be insufficient to guarantee a continuous operation.

The unexpected failure of one single component of a belt conveyor or of a drag chain can suddenly stop the complete conveyor, leading to an unexpected shutdown of the production line for the period necessary to mend the breakdown.

For some companies, the financial losses associated with unexpected, long and frequent line outages can be unacceptable. The Magaldi ECOBELT has been designed for the specific purpose of overcoming all troubles caused by the conventional type of conveying systems and like for all Magaldi products the key component is the Magaldi Superbelt®.

In the Magaldi ECOBELT conveyor, the Magaldi Superbelt® is completely enclosed in a tight steel casing to avoid dispersion of dust into the environment.

In its normal configuration the Magaldi ECOBELT was equipped with a cleaning chain (inside the carter), that conveys the fines accumulated on the bottom of the carter up to the discharge chute of the conveyor.

Cleaning chains, compared to the Magaldi Superbelt® though, have several limitations for applications over long distances and/or with steep inclinations. (for applications over

long distances or with steep inclinations or for applications over long distances and steep inclinations). In particular their limited resistance to high temperature and wear reduces their dependability. For these reasons, the Magaldi Company has patented, developed and produced a new fines recovery system, the “Magaldi O-Chain”.

The longest ECOBELT to transfer Bottom Ash from the crusher to the final ash silos after the extraction, crushing and partial cooling was designed and realized by Magaldi at the Millmerran Power Station in Queensland, Australia. The power station is composed of 2 Supercritical Units 426 MWe each. In 2007 Magaldi received the contract to retrofit the existing Submerged Chain Conveyor which was extracting the bottom ash in the old fashioned manner. In August 2008 the first unit was installed, one year later the following unit has been erected.

The ECOBELT conveyor at the Millmerran Power Station, as part of the previously mentioned benefits, contributes to the cooling effect of the bottom ash and is integrated into the Bottom Ash Handling system.

At the maximum belt speed the belt is designed to handle ash rates up to 50 t/h, but operates at about 12.0 t/h, which in the Millmerran case, means about 40 m^3/h (due to the very low ash specific weight) at a speed of about 0.12 m/s.

THE CHARACTERISTICS OF THE CONVEYOR ARE:

Interaxis Length:	132.8 m
Total belt length:	268.0 m
Belt width:	800 mm
Casing width:	1,000 mm
Slope:	10°
Drums diameter:	800 mm
Drive motor installed power:	11 kW
Tensioning drum run:	1,000 mm

South Korea

FLUIMAC® System for a 340 MWe-class Circulating Fluidized Bed Boiler at Yeosu Thermal Power Plant No. 2

by **Ivano Pennella** *Sales Engineer*

ivano.pennella@magaldi.com

After more than two years and several meetings held directly with Foster Wheeler and Doosan, Magaldi Power S.p.A signed a contract with Doosan Heavy Industries & Construction Co. Ltd. for the supply of a dry ash extraction and cooling system for the 340 MWe-class Circulating Fluidized Bed Boiler to be installed in Korea at Yeosu Thermal Power Plant No. 2.

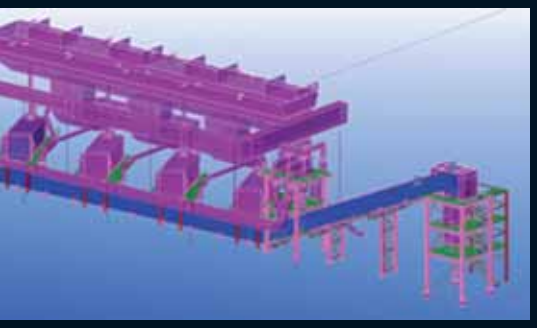


Figure 1. View of FLUIMAC® system

Thanks to this reference, the 7th in Korea, Magaldi confirms its leadership in dry ash extraction and cooling systems worldwide, not only for the PC Boilers but also for the CFB Boilers, in fact the Yeosu boiler is Korea's largest Fluidized-Bed Boiler and among the largest in the world.

Unlike as with a Pulverized Coal Boiler, which is used in most conventional power plants, with a Circulating Fluidized Bed Boiler, an eco-friendly boiler using low-grade coal as fuel, the Yeosu Thermal Power Plant will not only significantly cut down fuel costs, but will also remarkably reduce pollutant emissions such as nitrogen oxide and sulphur oxide.

With these expectations in mind, installing a FLUIMAC® System was a natural choice for Yeosu TPP. In fact, the FLUIMAC®, the innovative Magaldi system for dry extraction and cooling of bed ash from fluidized bed boilers, is able to increase the boiler performance by recovering heat back to the combustion chamber, reducing the coal consumption and eliminating the water usage to cool down the bed ash fully in line with the advantages given by the boiler.

Nevertheless, the Magaldi FLUIMAC® system, compared with the screw cooler, assures a very low maintenance and a long lasting performance. In the screw cooler, in fact, the hot ash is forced to move between the screw and the shell, whilst inside the screw as well as inside the shell fresh water is beeing circulated in order to cool down the ash. This kind of transportation, with relative motion between the ash and the screw/shell, produces a very fast abrasion of the screw/shell with water infiltrations that immediately reacts with the ash and therefore causes the breakage of the screws and the boiler outage.

Instead, in the FLUIMAC®, thanks to its innovative and patented design, the hot ash is uniformly distributed on the entire width of the Superbelt® and transported, without relative motion between ash and internal parts, while the ash is cooled down by an air flow in counter current to its direction. This design assures that the ash is confined on the Superbelt® without being in contact with any other part of the equipment guaranteeing a high life and no unexpected system failures.

For the relevant project, the Magaldi scope of supply includes the design for the dry bottom ash handling system from the drain pipes up to the discharge from the contact cooler, bringing together all of Magaldi's last innovations to perform in good operation under any conditions.

The entire system will be consisting of the following equipment:

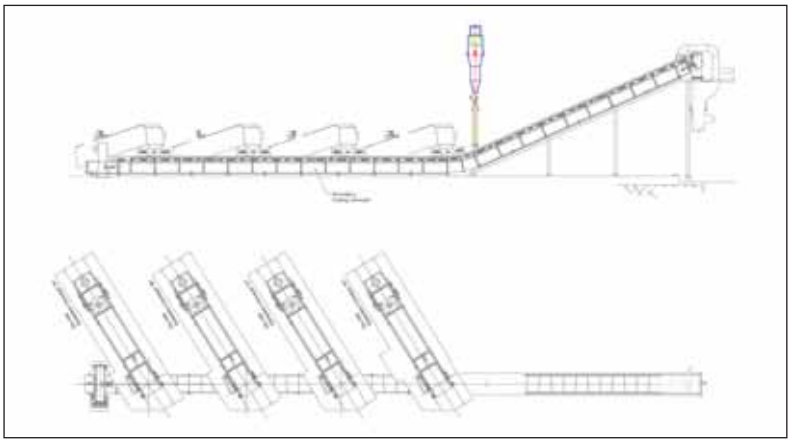


Figure 2. Fluimac System Layout for YEOSU Unit #2

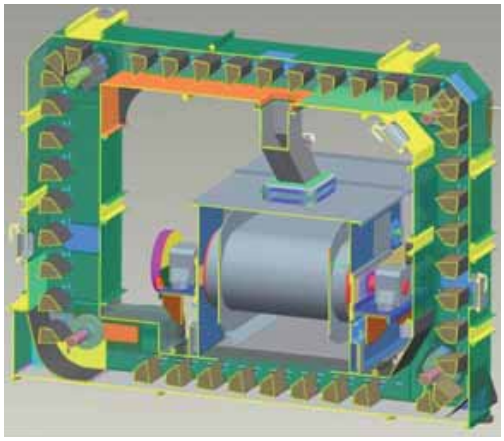


Figure 3. View of Ecobelt/O-Chain

4 Slide Gate Valves;
4 Mechanical Expansion Joints;
4 FLUIMAC® extractors;
1 ECOBELT Conveyor equipped with O-chain;
1 Contact Cooler;
2 Cyclones;
2 Small Power Rated Air Fans;
2 High Power Rated Air Fans.

Due to different operating conditions between the CFB Boiler and the PC Boiler, the FLUIMAC® system has a different operating concept compared to the MAC® system.

In fact, while the PC Boiler works in negative pressure and the cooling air is naturally drafted in the MAC® system from the boiler, the CFB Boiler works in positive pressure. Hence the necessity to separate the positive boiler ambient from the negative FLUIMAC® system ambient and induce a forced air circulation.

The ambient separation is guaranteed by keeping the drain pipes always full of ash regulating the belt extraction speed of the FLUIMAC®, in accordance to the boiler ash production during normal operations, and, in case of emergency by closing the slide gate valve installed between the drain pipe and the FLUIMAC®.

The circulation of the cooling air inside the system is guaranteed through air fans; the drafted air, after passing the FLUIMAC® and the ECOBELT, before being sent to the boiler combustion chamber, for heat recovery, passes through a cyclone in order to reduce the dust quantity and avoid erosion problems. According to the boiler ash production during normal operations the air rate is continuously adjusted in order to perform the best cooling effect.

Moreover, for an effective ash temperature reduction a special Magaldi device, the Contact Cooler, has been installed just below the ECOBELT discharge chute upstream of the bucket elevators. The purpose of the Contact Cooler is to perform an intimate contact between the falling ash and the fresh air entering from its bottom in order to be in compliance with the temperature limit required even when the ash production rate is very high.

Another new brand device, the Ecobelt/O-chain, has been installed to transport the fines away.

In this system, the Superbelt® and the conveyed materials are enclosed in an air tight steel carter.

Recovering elements are hinged to the Superbelt® and in the return section they graze the bottom, pushing the fines towards the O-chain.

The Magaldi O-Chain is a new cleaning chain enclosed in an independent frame that reloads the material recovered from the bottom of the casing onto the main belt. It is tailored around the Magaldi ECOBELT and runs in a direction perpendicular to the main belt. The O-chain is connected to the external section of the ECOBELT at two points, located on the top of cover and underneath the main casing.

In case of transportations over long distances, steep inclinations, with extremely abrasive and/or high temperature materials, which is the case at YEOSU, the Magaldi Ecobelt/O-chain overcomes the limitations of the other conveyors enclosed in a casing, such as the Apron conveyor or the drag chain ones, preserving the proven reliability of the Magaldi Superbelt® technology.

MAIN TECHNICAL DATA OF THE BOILER #2	
Boiler Capacity	340 MWe
Bed ash production rate (design/worst normal condition)	1.22/5.8 t/h
Bed ash production rate (design/worst design condition)	8.4/11 t/h
Bed ash production rate (emergency outlet condition)	22 t/h
Bed ash temperature leaving the boiler (Design Basis)	910 °C
Maximum particle diameter	30 mm
Furnace operating pressure (at drain pipe inlet)	8,000.0 Pa
Maximum furnace operating pressure (at secondary air inlet)	9,000.0 Pa

Chile

Bed ash transportation system for Mejillones CFB project

by **Vincenzo Quattrucci** *Marketing Manager* vincenzo.quattrucci@magaldi.com

Cobra Instalaciones y Servicios S.A., part of the Spanish ACS group, awarded Magaldi Power S.p.A. with a contract for a bed ash transportation and storage system for their project of two 165 MWe (gross megawatt electric) circulating fluidized-bed (CFB) boilers located at the Andino power plant in Mejillones, in the north of Chile.

ANDINO POWER STATION

Owner	GDF SUEZ Energy group
Units	CFB #1 and #2 (2 x 165 MWe)
Location	Mejillones (Chile)
Fuel	Imported coal, petcoke, biomass
Bottom ash rate	4 - 13 t/h

The scope of supply refers to the transportation system of the bed ash from the boiler to a storage silo of 690 cubic meter capacity.

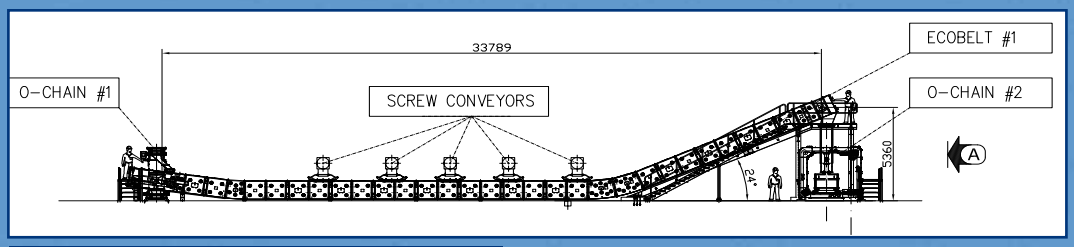
The system is based on a Magaldi ECOBELT which receives the ash discharged by the 5 screw coolers directly fitted under the drain pipes of the CFB boiler. The Magaldi scope also includes the expansion joints (or "bellows") located between the screw coolers and the conveyor.

During the operation, the Magaldi ECOBELT conveys boiler bed ash using a Magaldi Superbelt®, a steel belt conveyor enclosed in a metallic sealed casing, into which a controlled air flow is admitted from the external environment in order to improve the cooling of the material. It has been evaluated in this project that the main difference between the ECOBELT and other conveying systems is that our belt can withstand very high temperatures (max. 800 °C), without any problems. Both, the apron type, as well as the chain conveyor, as a matter of fact, may not tolerate temperatures higher than 300°C, which enhances the possibility of mechanical problems and a risk of wear and chain breakages.

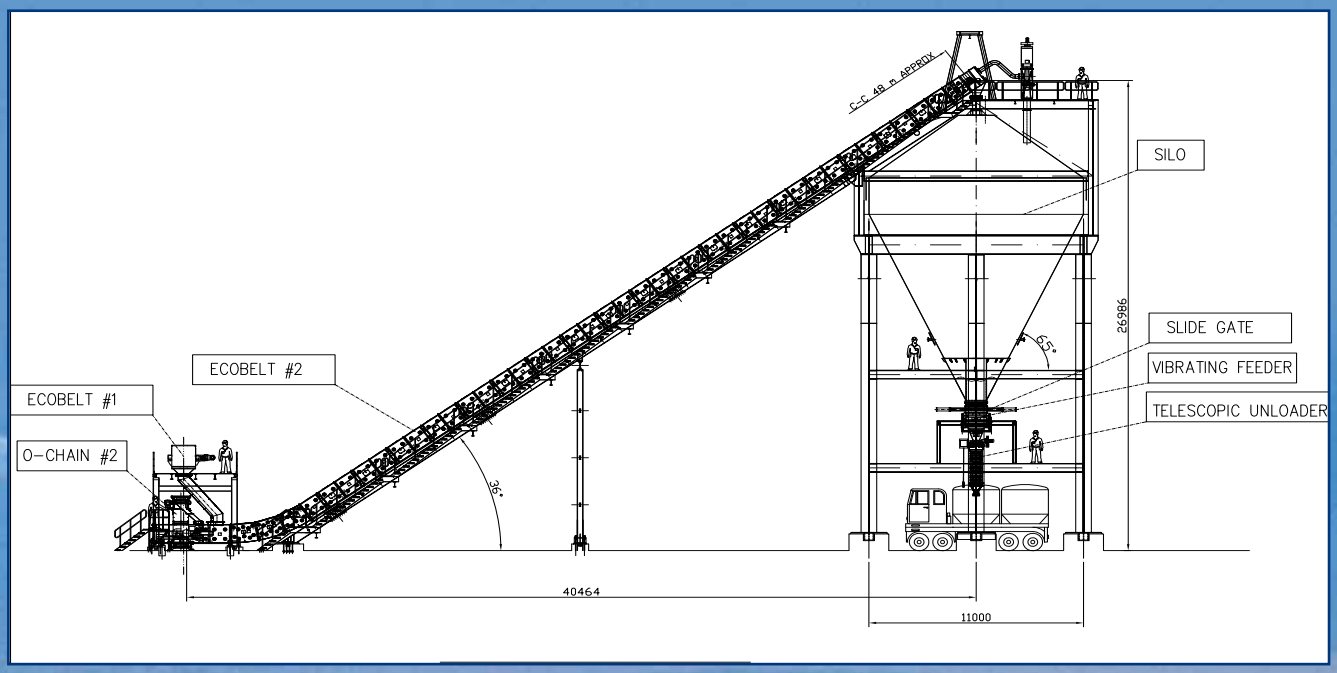
The 690 cubic meter storage silo is provided with an outlet, fitted with valves and equipment for discharging the ash directly onto trucks.

The 165 MWe CFB steam generator, auxiliary equipment and advisory services for erection and commissioning of the boiler island, has been supplied by Foster Wheeler . The boiler is designed to burn imported bituminous coal and/or petroleum coke and to provide the option of burning small amounts of biomass-type fuels. Commercial

operations for the two new boilers are scheduled for the second half of 2010 / beginning of 2011.
Magaldi is a well reputed and known name in Mejillones, a little coastal Chilean city located in one of the most dry areas on the planet, the Atacama desert.
Since 1997, two MAC® dry bottom ash systems have been successfully applied under two coal fired PC boilers, owned by Edelnor, a company that belongs to Suez Energy, the same energy group as Andino. In more than a decade of continuous operations, the two systems have always worked at the client's full satisfaction, neither causing any boiler shutdown nor requiring a high amount of spare parts.



Ecobelt #1 lateral view.



Ecobelt #2 lateral view.

India

Maintenance of a heavy installation: O&M in Durgapur Power Station

by **Simone Savastano** *Area Manager* simone.savastano@magaldi.com

Back in 2007 the very first dry bottom ash handling system in India, supplied by Magaldi, was started in Durgapur (West Bengal) under the new 300MW boiler provided by Dongfang Electric Co. The plant is owned by the Durgapur Projects Ltd.

The characteristics of the plant make it one of the heaviest MAC system installations ever put into operation: 34 t/h of bottom ash and 8 t/h of economizers ash are cooled, removed, handled and discharged from a 600 cum dedicated silo. For safe handling of such an important installation in May 2008 DPL decided to grant Magaldi an order for the complete Operation & Maintenance of the system. Furthermore for its execution Magaldi started its fully owned Indian subsidiary, Magaldi Power India Pvt Ltd.

Today, on site, the Magaldi team counts 15 skilled & unskilled workers involved in 24/7 maintenance work, inspections and system operation. Amongst them Manas Das (on site manager), Subhasish Das and Debadyuti Mitra (Elec. & Instrumentation), Susanta Chakraborty, Saibal Kanti Giri and Krishanu Mazumder (Mechanical) perform the daily activities supported by Mr. Debasish Chakraberty, General Manager of Magaldi Power India Pvt. Ltd.

This is the team in charge of all operational activities.

Maintenance activities are obviously also very important but thanks to the high dependability of the system they are limited to few interventions, such as:

- The lubrication of the rotating parts of the system
- Changing some of the teeth, cam plates and anvil plates of the primary crusher
- Checking the tensioning of the belt

Even though spare parts are provided to the Magaldi team from the fully

Simone Savastano, Subasish Das and Aniello Gaglione.

Magaldi team at work.

parts consumption has been well expected as certificated on June 1st, 2009 by the Power Plant General Manager Mr. P. Banerjee states: "As on date no spares have been required to be replaced and the plant is running satisfactorily with the original components."

ECO ash conveyor, postcooler and silo in Durgapur Unit #7.

THE DURGAPUR PROJECTS LIMITED

TO WHOM IT MAY CONCERN

This is to certify that the Dry Bottom and Economiser Ash Handling System which has been Designed, Supplied, Erected and Commissioned by M/s Magaldi Power SpA, Italy for the 300 MW Unit 7 in December 2007, is working satisfactorily since then. The unit is burning local coal.

The system is rated to handle 24 tons per hour of dry bottom ash and 8.7 tons per hour of dry economiser ash.

As on date (1st June 2009), no spares have been required to be replaced and the plant is running satisfactorily with the original components.

(P. Banerjee)
General Manager (Power Plant)
The Durgapur Projects Limited

General Manager
Durgapur Projects Limited
Power Station, DPL

Interview with Subasish Das

Subhasish Das is the site responsible in Durgapur for the Elect & Instrumentation of the dry bottom ash and ECO ash handling systems.
He has been working with Magaldi for more than 3 years following the unit since its start up. Today Subhasish enjoys an excellent knowledge of the overall control systems of the installation.

Q1: What are the typical activities you perform during your work day?
A1: We check each conveyors belt and spill chain for any defects or abnormalities in running condition, like the temperature of the drive motors, gear boxes and the sound of the rotating parts throughout the conveyors, the current (AMP) drawn by the motors , etc.

Q2: Which activity you perform first as soon as you start your day? Why?
A2: First we check the system with our software (Magaldi Integrated Supervision System) to make sure that the equipment runs as usual indicating normal signals. This also gives us some indications on the activities to be performed during the upcoming day. We also check the rate of the Ash flow in our system and the Plant load (MW). Then we are ready to start the daily activities in details.

Q3: How many hours do you typically work every day? Do you usually work extra time?
A3: Normally 8 hours, but as the plant is running 24/7 and we cannot allow a gap in our presence, we may stay well after our normal duties.

Q4: How do you find your working environment?
A4: Very good: we, the members of the Magaldi team, all share a very good spirit of cooperation and we all share a very healthy relationship

Q5: What are the pros and cons of your job?
A5: Pros- We are developing a very intimate relationship with the system and I can say today that I have a very good knowledge of it: we know all its "secrets".
Cons- The work load is quite heavy now as several of our colleagues are on other sites/ in the process of going to other sites

Q7: How is your relationship with the rest of the Magaldi team on site?
A7: As I said, there is a very good teamwork. The installation is pretty complicated and we feel like members of an orchestra: the positive contribution of each of us produces the outcome of an excellently performing system.

Q8: How in your opinion are the Magaldi team and the MAC installation judged by other companies maintenance teams?
A8: I would rather quote what senior DPL personnel have to say as "they have never seen any system operated and maintained with such " loving care & affection".

The MAS® technology: integration of all ashes generated by a coal fired boiler in a single by product

by **Daniele Coppola** *Area Manager* daniele.coppola@magaldi.com
by **Alfonso Pirro** *Area Manager* alfonso.pirro@magaldi.com

THE MAGALDI INTEGRATED ASH SYSTEM FOR WATER ELIMINATION IN ASH HANDLING

Ash handling is an important process for a coal fired boiler and any proved method or solution which could facilitate or improve the operations, including also economical savings to plant owners, is consenting a more efficient and more competitive power station.

Often in the past, bottom and fly ash were removed by the use of water, but when it became clear that there were significant advantages in having dry handling, the technology moved fast in this direction.

For bottom ash, the introduction of the Magaldi MAC® dry technology in middle '80s was a significant "revolution" for a process which since that moment was operating only with wet systems, such as hoppers, submerged chain scrapers, sluice ways, dewatering bins etc. Magaldi has broadly demonstrated in more than 25 years of operation and more than 100 installations serving 45 GW all around the world that the bottom ash can be, with the maximum reliability, extracted and cooled by air with a special conveyor.

Also fly ash, after the initial period of sluice ways and wet system, has been gradually converted to dry technologies, mainly by using pneumatic conveying systems. There are several types, all depending from the ash quantity and dimension, which could lead to vacuum or positive pressure, varying from dilute to dense phase systems, but all facing an high abrasiveness in the pipes. The wear is of course depending from the speed of the material transported by the air. To overcome this problem, pipes have been first made with more resistant materials, even internally coating them with hard layers like basalt or alumina, and second, it has been reduced as much as possible the speed of the transport. Issues still open with the existing dense phase systems are therefore related to the inevitable wearing of the pipelines, even with low velocities, and the possibility of plugging the pipes, which gives as result expensive operational and maintenance operations.

But a mechanical system, which by itself is a low cost maintenance equipment, offering no blockage of the transported material and continuous reliability all over the years, can easily solve the setbacks of the pneumatic systems.

Magaldi has therefore developed, based on its Superbelt technology, an integrated and complete solution,

Figure 1. A coal-ash spill late last year smothered 300 acres and choked waterways in eastern Tennessee. (Copyright 2009 The New York Times Company/Wade Payne/Associated Press).

named MAS®, which offers greater equipment reliability and the broadest range of customized solutions to better serve ash removal operations.
The MAS® is a patented and completely integrated dry mechanical system for ash handling at coal fired Power Stations, allowing a common management system for both fly and bottom ash. Rather than conveying and handle separately several typologies of ashes, the aim of this technology is to have only one output, fly ash, which is a more saleable by-product for either the concrete or blend cement industry. A single line means less equipment and a simpler solution.
The MAS® is structured in n. 3 subsystems (see figures 2 and 3), as follows:

- **MAC®** system for dry bottom ash cooling and further transportation;
- **MAR** system for dry bottom ash recycling into coal mills;
- **Magaldi ECOBELT** for mechanical fly ash transportation.

The MAS® basically extends the dependable and widely proven MAC® and ECOBELT, to handle bottom and economizer ash, to fly ash handling, serving the hoppers located at the flue gas side equipment such as the de-NOx, air heater (AH) and Electrostatic precipitator (ESP) / Bag House filter.
The safe mechanical transportation of fly ash is made possible thanks to the extensive experiences collected by Magaldi throughout many years in hot and abrasive material handling and based on two fundamental facts: first the mechanical system is by far more reliable than the pneumatic conveying system, second the power requirements for this latter are much bigger than the mechanical one. Therefore, extensive savings in O&M costs can be realized by adopting a mechanical system rather than a pneumatic one. This integrated solution permits to handle all the ash produced by the boiler (bottom, fly, ECO and AH ashes) in one single centralized transport and storage system, that results more simple since neither air nor water is anymore required for the ash transportation.
A completely integrated MAS® for ash handling at coal fired power stations mainly follows the following configurations:

- Bottom Ash is extracted in a dry way and recycled into the combustion chamber trough the coal mills by the MAC®-MAR system, being converted in such a way into fly ash;
- Fly Ash removed from the flue gas is mechanically conveyed to the ash storage silos.

The flow-diagram (Figure 3) shows the integration of Magaldi sub-systems for the ash handling as a part of the MAS®, which is able to manage the overall coal ash production with only one single coal combustion by-product.
The MAS® system offers several outstanding advantages both from an environmental and economical point of view. The MAS® allows to:

- Save Water
- Save Environment
- Save Money
- Save Energy

Save water: the MAS® does not require any water to quench and convey both bottom and fly ash.
Save environment: no water means no need for waste water treatment plant and less land for ash storage. The reduced demand for land makes the overall cost including lining of ash retention ponds less expensive.
Save money: less equipment requires reduced capital and O&M costs and reduced power consumption.
Bottom ash completely converted into fly ash, with same ash grain size distribution and lower LOI, results in a higher saleability of the ashes.
Save Energy: The MAS® system requires about 5 times less auxiliary energy since it is no longer needed to move air as it was required for a conventional fly ash pneumatic system. Similarly it is also no longer necessary to recirculate water. Ash can be handled into ash ponds by conveyor belts with a minimum quantity of water just enough for dust suppression .
The MAS® properly addresses the demand of coal-fired power plants for sustainable practices in ash handling. Dry coal combustion by-products can directly contribute to the effort towards the request of the most environmentally sound method of disposal. Ash reuse offers reduction of greenhouse gas emissions, conservation of natural resources. Safe and beneficial use of dry ash should be viewed as a preferred alternative to ash ponds avoiding the need for additional landfill space through sound technical and environmental management practices.

MAGALDI ASH SYSTEM TECHNOLOGY

MAC®-MAR: HANDLING AND CONVERSION OF BOTTOM ASH INTO FLY ASH

The patented MAC® (Magaldi Ash Cooler) is a unique system for dry extraction, cooling and handling of bottom ash from solid fuel fired boilers. With hundreds of references installed worldwide since 1987, the MAC® system is the world's leading dry bottom ash handling system for utility boilers. The MAC® system is allowing the dry cooling of bottom ash with a controlled amount of air; during which process, due to the favourable conditions (high temperature and oxygen), a post-combustion effect is obtained, giving a quick oxidation of the unburned fraction and consequently obtaining a strong reduction of the UBC content of the ash. The ambient air, used for bottom ash cooling and UBC post-combustion, brings back the sensible heat from the bottom ash and the post-combustion heat to the boiler allowing an overall boiler efficiency increase.
The MAR system has been developed to convert all the bottom ash in fly ash by their recirculation into the coal mills. The ashes produced can be re-

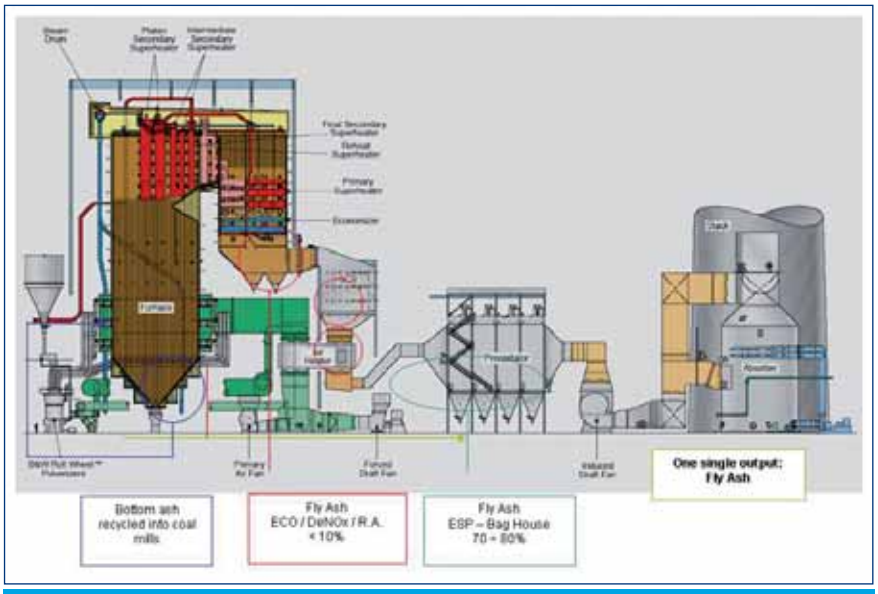


Figure 2. The integrated solution for coal ash handling "MAS® – Magaldi Ash System"

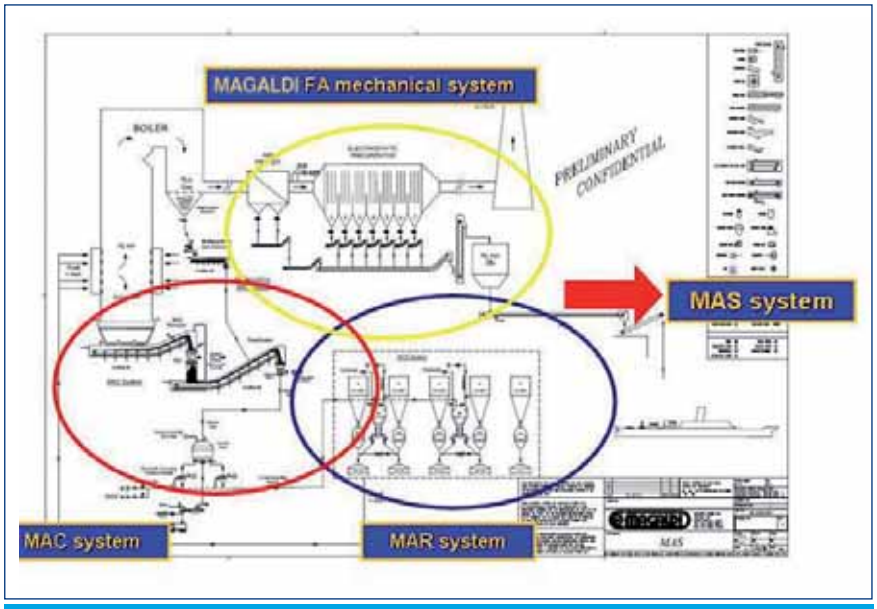


Figure 3. MAS® Flow-diagram

used in concrete preparation as a substitute of cement, according to applicable international standards. In EU these are EN 197-1:2000/A1:2004 for cement and EN 450-1:2005/A1:2007 for concrete.

As matter of fact, having only fly ash can be of beneficial effect for the power station residual management, since fly ash can be an inexpensive replacement for Portland cement used in concrete, where can actually improve strength, segregation, and ease of pumping of the concrete. Fly ash is also used as an ingredient in brick, block, paving, and structural fills.

Fly ash concrete was first used in the U.S. in 1929 for the Hoover Dam in USA, where engineers found that it allowed for less total cement. It is now used across the world. Consisting mostly of silica, alumina and iron, fly ash is a pozzolana, substance containing aluminous and siliceous material that forms cement in the presence of water. When mixed with lime and water it forms a compound similar to Portland cement. The spherical shape of the particles reduces internal friction thereby increasing the concrete's consistency and mobility, permitting longer pumping distances. Improved workability means less water is needed, resulting in less segregation of the mixture. Although fly ash cement itself is less dense than Portland cement, the produced concrete is denser and results in a smoother surface with sharper detail.

An application of the MAC®-MAR dry bottom ash handling system therefore determines at the same time:

- The elimination of water from the bottom ash handling process;
- The elimination of wet hoppers or SCC and their ash dewatering systems;
- Reduced need of ash ponds since the only single coal combustion by-product is fly ash;
- The elimination of waste water treatment plant;
- Higher quality of fly ash produced thanks to the carbon content dilution effect of recycled bottom ash;
- The possibility to use bottom ash as a saleable product for cement and concrete industry, giving the highest added value;
- Increased boiler efficiency, due to the recovery of heat and chemical energy from the ash;
- Less energy consumption – no need for water pumps or air compressors;
- Increased safety for operators;
- Reduction of CO_2 (Carbon Dioxide) emissions connected to the boiler increase of efficiency and strong reduction of auxiliary power.

MAGALDI ECOBELT TECHNOLOGY FOR MECHANICAL ECO, AH AND FLY ASH TRANSPORTATION

The "ECOBELT" is the most reliable mechanical conveyor for ECO, Air Heater (AH) and fly ash, based on the Magaldi Superbelt® technology (widely proven in more than 500 severe applications in hot and abrasive material handling).

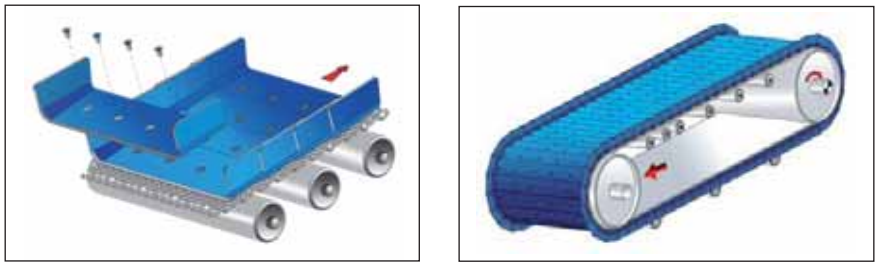


Figure 4. Magaldi Superbelt®

Figure 5. Magaldi ECO Ash System

A typical configuration is made by a series of ECOBELT conveyors that receive the ashes from the Electrostatic Precipitators (ESP) pick-up-points properly metered by the installation of specially designed rotating valves. An ECOBELT collector conveyor receives the ash from each one of the Ecobelt conveyors installed underneath each row of the ESP and feeds a bucket elevator to convey the fly ash first to a temporary storage buffer "Unit Silo" and then to a final storage silo (typically of thousands cubic meters).

The Magaldi Superbelt®, totally enclosed in the ECOBELT conveyor sealed steel casing, thanks to its unique design, is able to transport ashes with no wear because there is no relative motion between the material handled and the belt.

The Magaldi Superbelt® is made up of a steel mesh belt which partially carries overlapping steel pans forming a virtually sealed belt conveyor. The patented method of connecting the pans to the mesh belt leaves all components free to expand in any direction, without permanent deformation. As a result, the Magaldi Superbelt® withstands temperatures higher than any known competitive conveyor.

The Magaldi Superbelt® is supported by carrying idlers across the entire width, in order to withstand heavy mechanical impacts. All idler bearings are fitted outside the casing to protect them from heat and allow easy lubrication. The driving force is transmitted by friction between the head pulley and the belt, while a pneumatic take-up device on the tail pulley supplies a constant tension.

The ECOBELT is able to smoothly transport fly ash with neither the possibility that dust will be released to the surrounding equipment areas nor that any material will clog the system. Due to its unique design, conveyor maintenance operations can be performed without any safety risk to the personnel. Fines recovery devices are hinged onto the steel belt that, on its return part, sweeps the fines settled onto the conveyor casing floor up to the O-Chain chute. The O-Chain system then recovers the fines from the bottom of the casing and discharges them again onto the belt.

The O-chain system interfaces with ECOBELT conveyor in two sections: one arranged at the bottom of the casing and one on the ECOBELT cover.

The Magaldi ECOBELT conveyor can be easily fed by the material in more than one loading point, thus it is possible to fit only one conveyor per single row of fly ash hoppers.

The ECOBELT, when compared to other conveying systems, in particular to pneumatic ones, is characterized by the capacity to transport the material with a higher level of reliability, no matter how hot and abrasive the ash could be, with a considerably lower power demand. Problems related to pneumatic dense phase systems, like difficulties to start conveying with a full pipe, are completely overcome.

PNEUMATIC VS. MECHANICAL SYSTEMS: DIRECT COMPARISON

As an example, the operation of an existing coal fired 660 MWe unit has been analysed and used for a comparison between the pneumatic and the mechanical handling of ashes. This unit, burning imported coal, has a total ash production of 22,4 t/h (see table below).

Electrical power output	660 MWe
Coal feed rate:	160 t/h
Coal ash content:	14%
Overall coal ash produced:	22,4 t/h
Fly Ash produced:	20 t/h (approx. 90% of total ash)

Nowadays an increasingly important

parameter to be considered for fly ash conveying system is power requirement. When comparing a pneumatic conveying system to a mechanical one, assuming the same ash capacity and the same plant layout, there is a dramatic difference of 1 to 5 in terms of adsorbed power, in favour of the mechanical system.

The existing pneumatic fly ash handling system installed on the unit is made by the following sub-systems:

1. Fly ash transportation from bag-filter hoppers (FF), air heater hoppers (AH), and bottom ash (BA) up to a "Unit Silo" of approx 30 m^3: Pneumatic – dense phase – 18 t/h
2. Ash transportation from "Unit Silo" to "Final Storage Silos" 3 x 12.000 m^3: Pneumatic – dense phase – 150 t/h

The fly ash produced by the boiler is conveyed by a dense phase pneumatic system. Two screw compressors are used with 450 kW/each of installed power, providing the necessary conveying air. After a determined period of observation and power meter readings, the following power average absorptions have been determined:

HOURLY POWER CONSUMPTION OF COMPRESSORS FOR FLY ASH PNEUMATIC TRANSPORT

	Hourly Average power
Compressor n. 1	317 kW
Compressor n. 2	220 kW
TOTAL POWER	**537 kW**

Applying a Magaldi ECOBELT conveyor for a mechanical transportation system will first of all improve the reliability of the removal process: fly ash settles into the collecting hoppers, where, at their outlet, a slide gate valve is arranged to separate the hopper from the downstream equipments. Another strong advantage of the Magaldi ECOBELT is that due to the large width of the Superbelt used (from 650 to 1000 mm) the ash hoppers outlet dimension can be of larger dimensions (if compared to the dimensions necessary for a pneumatic intake), thus reducing the possibilities of plugging.

The PLC, acting on the high level signal either on the pressure signal coming from the hopper, activates the opening/closing sequence of the slide gate valve. A rotary feeder doses the fly ash to the downstream Magaldi ECOBELT conveyor.

The fly ash from ESP and ECO is then transported by a series of Magaldi ECOBELT conveyors to the unit silo. A bucket elevator lifts the fly ash up to a suitable elevation and loads n. 3 air slide system (with n. 2 discharge slide gate valves) feeding the final storage silo.

The power requirement for the mechanical system, covering the same distance of the pneumatic one is as follows:

EVALUATION OF ABSORBED POWER FOR A FLY ASH MECHANICAL HANDLING SYSTEM

	Hourly Average power
Conveyors motors (Σ)	50 kW
Filters motors (Σ)	25 kW
Fans motors (Σ)	15 kW
TOTAL ABSORBED POWER 90 kW	

The expected energy saving due to the installation of mechanical conveying system for fly ash, instead of a pneumatic conveying system will be:

EVALUATION OF ABSORBED POWER SAVING

Pneumatic System	537 kW
Mechanical System	90 kW
Operational period	7000 h
TOTAL POWER SAVING	**3,129 MWh / year**

These energy savings will also consent a reduction of CO_2 emission, estimated as 2,190 tons per year.

Multiplying these savings for the operational life of the plant is giving the complete scenario of all the advantages in changing a pneumatic system with a mechanical one (almost 100 GWh saved as well as 66.000 t of CO_2 avoided over 25 years). At the same time Magaldi offers with this solution an effective method to reduce the harmful environmental impact of coal ash, allowing its complete reutilization as by-product, as well as the elimination of water use for all ash handling process at coal fired power stations.

More detailed data relevant to estimated cost savings are shown in the tables 1 and 2.

The implementation of the MAS® technology will then lead to the following benefits:

1. Only one integrated system for coal ash handling and storage;
2. Production of only one coal combustion by-product with the highest added value which can be certified;
3. Higher quality of fly ash produced thanks to the carbon content dilution effect of recycled bottom ash;
4. Elimination of water from the cooling and transportation process of bottom and fly ash;
5. Elimination of waste water treatment plant, serving bottom and fly ash handling systems;
6. Auxiliary power consumption reduction for ash handling;
7. Global plant efficiency increase (boiler combustion efficiency increase and auxiliary power consumption decrease) associated with coal consumption saving and CO_2 emission decrease;
8. Reduction of maintenance operations and spare parts for ash handling system;

Last but not least, MAS® consents the optimization of the final destination of ash.

CASE 1 - common ash pond both for fly and bottom ash:

Less space requirements (or, on the other hand, a longer storage time, if the ash pond volume is existing) for ash disposal having only fly ash in dry state. In case of ash slurry systems the ash pond receives a significant amount of transportation water thus reducing the ash pond storage capability.

CASE 2 - two separate ash ponds for bottom and fly ash:

Complete elimination of one ash pond

and use of the other existing ash pond with higher storage capability (one stream of ash from the power plant requires only one storage pond).

CASE 3 - ash pond for bottom ash and fly ash sold as concrete addition or for blended cement production:

Fly ash selling revenues are increased thanks to the bottom ash conversion into fly ash and complete elimination of bottom ash pond.

MAS® REDUCES THE FOOTPRINT OF COAL ELECTRIC GENERATION

Dry coal ash handling represents a series of innovative technologies for the world wide market and the more efficient and ecological way to remove and handle the ash produced by the coal combustion.

Applying the MAS® technology can dramatically reduce the water usage and pollution, allowing the recycling of ash in other industrial fields and reducing the environmental impact of the coal fired boilers.

As it was described, the MAS® reduces water consumption, CO_2 emissions and makes easier the complete utilization of coal ash.

Finally, the application of a MAS® integrated system is strictly following the indication given by environmental legislation and technical standards, to consider coal fly ash as a usable and profitable raw material for the obtainment of several products, with particular relevance in the concrete and cement production. In those cases, along with the above mentioned benefits by the MAS® technology implementation, the power station could potentially achieve the complete saleability of coal ash produced as one single stream of fly ash. The complete recycling and utilization of coal ash is a significant step forward in reducing the footprint of coal electric generation.

COST SAVINGS ESTIMATION DUE TO REDUCED ABSORBED POWER PER 660 MWe UNIT

	Existing pneumatic system	Magaldi FAS
System 1 (from filters to silos)	537 kW	**90 kW**
Estimated power saving: **447 kW**		
Estimated power saving per year (7.000 h): **3129 MWh**		
Estimated power saving in twenty-five (25) years: **78.225 MWh**		
Estimated energy cost saving in 25 years (@ 70 €/MWh): **5,48 M€**		
System 2 (from silos to ship)	1260 kW	**130 kW**
Estimated power saving: **1130 kW**		
Estimated power saving per year (assumed 900 h): **1017 MWh**		
Estimated power saving in twenty-five (25) years: **25.425 MWh**		
Estimated energy cost saving in 25 years (@70 €/MW): **1,8 M€**		
TOTAL ESTIMATED ENERGY COST SAVING (system 1 + system 2) in 25 years		**7,3 Million**

Table 1

COST SAVINGS ESTIMATION DUE TO CO_2 REDUCTION PER 660 MWe UNIT

	Existing pneumatic system	Magaldi FAS
System 1 (from filters to silos)	537 kW	**90 kW**
Estimated power saving in twenty-five (25) years: **78.225 MWh**		
Estimated CO_2 saving in twenty-five (25) years: **54.758 tons**		
Estimated energy cost saving in 25 years (@ 20 €/MWh): **1,1 M€**		
System 2 (from silos to ship)	1260 kW	**130 kW**
Estimated power saving in twenty-five (25) years: **25.425 MWh**		
Estimated CO_2 saving in twenty-five (25) years: **17.800 tons**		
Estimated energy cost saving in 25 years (@70 €/MW): **0,36 M€**		
TOTAL ESTIMATED CO_2 COST SAVING (system 1 + system 2) in 25 years		**1,5 Million**

Table 2

(*) For deeper details about boiler efficiency increase due to MAS® technology implementation please refer to page 35.

Abbreviation:
WIH: Water Impounded Hopper;
SCC: Submerged Chain Conveyor;
HCS: High Content Slurry

MAR (Magaldi Ash Recycling): an innovative system to turn bottom ash into fly ash in coal-fired power plants

by **Daniele Ricci** *R&D Engineer* daniele.ricci@magaldi.com

In the last years the respect for the natural environment has emerged as the most serious sustainability issue for most of the power plants in the world. High rates of energy consumption and lack of space for safe disposal of huge volumes of solid, liquid and gaseous wastes generated by the Power Sector has triggered climate changes that are potentially devastating life on planet earth.

Burning fossil fuels in power plants throughout the world is amongst the largest source of CO_2 emissions. Besides energy, a variety of different kinds by-products are also obtained from the combustion of coal, in particular fly and bottom ash, which are inevitable at coal-fired boilers due to the presence of refractory mineral matters and of some components in the fuel, as the combustion is slower and incomplete.

Among the coal combustion products (CCPs), fly ash is highly effective in reducing the carbon footprints associated with the use of Portland cement clinker, which is the principle ingredient of modern cements.

International standards regulate the possible uses of coal combustion ash as a constituent of cement and concrete: in the EU these are the EN 197-1:2000/A3:2007 for cement and the EN 450-1:2005/A1:2007 for concrete.

Therefore, instead of being considered a waste, coal ash can be used beneficially and considered as a source of a usable and valuable by-products that cost-effectively improves the quality of many building materials while creating significant environmental benefits.

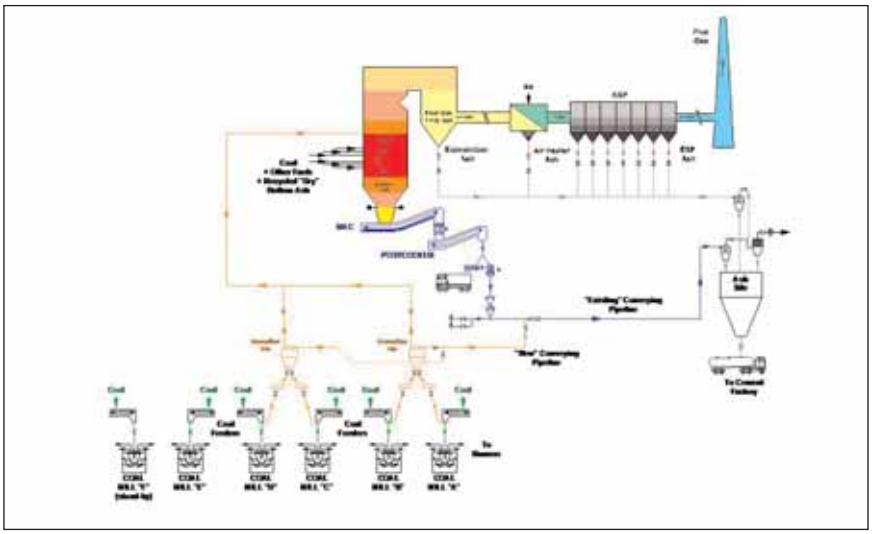
In order to reduce these environmental impacts as much as possible and to make ash usable in the cement industry and in the concrete production, Magaldi Power S.p.A. has developed and patented a system that is able to extract, cool and recycle the coal bottom ash into the combustion chamber. This new system combines the MAC® Magaldi Ash Cooler system and its development, called MAR Magaldi Ash Recycling system, thus resulting in an integrated ash handling system. The MAC® system allows to extract, convey and cool the bottom ash of a solid fuel fired boiler in a completely dry way, while the MAR system recycles dry bottom ash into the combustion chamber turning it into fly ash.

In 2007 the first two industrial applications of the MAR system were deployed in the Fiume Santo power plant (Units #3 & 4), owned by E.On Italia and located in a delicate natural environmental area in the North-Western part of Sardinia. The pulverized coal-fired Units #3 & 4 have a 320 MWe nominal power each. The tangential boilers burn imported coals and are equipped with six burner levels fed by Raymond XRP 783 coal bowl mills.

Few years earlier, in 2003, two MAC® Magaldi Ash Cooler systems were successfully installed under the mentioned Units # 3 & 4. The dry systems brought significant advantages, providing solution to environmental problems thanks to the elimination of any water usage for the ash processing, thus providing the simplest and most reliable way to solve the problem of complying with new stringent environmental regulations.

The MAR system generally consists of the following equipment:

- A pneumatic conveying system, placed downstream a mill and used to convey bottom ash to the recep-



MAC®-MAR system flow-diagram

A Reception Bin of the MAR System

tion bins. Reception bins, that temporarily store bottom ash to be recycled. The finest fraction is directly drafted into the combustion chamber or the flue gas ducts (due to the negative pressure), while the coarse ash fraction is dosed to the coal feeders. Each bin is provided with two separated discharge ducts, one per single coal mill.

- Vibro-feeders, that extract the ash from the reception bins and then dose it in the coal mills. The ash feed rate per each coal mill is automatically adjusted as the corresponding coal feeder rpm managing as constant as possible the ash-to-coal ratio.
- A vent connection per each reception bin to draft the conveying air and the fines into the combustion chamber or the flue gas ducts.
- Pneumatic valves, installed at each vibro-feeder discharge point and on the vent pipes.

The coal and coarse ash blend is then pulverized and conveyed by the primary air to the coal burners to be injected in the combustion chamber: the pulverized bottom ash is finally turned into fly ash.

After the MAR system installation in the Fiume Santo power plant, some experimental activities were carried out with the following aims:

- Coal mill wear rate evaluation.
- Fly ash (produced with MAR system in operation) certification in compliance with the European standard EN 450-1:2005/A1:2007.

Regarding the first issue, after a two-year observation period on the coal mill grinding rolls, a wear rate increase of only +2.2% has been observed. This wear rate deviation has been evaluated with a bottom ash average rate equal to ~1.0 t/h, meaning an ash-to-coal ratio approx. of 1.1% on each coal mill. Moreover, the checks carried out on the coal mill classifiers have shown no appreciable wear differences. The same remark can be done on the boiler burners after the going-over in January, 2008. Regarding the pulverized coal line, there has been no significant difference between the measured and the expected wear.

The implementation of the MAR system has gained a further challenge demonstrating that there has been no impact on the fly ash properties due to the bottom ash recycling. All fly ash and recycled bottom ash in compliance with the European standards are recognized as a valuable product for the cement and concrete industry.

Therefore, through the MAR system, bottom ash is not considered a coal combustion waste any more but a marginal benefit product as it has been turned into fly ash.

The MAR system may be installed in every coal-fired power plant depending on the boiler size, the available dimensions, the coal types, the ash characteristics and the local environmental laws.

The MAR has many advantages over other systems and allows these benefits:

- Conversion of all bottom ash into saleable fly ash.
- Complete elimination of costs associated with bottom ash disposal.
- LOI (Loss On Ignition) content reduction in fly ash due to dilution effect.
- Fly ash in compliance with international standards. In the EU these are the EN 197-1:2000/A3:2007 for cement and the EN 450-1:2005/A1:2007 for concrete (LOI 5% and fineness 40% by mass as oversized particles on a 0.045 mm mesh sieve when wet sieved).
- Environmental benefits occur from mixing fly ash with cement, thereby reducing the production of cement and leading to a decrease in CO2 emissions that would have been produced without using fly ash as a “type II addition” (approximate reduction of 0.9 tons of CO2 for each ton of fly ash used).

BOILER IMPROVEMENT

The Magaldi ECO Ash System for Economizer "pop corn" ash transportation

by **Alfonso Pirro** *Area Manager* alfonso.pirro@magaldi.com

Handling economizer ash presents several challenges due to a combination of ash characteristics, high calcium oxide content, high unburned carbon content and coarse particles that are prone to forming clinkers. Magaldi can successfully meet these special requirements thanks to the ECO Ash system.

Most of the ash (70–80%) from a pulverized coal-fired boiler is carried through the boiler and the air heater by flue gas. When flue gas abruptly changes its direction, generally the fly ash drops out of the flue gas. This phenomenon typically happens downstream of the economizers banks and the air heaters.

Fly ash (around 5% of the total) removed from the economizer hoppers tends to contain larger particles along with fine dust, like ash collected in the air cleaning devices. The larger particles, called *pop-corn ash*, may contain concentrations of unburned carbon. Because of the high gas temperatures at these points, the ash may tend to sinter and become difficult to be removed if permitted to sit for long periods. For these reasons, it is common to continuously remove the ash from the economizer hoppers so the tendency to sinter is eliminated and the ash remains primarily as a fine dust with some pop-corn ash particle.

The Magaldi ECO Ash System is specifically designed to collect the ash from the economizer hoppers and to convey it in a complete mechanical way to a disposal site. The system allows to perform the economizer ash handling with the lowest wear phenomena on the equipment, meaning a very low maintenance charge.

Further advantages of the mechanical conveying compared to the pneumatic systems are:

- easy removal of ash conglomerates that frequently form during operations;
- a significative reduction in power consumption;
- reduction of CO2 emission due to energy savings.

The system is designed to operate under any boiler condition in a completely automatic way, meaning no personnel need.

The ash is collected in each economizer hopper, through a pneumatic slide gate valve and discharged onto a Magaldi ECOMAG steel belt conveyor by a counterweight flap valve.

At the operation start, the first hopper pneumatic slide gate valve is automatically opened. The material column weight will cause the opening of the downstream counterweight flap valve that will gain the closure position at the ash discharge end. The flap closure will give a signal that will close the upstream pneumatic slide gate valve and will open the following one in order to start the next hopper's discharge.

At the last pneumatic slide gate valve closing, before a new discharge cycle, it's necessary to wait a delay time of about 10 minutes in order to allow the passage of the ash (coming from the last hopper) under the hopper No. 1 outlet point.

During normal operations, the pneumatic slide gate inlet valve is normally closed while the ash continues to accumulate in each ash hopper. The system logic control periodically activates the ash hopper unloading (one by one) onto the steel belt conveyor. During each economizer ash extraction cycle, the system conveys the ash up to the final discharge point. When the main conveyor is running, the pneumatic slide gate inlet valve is opened and the tilting counterweight outlet valve remains naturally opened under the load of the ash columns, the pneumatic slide gate inlet valve is closed. After the pneumatic slide gate inlet valve closing, the weight of the ash itself causes the tilting outlet valve opening and the ash discharging onto the main steel belt conveyor.

The ECO ash system basically consists of one or two Magaldi ECOMAG conveyors. The belt conveyors collect the ash at the economizer hopper discharge points and either unload it in a temporary storage silo or usually add it to the MAC® dry bottom ash system. In that case the ash is discharged in this bottom ash silo, avoiding therefore a dedicated silo and its relevant discharging equipment.

Improving boiler efficiency from the bottom up

by **Fulvio Bassetti** *Technical Manager* fulvio.bassetti@magaldi.com

Although the MAC® system is a well proven technology for the dry extraction of bottom ash from pulverized coal boilers, its developer Magaldi decided to conduct a rigorous assessment in accordance with the ASME PTC 4-1998 standard to demonstrate the technology's ability to improve overall boiler efficiency compared to a traditional wet bottom ash system.

As an alternative option to the traditional wet bottom ash system (WBAS), the MAC® system is a well proven technology for the dry extraction of bottom ash from pulverized coal (PC) boilers of any size and burning any type of coal. The MAC® system, which was developed by Magaldi in the early 1980s, is now one of the most referenced systems on the market, with more than 127 units in operation.

One of the most important effects related to the use of the MAC® dry bottom ash technology is its impact on the boiler efficiency. When a MAC® system is used instead of a WBAS, the overall efficiency of the boiler has been demonstrated to improve, primarily because of the use of air as the ash cooling medium rather than the use of water.

To evaluate the overall impact of the MAC® system on the boiler efficiency, Magaldi decided to use a calculation-based method that strictly adhered to the ASME PTC - 4 1998 Fired Steam Generators, which is the widely accepted performance test code for determining boiler efficiency.

This article briefly illustrates the basis of the calculation method used and presents the main results, using formula and values specified in the ASME PTC 4 - 1998 to compare all relevant heat losses and credits obtained when a boiler is equipped with a MAC® system rather than a WBAS.

Although differences in all heat losses and credits are evaluated, particular attention was paid to three process parameters that have the greatest influence on efficiency, namely the impact on heat losses in the lower part of the boiler, the impact of cooling air on the heater performance and the impact of the MAC® system on unburned carbon in the bottom ash.

ASH COOLING PROCESS

In a typical arrangement of a WBAS, submerged chain conveyor (SCC) type, located below the boiler, a hydraulic seal prevents that any air enters the boiler throat. There is no difference in terms of boiler efficiency between a WBAS SCC type or an impounded water hopper (IWH) type. Figure 1 focuses on the lower part of the boiler, where bottom ash crosses the boiler throat at quite a high temperature and falls into the water. This bottom ash then leaves the SCC wet and at a low temperature. Some water flows in and out of the SCC are necessary to keep the water in the pit at a suitable temperature (approximately 50 °C). A small amount of water evaporates and infiltrates the furnace, and this water evaporation rate can be estimated at around 7.5 per cent of the bottom ash rate (BA).

The situation is different in a MAC® system, where the bottom ash is cooled by MAC® cooling air (MCA) entering the MAC® extractor – due to the furnace negative pressure – through properly sized air intake valves (Figure 2). The system is designed to maximize the counter-current bottom ash cooling. Following the air/ash heat exchange the cooling air enters the furnace through the boiler throat at quite a high temperature.

It has been demonstrated by tests performed in units retrofitted with a MAC® system that the cooling air contributes to the combustion process in exactly the same way as the other combustion air provided that the MCA is restricted within certain limits· The ash discharge temperature from the

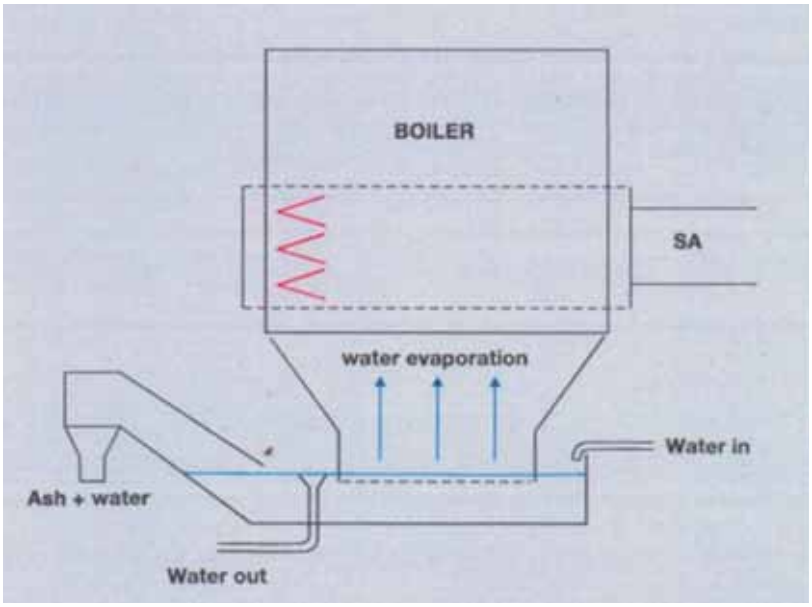


Fig. 1 In a WBAS, submerged chain conveyor (SCC) type, the ash leaves the SCC wet and at A low temperature

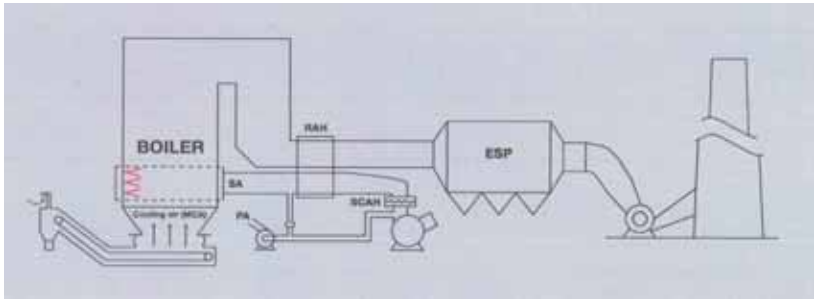


Fig. 2 The MAC® system, where the bottom ash is cooled by air, has been designed to maximize counter-current cooling

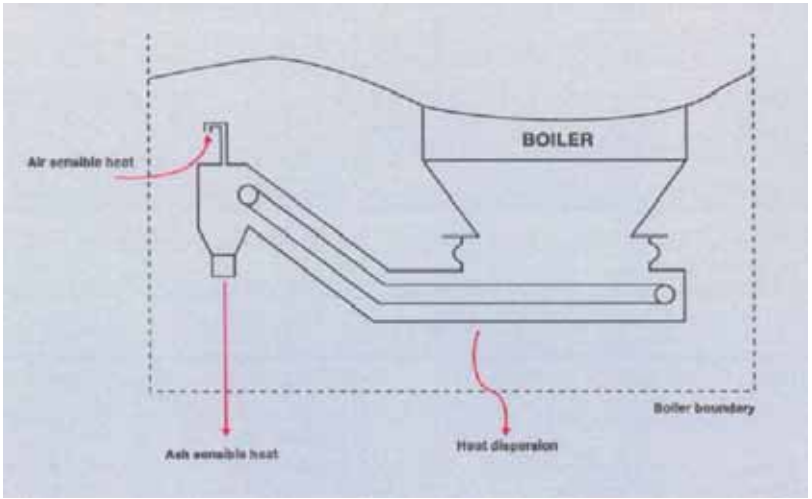


Fig. 3 Parameters required for evaluating the ash pit loss in a MAC® installation

system varies on a case by case basis as a function of the bottom ash rate, the cooling air rate, the MAC® system geometry, ash grain size distribution and other secondary factors. Bottom ash cooling can be completed in the downstream part of the MAC® system (post-cooler, contact cooler, etc) as required in each case. The counter-current heat recovery continues in this downstream part of the MAC® system.

PARAMETERS INFLUENCING BOILER EFFICIENCY

As outlined above the MCA mainly impacts on three boiler parameters, namely unburned carbon (UBC) in the BA, heat recovery in the lower part of the boiler and flue gas temperature. These in turn influence overall boiler efficiency. The MCA enters the boiler throat at a quite high temperature (normally between 400-500 °C) because of the heat recovered by the bottom ash cooling. This high temperature air creates a hot and oxidizing atmosphere in the lower part of the boiler (immediately above the boiler throat), which produces a strong reduction in UBC (normally in the order of 80-90 per cent). Such UBC reduction has been confirmed by specific site tests by measuring UBC content from bottom ash samples before and after the retrofit of a WBAS with a MAC® system. This is clearly a positive contribution to the boiler efficiency increase, since the heat loss associated with UBC in the bottom ash is significantly reduced.
In a WBAS, the energy crossing the boiler throat (both as radiation flux and as ash heat content) is dumped in the water, resulting in a significant heat loss. In contrast, with a MAC® system the MCA returns a large part of the energy crossing the boiler throat to the boiler because of the ash/air heat exchange reducing the heat loss from the lower part of the boiler. Again this makes a positive

contribution to increasing the overall boiler efficiency.
Finally, as mentioned previously the MCA makes up part of the combustion air so consequently the combustion air to the burners is correspondingly reduced. At the same time, this reduces the air crossing the air heater, and because of this the air heater sees the same volume of flue gas (valid in first approximation) but with a reduced air rate, which produces an increase of the flue gas exit temperature. Contrary to the two process parameters above, this will make a negative contribution to the increase in boiler efficiency.
Having said that, if one looks at the aggregate effect of the MCA on these three process parameters, the impact of a MAC® system on overall boiler efficiency is always positive compared to a WBAS.
However, because of the difficulty in predicting the increase in the flue gas temperature, coupled with healthy scepticism, some clients have expressed concern relating to this statement. Thus, Magaldi decided to respond to this concern by using a rigorous method in compliance with ASME PTC 4 - 1998 Fired Steam generators performance test code to demonstrate that the MAC® system did indeed improve overall boiler efficiency.

HEAT LOSSES AND HEAT CREDITS

The use of ASME PTC 4 - 1998 as a method to compare two different configurations, i.e. WBAS and MAC®, required a completely new formulation of the problem by calculating all boiler parameters affected by the change from a WBAS to MAC® technology, as indicated in the Chapter 5.14 of the code.
In order to calculate the boiler efficiency, all pertinent heat losses and heat credits had to be considered as per the ASME code. The two areas most affected by the introduction of the MAC® technology are the lower part of the boiler and the air heater. The physics of the dry technology had to be duly introduced into the ASME code framework.
The calculation was further complicated by the need for iterative calculations because of two reasons.
Firstly, the prediction of the air and flue gas temperature at the air heater outlet. This prediction had to be performed by running the air heater code in two different situations. After a number of checks with the results of the air heater code, a correlation was found to forecast the air heater exit temperatures, which corresponded with the output of the air heater code.
Secondly identifying the basis of the right comparison, which was found to be the same 'gross power output': assuming there is an efficiency improvement with the MAC® system the coal rate to the boiler will be lower. Although the effect is small it has important downstream implications, i.e. less coal means less combustion air and flue gas, which in turn reduces the pressure drop in the main ducts and pressure differential between the air heater, and consequently reduces the air heater leakage. The latter contributes to a further reduction in the air to the air heater, and so on, which partially reduces the negative impact of the increase in the flue gas temperature.
As in regards to the heat recovery in the lower part of the boiler, it should be noted that while the ASME PTC 4 - 1998 provides specific information and rules to evaluate the 'ash pit loss' for a WBAS, there is no guidance on how to perform the same balance in the lower part of the boiler fitted with the MAC® technology. However, by following the spirit of the ASME PTC 4 - 1998, the ash pit loss in a MAC® installation can be achieved by outlining a boiler boundary as illustrated in Figure 3 and performing a heat balance calculation as follows: ash pit loss = ash sensible heat + heat dispersion – air sensible heat.
It should be noted that in an energy balance comparison it is not only boiler efficiency that is affected by a switch from a WBAS to a MAC® system. Boiler auxiliary power consumption is also affected due to the change in the coal rate, the combustion air rate and the flue gas rate and temperature: the power consumption of all the running equipment in these lines is affected.

CONFIRMING BOILER EFFICIENCY INCREASE

Conducting the above mentioned calculations is a long and time consuming process so Magaldi devised a spreadsheet containing relevant instructions and illustrations of the formula utilized. Such a tool is important not only because it makes it easier to evaluate what the efficiency improvement and the auxiliary power saving can be, but it is possible now to simulate different operating conditions (variations in bottom ash rates, UBC content, cooling air rates, etc) and find what is the MCA value that maximizes the improvement, while also optimising the ash cooling process.
By rigorously following the ASME PTC 4-1998 code when calculating boiler efficiency improvement through the substitution of a WBAS with a MAC® system, Magaldi has been able to confirm that its MAC® dry technology produces an increase in the overall boiler efficiency.
In Magaldi's experience, the boiler efficiency improvement seen by switching from a WBAS to a MAC® system normally falls within the 0.1-0.5 per cent range, depending mainly on the coal quality. Normally, poor coals give better boiler efficiency improvements because of the higher ash quan-

tities generated and relevant higher heat losses associated to them when using a WBAS.

The results show that the improvement of the boiler efficiency can be expected to range between 0.1-0.2 per cent for normal bituminous coals, while with high ash content coals an improvement in boiler efficiency up to or even higher than 0.5 per cent is achieved.

As a sample calculation, two typical 600 MW Units (one typical burning Indian coal [Plant A] and one typical burning imported coal [Plant B], have been investigated and the results are shown in the table below. Positive or negative effects on energy savings are shown for each heat loss and credit. The overall efficiency improvement is indicated in the final row.

The availability of a spreadsheet that easily performs all the calculation, including iterative computation due to backwards effect in some recalculated boiler parameters, has shown higher efficiency improvements than expected and discloses auxiliary power savings too.

Further, by using this calculation tool it is now possible to quickly identify the MCA value that maximizes the boiler efficiency improvement. This way, the boiler and the MAC® system can be considered integrated, creating a single system, whose overall performance can be optimized in the design phase contributing to an important efficiency recovery.

Relevant savings in terms of coal rate reductions, auxiliary power reduction, as well as other environmentally important parameters like carbon dioxide emissions and cooling water savings can be easily calculated to quantitatively appreciate, within the framework of the ASME PTC4-1998, the major benefits of the MAC® technology.

INPUT DATA		PLANT A	PLANT B
UNIT DATA			
Unit Gross Power Generation (Generator Terminals)	MW	600	660
Unit Capacity Factor	-	0.8	0.8
COAL DATA			
Ash kg/kg	0.40	0.13	
Mineral matter fraction to bottom ash	kg/kg ash	0.15	0.15
Coal high heating value	kJ/kg	14200	25960

RESULTS FOR HEAT LOSSES, CREDITS AND BOILER EFFICIENCY (according ASME PTC 4)

Dry gas loss, percent	%	0.1347	0.0875
Loss due to water from the combustion of H2	%	0.0106	0.0044
Loss due to water in the solid fuel	%	0.0045	0.0011
Loss due to moisture in air	%	0.0018	0.0012
Loss due to unburned carbon in residue (bottom ash)	%	-0.2350	-0.1077
Loss due to sensible heat in residue	%	0.0060	0.0007
Loss due to additional moisture (evaporation from ash pit	%	-0.0851	-0.0155
Wet ash pit loss or MAC® system Loss	%	-0.2467	-0.1124
Total losses	**%**	**-0.4092**	**-0.1409**
Credit due to entering dry air	%	-0.0020	-0.0015
Credit due to moisture in entering air	%	0.0000	0.0000
Total Credits	**%**	**-0.0020**	**-0.0015**
Efficiency Improvement due to WBAS/ MAC® change	**%**	**0.4073**	**0.1394**

USA

Alamo Cement clinker transportation

by **Paolo Magaldi** *Service Manager* paolo.magaldi@magaldi.com

It is not quite uncommon that a problem on a material handling system could affect the production of a cement plant: this was the case in 1995 at a cement plant located nearby San Antonio, TX - USA, Alamo Cement made some detailed analysis on the failures registered during the operation of their L07 rubber belt conveyor transporting cement clinker from a kiln cooler to a silo.

As it finally came clear that from time to time, the combination of some high temperature material spots and the abrasiveness of the clinker were the main causes for these belt failures, Alamo Cement decided to contact Magaldi to verify the feasibilty to retrofit their exisiting rubber belt conveyor with a Magaldi Superbelt®.

After a detailed survey and an accurate design performed by our engineering team, Alamo awarded Magaldi with a contract to replace their insufficiently working conveyor; and certainly the project was accomplished timely and in budget. Since the installation of the Superbelt® in 1995 it impeccably works in this cement plant eliminating completely all problems previously encountered.

Ever since, the 90-meter long conveyor has been pulling 120 tons/hour of cement clinker 24/7, which equals a total of 15 million tons of clinker transported without any major failures reported.

As a matter of fact the 15-year-old conveyor is still using the original belt that, at a speed of 0,25 m/sec, has been running for an equivalent of 108.000 kilometers since its installation and it has never yet been replaced. For safety reasons this year the plant decided to order a spare belt that will be kept in the warehouse until the next scheduled plant outage. During the outage one of our skilled Service engineers will inspect the belt to determine whether it will be necessary to replace it or not.

Magaldi is really proud of the dependability demonstrated by their Magaldi Superbelt® conveyors.

There are approximatevely 500 of them in various application ranging from cements, foundries, power plants, steel mills and all of them show the same sturdiness and reliability.

December 1995: Mario and Paolo Magaldi visiting the site.

Luxembourg

CIMALUX - AUTOMATIC clinker mill refuse transportation

by **Alberto Lalia** *Sales Area Manager* alberto.lalia@magaldi.com

The Magaldi Superbelt® conveyor has always been used in all applications where dependable equipment for the transportation of hot, abrasive, heavy material in hard conditions is necessary.

It is used in several industial sectors for heavy applications.

Since the core business of the Magaldi Group is the bottom ash handling system in coal fired thermal power plants, the Magaldi Superbelt® conveyor is used in cement factories, foundries, mines, hot DRI (Direct Reduced Iron), etc.

The last application in a cement factory, developed for the Customer CIMALUX in Luxemburg, is the transportation of the refuse coming from clinker mills. Also in this case Magaldi engineers and technicians applied experience from another field (coal mill reject conveying system) to design an equipment for the clinker mill refuse.

In the existing layout, the refuse was collected in a box through an unloading pipe which directly came from the clinker mill.

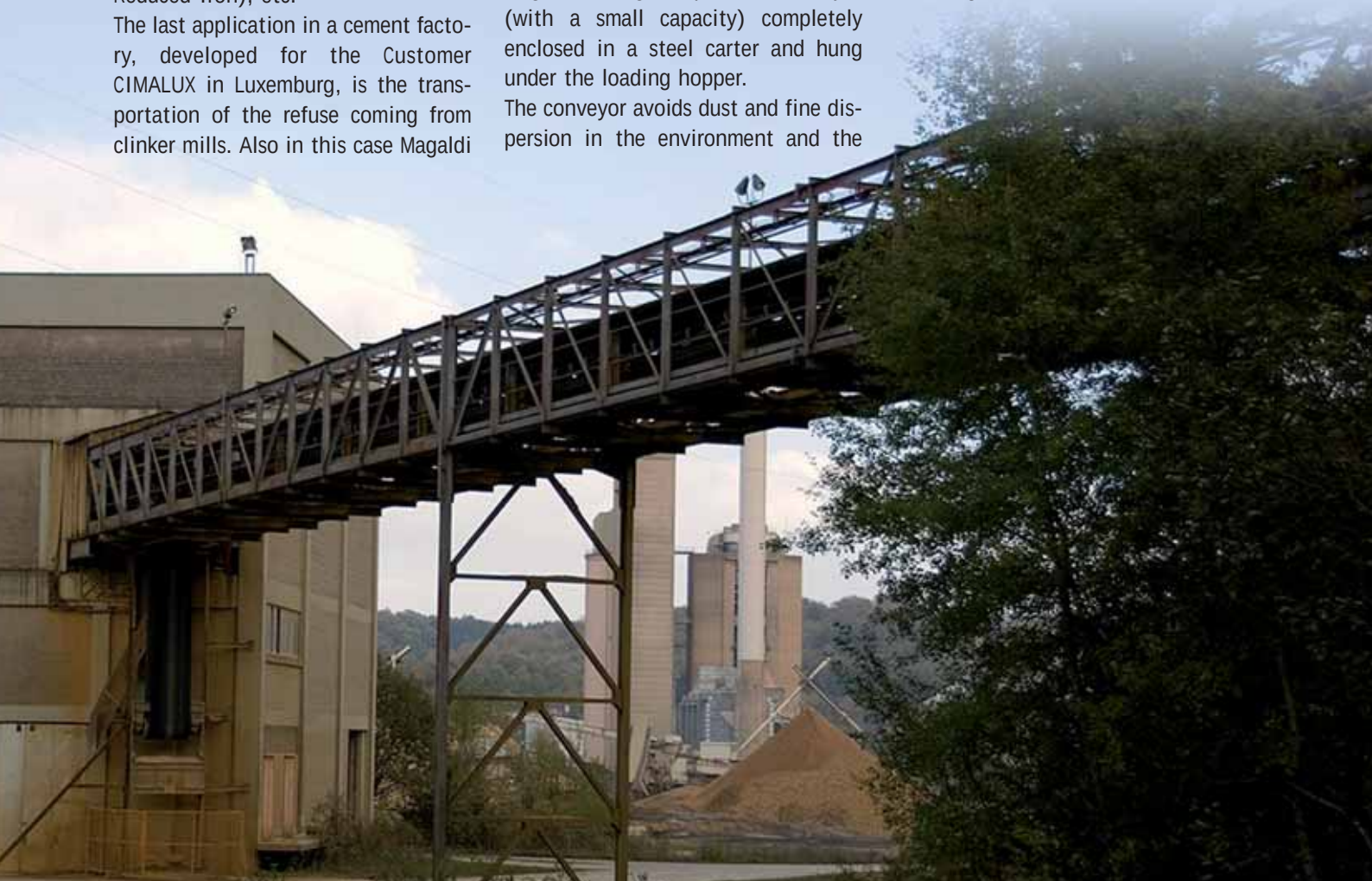
Of course the surrounding area was dusty and not comfortable for the workers that had to manually move the box once it was full, unloading the refuse in a collecting hopper.

The technical solution proposed by Magaldi is a light Superbelt® conveyor (with a small capacity) completely enclosed in a steel carter and hung under the loading hopper.

The conveyor avoids dust and fine dispersion in the environment and the material is automatically conveyed from the clinker mill to the unloading hopper. In order to avoid the wear to the unloading chute, it was lined by Hardox 400 steel plates at the impact points.

The chute is arranged to be connected to an eventual de-dusting system. It will be used in the presence of several fines due to a change of the process conditions.

Thanks to the proven dependability of the Magaldi Superbelt® conveyor, also in this case Magaldi Industrie has supported the Customer on his requests founding the best technical solution.



Sweden

VOLVO - Hot core sand and sprue transportation with magnetic separation

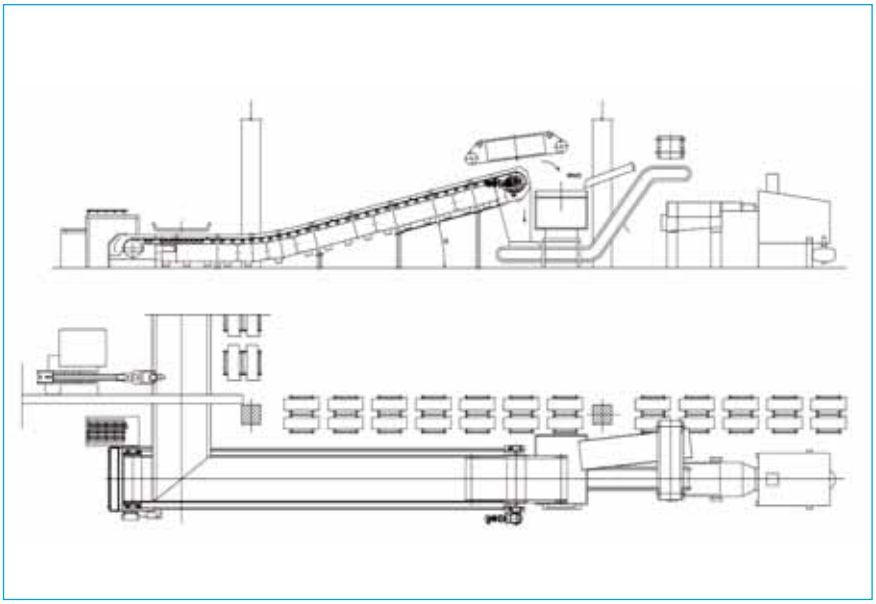
by **Alberto Lalia** *Sales Area Manager* alberto.lalia@magaldi.com

In 2008 Volvo Powertrain decided to expand its Swedish foundry based in Skovde by installing a new moulding line for the production of cylinder heads for six cylinder engine blocks.

The line will be made with unique technology patented by the Volvo Company which has already been used in the existing foundry. It allows to obtain a higher productivity with a small use of sand and a significant reduction of the cycle time.

THE PROCESS

The molds, containing truck engine heads weighing over 500 kg, fall on a vibrating conveyor that opens the core package during transportation.
At the end of the conveyor, a manipulator separates the castings from the sand and puts them on a pallet.
The sprues, approx. 1,100 mm long each, and the core sand are loaded on the Magaldi Superbelt® conveyor with a 15° slope that loads the lump braker and then the cooler loading.
The sprues are separated from the sand, by a magnetic drum with a completely automatic process, and then are loaded in a box.
For this specific application, the belt of the Magaldi Superbelt® conveyor is made of stainless steel that prevents the sprues from remaining attached to the pans.
This is the first moulding line installed in the new foundry. It is a part of a bigger project that Volvo wants to develop in the Skovde area and foresees the installation of other moulding lines in the same foundry.
For this reason a crucial target of the project was that the complete process, from electric furnaces to moulding lines, had to become compact to fit in a defined part of the building.
It was also necessary to foresee future developments of the project in order to understand how to optimize the entire process using the equipment already installed in the first line.
The Magaldi Superbelt® conveyor has been appreciated for its features to be designed in a modular way too. In the future it will probably be extended in length just adding the necessary intermediate sectors and the Magaldi Superbelt® belt.
This project confirms Volvo satisfaction with the Magaldi Superbelt® conveyors.
In fact there are three additional conveyors in operation in the Volvo foundries for sprue handling and hot core sand transportation.



The key role of Research and Development at Magaldi

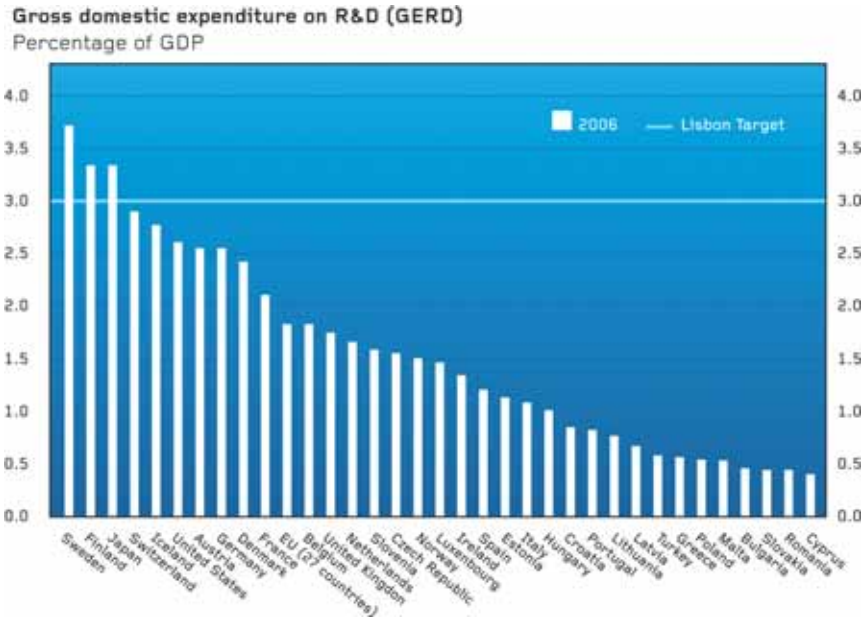
by **Monica Di Domenico** *IP department* monica.didomenico@magaldi.com

Innovation and reliability are two key words at Magaldi, and since the foundation of the company, in 1929, they have been the interconnecting guide line for technologies and products created in-house. Innovation is a very hard R&D task, intrinsically risky. Almost by definition R&D tries out new ideas to see how well they work, seeks information that is as yet unknown, and strives for application as yet undiscovered.

The development of new technologies and products at the Magaldi group, as well as managing the creations and the organization of the patents, demand a motivated team of experienced engineers and researchers. Reporting directly to the President, Mario Magaldi, is a procedure which guarantees that the company will dedicate the highest attention and the appropriate resources to the needs and results of this group. Every researcher of our team knows that he should join the creativity of a highly specialized technique, with a strong sensitivity to customer needs and market requirements.

Overall in the Italian industrial scenario, very few manufacturing companies invest in R&D like Magaldi does; looking at Italy as a whole, the country is spending only 1% of its GDP in R&D (year 2006 data), with the major part of the Italian industries more or less in line with these figures.

In the EU, in 2000 "the Lisbon strategy" has been recommended by the European Council, with the aim to transform the EU by 2010 into "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion" with an expenditure in R&D set at 3%.

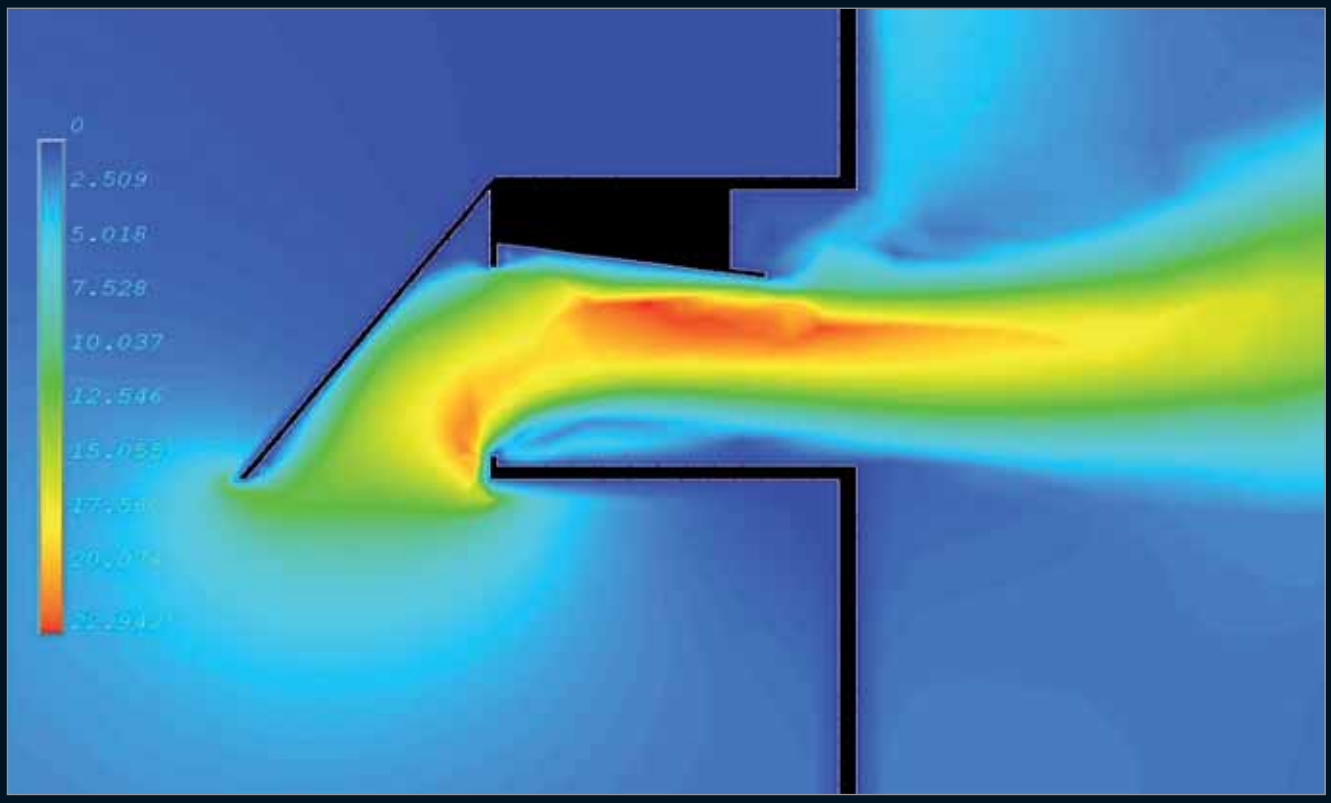


The Magaldi group, in the past years, has invested every year in R&D resources equal to an approx. 5% of its yearly sales revenues, almost double of the recommended European indication, and is continuing with this trend.

This intensive work has of course given us tangible assets and a large number of recognitions: more than 352 patents have been presented and registered, many of them related to the handling of hot and abrasive bulk materials. Moreover the Magaldi laboratory is officially accredited at the regional council "Regione Campania" for its "design, supervision, construction and installation facilities for bulk material handling and for extraction and process bottom ash out of solid fuelled boilers", carrying out theoretical and practical activities in conveying processes and techniques for "difficult" bulk materials. A dedicated space to test operations for new products and new devices has been reserved in the new Buccino plant, where the R&D team is checking and improving the characteristics of the tested products.

Many of the group innovative technologies have been developed here, in this "forge of ideas". Just to list few of

Simulation of fluodynamic effect in the MAC®



them: the MAR (Magaldi Ash Recycling system) a process to turn bottom ash into fly ash, allowing the complete sale of ash to the cement industry, the SUPERMAC, cooling and extraction system for high flow rates of coal bottom ash, the MRS (Mill Rejects System) for the mechanical handling of coal mill residuals (known as "pyrites"), the MAS® (Magaldi Ash System) which is an integrated mechanical system for the problem-free handling of all ashes produced by a solid fired boilers, and many others.
All activities are aimed to develop products and technologies that are marketable, and with solutions that connect competitiveness and reliability. The activities of a typical R&D project generally start with an accurate computerized model, first generated by a basic requirement, fed with data continuously collected from the operational parameters of hundreds of applications located all over the world and tested in the laboratory. Once a model is properly validated, a prototype is finalized and field tests planned and executed up to a satisfactory conclusion of all the simulation trials; the following step is then the industrial application of the new technology.
In this case, the R&D engineers are mobilized in the plant or factory where the first application is realized, verifying data and operational situations, collecting new data which, transmitted and analyzed in the headquarter could be used to improve the process.
Magaldi is also maintaining cooperation programs with other R&D institutions : new research programs are implemented with support and collaboration with Universities of Naples and Salerno and the National Research Council (CNR), while last year the prestigious Massachusetts Institute of Technology (MIT) has welcomed Magaldi as a member of its Industrial Liaison Program, committed to the identification and execution of specific research in the field of ash increase in value and renewable technologies, sources of major interest of Magaldi.
Magaldi is also an active member of Cotec, a government institution in charge of Italian R&D politics and for the improvement of technological competitiveness of the country. Members of this prestigious organization are important actors of R&D national scenario like ENI, ENEL, ANSALDO, ENEA, CNR, FIAT and many others.
Maintaining Innovation and Reliability at the highest level is a fundamental task for Magaldi, which focuses its main market strength in these two values, giving the ability and capacity to sustain and improve its reputation as a leader in the field of hot and abrasive bulk material handling and energy technologies.

On Wednesday November 4th, 2009 one of the largest Italian photovoltaic plants totally integrated on a roof has been inaugurated in Buccino, installed on Magaldi's workshop.

This solar photovoltaic power station architecturally integrated on Magaldi's workshop roof, is made of more than 8500 multicrystalline polysilicon modules and covers an area of about 18,000 m³. The plant is considered as one of the biggest ever located on a roof in Italy.

The installation ensures the production of about 2,500 megawatt-hours (MWh) of "clean" electricity per year, which is delivered to the national grid and consents to avoid annual emissions of one and half million kilograms of carbon dioxide (the quantity produced by fossil fuel power plants to generate the same energy) into the atmosphere. The electricity produced could cover the annual average consumption of about 1,000 families, or four times the power consumption of the workshop located below.

After the greetings of authorities, the power station was presented to a large audience with a briefing on the project characteristics; at the end of the session a tour of the plant and its main components such as panels, inverters and transformers was carried out, having specialized Magaldi personnel as guides.

After the first 2 MWp power station, the Magaldi group with its dedicated company RRS in the PV business, is willing to disseminate this type of installations onto many other sites. There are, as a matter of fact, other contracts with several non utility companies for PV systems on warehouses or workshops roofs.

These installations will help to reduce the gap of electricity produced by solar energy between Campania and other regions of Italy, some of whose (such as Trentino and Lombardia) solar radiation conditions are less favorable than the ones obtainable in this area.

Power Station site	BUCCINO (Salerno, Italy) 40,594 N 15,37 E
Power (peak)	2 MWp
Plant typology	Photovoltaic plant integrated on roof
Useful surface	18.000 m³
Number and brand of PV modules	8.500 modules of YingLi Energy Green Type YL-230 (of 230 W each)
Number and brand of inverter	8 inverter of Elettronica Santerno, Type TG 310800V
Date of connection to the grid	September 23rd, 2009
Subsidy for the energy produced	yes
Annual production	2.500 MWh

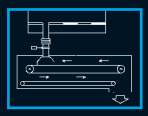
Worldwide Magaldi Ash Handling System Users

Enel
a2a
AgipPetroli
BAOSTEEL
BASIN ELECTRIC POWER COOPERATIVE
CERREY
vivendi
COLBUN
CFE Una empresa de clase mundial
CPPE Companhia Portuguesa de Produção de Electricidade, S.A.
Delta electricity
edelnor
edp
Electrabel GDF SUEZ
endesa
ENERGETIKA TŘINEC AKCIOVÁ SPOLEČNOST
e·on
Eraring energy
EVONIK INDUSTRIES
Florida Power CORPORATION
PGE Zespół Elektrociepłowni Bydgoszcz SA
GRIFFIN ENERGY
Millmerran Power
iSKEN
THE KANSAI ELECTRIC POWER CO.,INC.
KOBELCO KOBE STEEL, LTD.
hc energía
steag STEAG state power inc.
WBPDCL
cs energy generations ahead
Macquarie Generation
MPX Uma empresa do Grupo EBX
NOVA SCOTIA POWER An Emera Company
OPG
ΔΕΗ
RWE
SUMITOMO METALS
Tirreno Power
JSW
PLZEŇSKÁ TEPLÁRENSKÁ
KOREA WESTERN POWER CO., Ltd.
KOSEP
KOSEP KOREA SOUTH-EAST POWER CO.
Hokkaido Electric Power Co., Inc

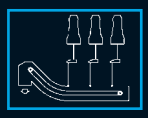
MAGALDI
Dependable technologies

MAC – Magaldi Ash Cooler
Dry bottom ash extraction system

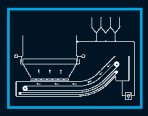
SUPERMAC
Extraction and air/water cooling system
for large quantities of heavy ashes



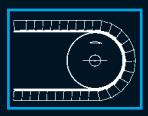
Magaldi Fluimac
Dry ash extraction system for fluid bed boilers



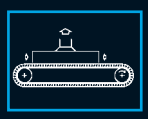
MAGALDI MRS – Magaldi Mill Rejects System
Dry coal mill rejects handling system



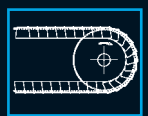
MAR – Magaldi Ash Recycling
Dry extraction and recycling of bottom and fly ash



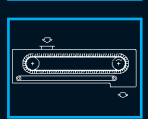
Magaldi Superbelt
Dependable steel belt conveyor



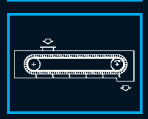
MCC – Magaldi Casting Cooler
Magaldi Superbelt for forced air casting cooling



Magaldi Superbelt PR/PRZ
Magaldi Superbelt for casting sorting over sprues

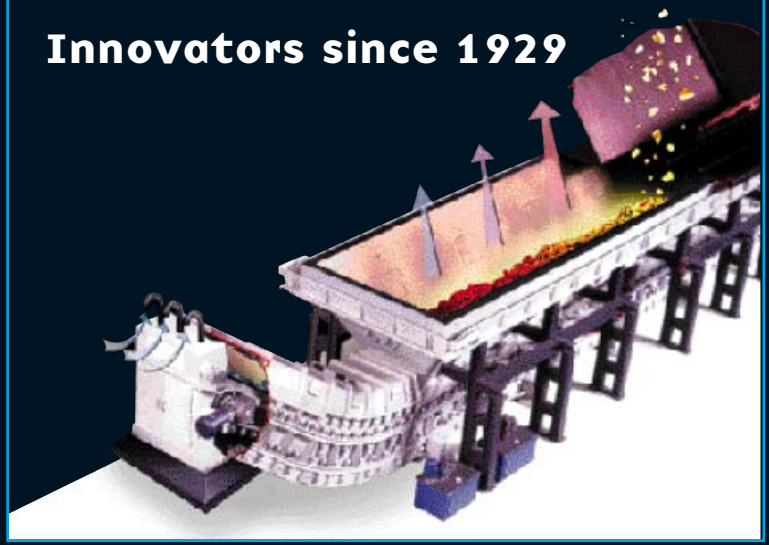


Magaldi Ecomag
Dust proof Magaldi Superbelt conveyor



Magaldi Ecobelt
Enclosed self cleaning Superbelt conveyor

Innovators since 1929



Magaldi Group:

219, Via Irno - 84135 SALERNO, Italy
ph. +39 089 688 111 - fax +39 089 481 766
ph. +39 089 489 111 - fax +39 089 274 431
group@magaldi.com

Australia General Licensee
Magaldi Power Pty Ltd
Unit 302 – 354, Eastern Valley Way
2067 Chatswood - NSW
ph. +61 2 9882 3333
fax +61 2 9882 3399
e-mail: mario.sica@magaldi.com

Germany General Licensee
Magaldi Power GmbH
Boschstr. 10
73734 Esslingen, Germany
ph. +49 711 93150 340
fax +49 711 93150 345
e-mail: guenter.baur@magaldi.com

India General Licensee
Magaldi Power India Pvt Ltd
Flat 8, 4th Floor, 147 Lake Gardens
700 045 Kolkata
ph. +919830808228 / +919434748228
e-mail: chakraberty.debasish@magaldi.com

USA Utilities Boilers Licensee
Diamond Power A-S-H division
457 Creamery Way
19341-2508 – Exton, Pennsylvania
ph. 484-875-1673
fax 484-875-2080
e-mail: JJMurphy@a-s-h.com

Japan - Power Internal Market Licensee
Kawasaki Plant Systems, Ltd.
11-1 Minamisuma, 2-Chome, Koto-ku
136-8588 - Tokyo
ph. +81-3-3615-5295
fax +81-3-3615-5296

www.magaldi.com

designed by **Menabò snc** *Printed by* Arti Grafiche Sud, Salerno_10