Integrated Drive Systems

What Is an Integrated Drive System? ............................................................. 3

The Siemens Integrated Drive Systems ...................................................... 6

Siemens Legacy as an Electrical Equipment Supplier ............................. 9

Business Issues Faced in Absence of an Integrated Drive System Offering ........................................................................................................ 12

Mining Industry Benefits of Integrated Drive Systems ......................... 15

Oil & Gas Industry Benefits of Integrated Drive Systems ..................... 17

Cement Industry Benefits of Integrated Drive Systems ....................... 18

Last Word .................................................................................................. 21
Integrated Drive Systems

- Single purchase order for entire drive system; streamlined processes
- Coordinated delivery times across multiple products
- Custom service contracts and extended warranty options
- Technologically innovative products and processes from a single source
- Matched engineered components
- Time to market, development and implementation efficiency
- Highly flexible, complete process and customer-oriented solutions
- Optimized design efficiencies
- Engineered systems built from a comprehensive range of components

Streamlined Business Process Benefits of Integrated Drive Systems for EPCs, OEMs and End Users
What Is an Integrated Drive System?

Integrated Drive Systems are used across varying horse powers and all industries. However, this white paper focuses on Integrated Drive System applications above 1000 horse-power, and specifically on three key vertical markets: cement, oil & gas, and mining. Common practice in the industry is to specify and purchase individual components or subsystems from multiple vendors, as needed, and assemble these into a complete drive train. A completely assembled drive train package, designed and integrated to work together, is referred to as an Integrated Drive System.

An Integrated Drive System mitigates many of the indirect costs associated with drive train projects. Today’s practice of using multiple vendors for each engineered component burdens the users’ engineering organization with excessive project management. Such practices often result in suboptimal solutions which increase the operational cost throughout the entire life of the machinery. Purchasing an Integrated Drive System allows the single vendor to employ system engineering principles that provide benefits from the initial specifications through the installed operational life. It also provides additional benefits such as:

- **Purchase agreements, service agreements, and warranties** are handled more efficiently by managing the relationship with only one vendor.

- **Single vendor system** is efficient at optimizing the design of each component based on ideal performance goals of the overall system.

- **Projects are more likely to be finished on time due to** the delivery of components for integration and final assembly is well coordinated by a single vendor.

- **Finger pointing among vendors is eliminated** because all diagnostics from acceptance testing through the operational life of the system is performed by single vendor.
Drive Trains Are Engineered Solutions Often Posing Huge Challenges

This paper addresses applications for drive trains having a power capacity above 1000 HP (750 kW), focusing specifically on applications in three industries: mining (page 15), oil and gas (page 17), and cement (page 18). Drive trains in this power range play a critical role in maximizing productivity, reliability, and energy efficiency in industrial operations. Designing systems in this power range often requires some degree of custom engineering for each component; however, each component is often sourced from a different vendor.

Multiple vendors create more challenges. Managing and selecting an optimally matched set of components that provide high reliability as an integrated system is an engineering challenge that is often magnified by project budget limitations. Project engineers have a limited amount of time to gather vast amounts of technical data to assess each vendor’s portfolio of components. The pressure on project time constraints increases as engineers spend time managing schedules and design alternatives with multiple vendors for each component of the drive train. Moreover, there is usually a question as to who has the system responsibility. Assessing each vendor’s capability, managing multiple service agreements and warranties, reviewing and negotiating multiple quotes, and engineering the drive train is a monumental task. There is a significant project cost associated with these activities. A far less costly and lower risk alternative, now available, is the Integrated Drive System.

Reducing Risk and Cost of a Drive Train Implementation

An Integrated Drive System (IDS) is an approach where one vendor provides a set of matched components as a system that meets the user’s requirements. This creates efficiencies in engineering processes used to design a user specified Integrated Drive System solution. An optimally designed Integrated Drive System reduces space consumed around the machine, maximizes energy efficiency, optimizes dynamic performance, and increases reliability. The Integrated Drive System approach allows users to view the drive train as a single purchase that undergoes engineering, mod-
eling, and analysis by the vendor to specifically match the dynamics of the mechanical equipment being driven.

Siemens Integrated Drive System Components

Integrated Drive Systems are NOT a collection of catalog components that are mixed and matched; that could result in a solution that generally does not reach optimum potential. The benefit of a custom engineered Integrated Drive System is that the system meets the end user’s design specifications, optimized for performance, and saves a significant amount of time in project startup.

- Maximize ability to customize products/solutions to meet my specs (operational effectiveness)
- Optimized components designed to work together (operational effectiveness)
- Maximize speed of implementation (simplification of the process)
- Minimize installation downtime (efficiency)

Siemens streamlines the business process associated with purchasing drive train components as an Integrated Drive System. However, the business case goes beyond the initial purchase and lowers the total cost of ownership. A single vendor ensures that the selection of components meet or exceed technical specifications, system performance, reliability requirements, and economic requirements. A single vendor validates component mechanical fit as well as environmental and performance specifications. Finally, when delivered to the site it can be installed directly onto the equipment thereby reducing installation and start-up time.
The Siemens Integrated Drive Systems

The Integrated Drive System is a unique offering from Siemens that streamlines business processes for deploying high horsepower rotating equipment. Engineering and development resources required for heavy industrial applications such as conveyors, pumps, compressors, crushers, and mixers can be significantly reduced with an Integrated Drive System. While Siemens is known primarily for a comprehensive electrical portfolio of adjustable frequency drives and induction motors the portfolio has been extended with mechanical power transmission components. The mechanical drive and coupling product line of Siemens, formerly FLENDER, fills a gap typically found in the portfolio of drive train solution providers. Mechanical couplings and mechanical drives matching the high horsepower ranges applied in Integrated Drive Systems are now available.

Purchase Order Process Streamlined

An Integrated Drive System purchase order is handled by a business process that streamlines design, engineering, and procurement. Siemens has standardized these business processes to ensure that each order is managed most efficiently as not every Integrated Drive System order requires the same level of services because each project has specific characteristics that require a tailored approach using standard processes. From the beginning, customers work with a single point of contact who qualifies each project application for the right level of services. Projects requiring customized products and system integration services are handled by the Operations and Engineering Center.

Operation and Engineering Center (OEC)

The Operations and Engineering Center (OEC) is an organization established specifically to support customization and execution of IDS orders, specializing in IDS orders in the Oil & Gas, Cement and Mining Industries as well as several other industries. The OEC is a business center that facilitates collaboration across the all of the business units product groups within Siemens needed to support an Integrated Drive System project. Each project is treated individually to deliver a custom solution that optimizes the operational performance of the equipment. However, by repeatedly using the same organization and standardized processes for In-
tegrated Drive System designs, customers benefit from the experience and knowledge acquired from prior projects.

Project Management
The OEC assigns a project manager who assembles a team that understands the customer’s specific industry application. Engineering services from each product group determine the ideal selection and specification of components for each application. Through collaboration, situations such as over-engineering and over-costly designs or under-engineering and failing to meet requirements are avoided. The project management group evaluates the work streams required to ensure that each component is delivered at the scheduled time for integration and test. Each engineering lead is responsible for component testing; however, a Technical Review Board oversees the final integration of the system. The Technical Review Board functions as a system engineering group for the entire project, responsible for assessing the dynamic performance of the final system. However, the project manager remains as the single point of contact from initial consultation, delivery, installation, and ongoing maintenance of the equipment as well as valuable project coordination.

The OEC reduces the design risk by employing a system engineering approach to Integrated Drive System design and development. System
Siemens Provides Critical Technical Overview Necessary for IDS

- Evaluating direct online vs. VSD starting for energy efficiency, cost, and performance
- Optimizing economic, efficiency, and reliability for specific application
- Provide comprehensive diagnostic tools for entire drive train
- Optimization with ‘what if’ scenario
  - Modeling analysis
  - Thermal analysis of a system
  - Torsional analysis
  - Resonance points
  - Load dynamic analysis
- Appropriate method of cooling gear units to prevent overheating
- Flexibility requirement in coupling to avoid vibration

Engineering is a widely accepted methodology that coordinates a timely delivery of each component and optimizes the design of complex systems. In contrast, selecting individual components from multiple vendors that have minimal interaction generally results in a suboptimal solution. With a system engineering approach, Siemens has more end-to-end information with regard to the entire system requirements allowing the opportunity to apply the appropriate expertise at each stage of the drive system design and development. Moreover, a dedicated Siemens contact person for the Integrated Drive System provides continued savings throughout the entire product lifecycle.

Value Derived from a Global Base of Proven Products

An Integrated Drive System is a custom engineered solution designed from a global base of proven products which optimizes performance while minimizing design and delivery risk. An investment in Siemens Integrated Drive System equipment is a good business decision because value is derived from:

- A streamlined procurement process
- Single point of contact for pre-sale purchase administration
- Front-end quotation and specification
- Single vendor to repair and upgrade
- Simplified maintenance of a complex system
- Coordinated logistics management
- Post-sale warranty administration

The complexities that arise when working with multiple vendors on a single project are virtually eliminated. The role of EPCs will continue to remain important in fulfilling end user objectives. Siemens extensive experience working directly with EPCs will further assure that end users will achieve these objectives.
Siemens Legacy as an Electrical Equipment Supplier

Siemens Drive Technologies accounted for over $12.8 billion in global revenues in the 2012 fiscal year making it the largest division within the Siemens Industry Sector. Drive Technologies comprises Large Drives, Motion Control, and Mechanical Drives. Energy efficiency, productivity, and reliability are made attainable to Siemens customers through the technological innovation that is the driver behind these products and services. There is a tremendous amount of synergy between the underlying technologies of the large drives, mechanical drives, and motion control solutions that requires the scope and breadth of a large, global organization to ensure R&D is leveraged across all of the product ranges. The synergy that Siemens gains in research & development in these domains is often used as guidance and input to standardization and regulation boards.

Electric Drives

Siemens variable speed drives’ offering maximizes energy efficiency and productivity with broad functionality to suit almost all industry verticals. The product portfolio has a strong technology base and includes low voltage and medium voltage drives, as well as DC drives to achieve energy savings and process improvements goals. Siemens has a comprehensive range of low and medium voltage drive products in its high power AC drives portfolio. Siemens has strong application and industry knowledge and a wide customer base with its huge penetration in MV AC drives market in North America. This extends the Siemens AC Drives portfolio which includes a broad power range of SINAMICS drives.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Product Family</th>
<th>Max Power Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Voltage AC Drives</td>
<td>SINAMICS S120, S150, G130, G150, G180</td>
<td>4.5 MW</td>
</tr>
<tr>
<td>Medium Voltage AC Drives</td>
<td>SINAMICS GM150, SM150, GL150, SL150 GH180</td>
<td>85 MW</td>
</tr>
<tr>
<td>DC Drives</td>
<td>SINAMICS DCM</td>
<td>2.5MW</td>
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Siemens’ Variable Speed Drive Portfolio

Siemens also offers value-add services, such as electro-mechanical support, remote trouble-shooting and diagnostics and web-based preventive
maintenance. Siemens engineers leverage the analytical tools that are integral to the SINAMICS drive systems to improve the overall performance of the machine, while minimizing cost. SINAMICS drives also incorporate features such as diagnostic tools and machine performance improvement tools providing greater value over the life of a drive system.

**Electric Motors**

A comprehensive range of electric motors for heavy industrial applications are available in the SIMOTICS motors family. These motors provide performance and efficiency with built in reliability and ruggedness. SIMOTICS motors include efficient induction motors for pumps, fans and compressors, DC motors, and powerful high-voltage motors for use in ships, rolling mills, ore mills, and large pumps, fans, and compressors such as in the oil and gas industry. Siemens motor portfolio offers a wide range of models and configurations. The company also has design capability for power over 100,000 HP to use in a variety of Integrated Drive System applications.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Product Family</th>
<th>Max Power Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Purpose AC</td>
<td>SIMOTICS GP</td>
<td>200 HP</td>
</tr>
<tr>
<td>Severe Duty AC</td>
<td>SIMOTICS SD</td>
<td>1,650 HP</td>
</tr>
<tr>
<td>Trans-standard for harsh conditions</td>
<td>SIMOTICS TN</td>
<td>1,650 HP</td>
</tr>
<tr>
<td>Definite Purpose AC</td>
<td>SIMOTICS DP</td>
<td>1,650 HP</td>
</tr>
<tr>
<td>Explosion Protected AC</td>
<td>SIMOTICS XP</td>
<td>1,350 HP</td>
</tr>
<tr>
<td>DC Motors</td>
<td>SIMOTICS DC</td>
<td>2,150 HP</td>
</tr>
<tr>
<td>Large Custom Motors &amp; Generators</td>
<td>Multiple Product Families</td>
<td>100,000 HP</td>
</tr>
<tr>
<td>High HP</td>
<td>Engineered Motors</td>
<td>2,950-136,000 HP</td>
</tr>
<tr>
<td>Geared Motors</td>
<td>SIMOGEAR</td>
<td>260 HP</td>
</tr>
</tbody>
</table>

*The Siemens Global Motor Portfolio
Note: Engineered solutions available in higher power rating*
**Flender Acquisition Complements the Core Business**

The acquisition of Flender Holding GmbH in 2006 strengthened Siemens position in complete drive train solutions. Flender is now a Siemens brand of mechanical drives within the Siemens Industry organization. The mechanical drive portfolio spans industrial gear units, couplings, and geared motors for ships, wind power, and heavy industrial applications such as in mining, cement, and oil & gas industries. Mechanical drives and couplings are an integral component in many applications and systems in industrial operations. With the purchase of Flender, which was a leading supplier of mechanical drive equipment, Siemens has expanded its know-how within its portfolio toward complete drive systems. The Flender acquisition enabled Siemens to provide customers with an efficient, coordinated package of integrated drive systems. This is especially true for the oil & gas, mining, and cement industries along with conveyance and material handling systems in many sectors.

**Mechanical Drives and Coupling**

The Flender brand of product continues to play a more strategic role in the Siemens organization. A common research and development organization enables alignment and optimization of electrical and mechanical drive solutions for customers. Development and engineering among drive train component technologies has led to smaller, lighter, long-lasting and high-performing drive systems. Furthermore, Siemens is now able to optimize the value of its offering to industrial customers by transforming its broad range of drive train product portfolio into an integrated drive systems offering.

Siemens offers mechanical drive solutions ranging from a line of gear reducers and couplings to gear motors and open gearing. As one of the largest manufacturers of mechanical couplings worldwide, Siemens ensures that machine shafts are securely connected. The high-quality industrial couplings are very well suited for use in many fields of application and the product range spans couplings with torque requirements of up to 10,000,000 Nm. Mechanical drives are also available with similar torque ranges. Gear units and coupling systems are designed to reduce system vibrations in a wide range of conditions. Flexible, highly flexible, hydrodynamic, and torsionally rigid couplings are all available. Integrated Drive Systems without mechanical
drives are available up to 50MW. This combination of the Siemens and FLENDER brand product and service portfolios offers the most comprehensive drive system solution in the industrial marketplace.

**Business Issues Faced in Absence of an Integrated Drive System Offering**

Custom product design, order management, optimizing designs, integration, and system responsibility are issues that contribute to the cost of business throughout the life cycle of a drive train solution. End users have often overlooked associated costs in the absence of Integrated Drive Systems. However, the challenges are clear so it is an important exercise to assess current practices for drive train projects and place a value on the cost incurred in a business.

**High Power Drive Trains Are Custom Engineered**

Custom engineered drive train solutions are generally considered economically feasible in applications with power requirements above 1,000 horsepower (HP). Basically, induction motors above 1,000 HP are often built to order in quantities of one. The market for induction motors less than 1,000 HP is much larger, leading to mass production of this class of motor. Thus, induction motors less than 1,000 HP are generally catalog items and are ordered from stock. The 1,000 HP break point applies similarly to the business case for manufacturing mechanical drives and couplings as well. The line of demarcation in horse-power means that above 1,000 HP virtually all induction motors are built to individual specifications for windings, environmental considerations (temperature, humidity, etc.), explosion proof requirements, wire insulation, and shaft sizes.

At power levels over 1,000 HP an IDS is almost certain to be custom designed for the specific application requirements; however, the challenge a design engineer faces is that each engineered component of the drive train is often sourced from multiple vendors. Design requirements for the AC drive, motor, mechanical drive and coupling are all interrelated requiring project management be coordinated across all of the vendors. It is even more critical in high power applications. This is a daunting task to ensure that lines of communication between engineering groups at each vendor
organization remain synchronized. Moreover, the ability to identify areas to optimize the solution as a system is severely compromised.

**Unifying Order Management across the Drive Train**

Whether it is custom engineered or off-the-shelf components, the business cost associated with order management, service, repair and ongoing preventive maintenance in drive train applications is generally overlooked. Every end user should evaluate the associated costs of purchasing drive train components from multiple vendors. This specifically includes the cost of unique purchasing agreements, service agreements, and warranties. These business issues are often underestimated in terms of their impact on the total life-cycle cost from initial purchase through the entire operational life expectancy of the components.

When factoring in the cost of manufacturing downtime the value proposition of unifying order management becomes an increasingly significant component in the total cost of ownership. Manufacturing downtime associated with service and repair agreements from multiple vendors is often an area where the responsibility for a failure is difficult to identify when components are assembled and operating as a system. Thus, the benefit of a single vendor solution allows the customer to treat the drive train as an inseparable system with a single point of contact for service and warranty. This is a key business issue that must be factored in when evaluating the value stream in any project.

**Opportunities to Optimize the Design**

A drive train is a system. As in any system, it is critical that the right products for the application are selected. A vendor’s depth and knowledge of the application is critical to the product selection process. Thus, a system approach that optimizes the overall performance has a greater chance of success when a single vendor is cognizant of the system’s design goals and requirements. From a control system’s analysis perspective, it is difficult to achieve global optimization of the solution when only considering the design requirements of a subcomponent. Optimization of an integrated drive system achieves higher performance than individually optimizing each component.

Multivendor solutions require the end user to serve as the project manager for up to five independent organizations that do not readily share intellectual property. In many cases, the end user relies upon an outside integrator
for overall system expertise. The scenario is not ideal as the end user or system integrator is positioned in the middle of the vendors. There are many options for design engineers to improve on the energy consumption, economics, flexibility, and overall performance by looking at alternatives from a system level perspective and determining the ideal criteria for each subsystem component.

However, the ability to identify what technological changes or manufacturing alternatives are viable across multiple vendors simultaneously is generally not achievable. Incremental improvements are often achievable, but the opportunity to make large improvements in optimizing the overall performance and potentially reducing system cost is generally very difficult to achieve.

Integration Challenges Faced
The challenges end users face when integrating multi-vendor drive solutions are exacerbated by managing multiple delivery times and the inability to coordinate design changes that affect each vendor. Many systems are final assembled at the production site where the miscommunication among component vendors and delivery delays create critical paths in getting the machinery to an operational state. Thus, the benefits offered by a supplier of an integrated drive system are the support and services available throughout the selection and integration process that resolve issues rapidly. Miscommunication among component vendors and delivery delays can become critical paths in getting the overall facility into operation.

Service and Repair
A common occurrence in any type of complex electromechanical system is the unwillingness of a single vendor to accept responsibility for a design flaw. This is where finger pointing among vendors is prevalent especially with very high value components used in drive trains. Determining who is responsible requires diagnostic skills across multiple disciplines to perform a root cause analysis. However, the challenge is that each vendor has a limited scope of engineering knowledge leaving the analysis to the end user’s engineering group. These types of problems can be virtually eliminated by relying on a company which offers an Integrated Drive System, a single vendor for the drive train. In addition, a holistic view of the Integrated Drive System performance data will reduce the bias toward an individual component vendor and can achieve optimal system performance.
Mining Industry Benefits of Integrated Drive Systems

The mining industry has undergone tremendous change over the last ten years with consolidation and a greater demand for raw materials. The industry consolidation over this time period is driven by desire to increase economies of scale of mining operations and to generate operational efficiencies. Despite a period of rising commodity prices and an insatiable demand for ore, miners continued to face operational challenges such as:

- Shortage of skilled people
- Shortage of spare parts
- Reducing project startup time
- Reduction in cutover time for modernizations
- Escalating project costs
- Limited availability of equipment
- Increasing energy costs
- Increasing transportation costs

These business issues place a tremendous burden on profitability. Underlying all these issues is the deployment of capital equipment. Machinery must remain highly available for production operations to continue uninterrupted. The availability of mining equipment largely depends upon best practices in maintenance, however, it is equally important to properly specify and engineer the technology used in capital equipment. Capital equipment is being placed in remote, hard-to-reach locations, and often in extreme temperature ranges. Also energy efficiency is a major and increasingly important factor particularly in areas where electrical energy is in limited supply. Thus, the long-term performance of a drive train is highly dependent on the initial engineering and design of the system.

Mining companies can improve their operational performance by working closely with EPCs to create a user specification for a single vendor drive train system. The Integrated Drive System from Siemens allows the mining industry to make this change. As mining operators become more aware of this opportunity to simplify the way equipment is designed, maintained
and serviced, the industry will see tremendous improvements in productivity, energy consumption, reliability, and total cost of ownership (TCO).

A drive train applied in machinery in this industry is rarely a standard offering from a vendor. Virtually all drive train applications in the mining industry are custom engineered solutions in the range of 1,000HP to 25,000HP. At these power levels, the Integrated Drive Systems provides machinery engineers an opportunity to take advantage of a system engineering approach to achieve lower power consumption, increase equipment availability, and reduce unscheduled downtime. In the past, the industry has never had the opportunity to purchase mechanical drives and couplings from their supplier of electric drives or motors. Siemens Integrated Drive System can provide all the components for a turnkey electromechanical solution. This is supported by a Siemens business process that allows mining engineering teams to pursue optimized solutions.

Using the Integrated Drive System approach, Siemens has the resources to offer engineered solutions for large conveyor and Ball Mill applications. Working directly with the customer’s engineering group a drive train that best suits the mining operations can be identified. Siemens experience in mining applications allows it to evaluate a number of alternative designs that reduce the initial purchase cost as well as lowering the Total Lifecycle Costs. In some cases, customers have chosen to eliminate mechanical drives and couplings altogether by using a cyclo-converter or a variable frequency drive in combination with a slow speed synchronous motor. This is particularly advantageous in power ranges that exceed the capacity of mechanical drives for speed reduction. This approach is not for all operations, but illustrates the possibilities when working with a single vendor.

The primary goal of an Integrated Drive System approach is to provide solutions that are most suitable for the mining operation while increasing reliability by reducing mechanical complexity. For example, Siemens directly works with each customer to determine what are the most appropriate geared and gearless offerings for the application.

Individual pieces of equipment in the mining industry can cost as much as $50 million with motors alone valued in the $20 million range. With these types of investments prevalent in the industry, leveraging the engineering
skills of a single vendor for the entire drive train is an opportunity for the industry to simplify equipment design and achieve higher productivity. Innovations in drive train design are more achievable with a single supplier taking the lead on engineering. This is a tremendous benefit to an end user or OEM in the mining industry. They can focus on core processes or basic mining machinery design and maintenance.

Oil & Gas Industry Benefits of Integrated Drive Systems

Siemens is a single source supplier for solutions across the entire oil and gas value chain. For both onshore and offshore oil and gas projects, customers seek reliable, innovative, efficient, and environmentally-friendly products, systems, and solutions designed for operation under challenging conditions. Siemens Drive Technologies provides integrated solutions for the oil and gas industry in upstream, midstream, and downstream activities. Exploration, production, and refining all use solutions from Drive Technologies. Customers work closely with Siemens in developing cost-saving integrated solutions that provide a high return on investment by lowering life-cycle costs. These integrated solutions span the entire drive train with electrical and mechanical components, including gearless high-speed direct drive systems. Drive Technologies is able to offer a comprehensive spectrum of electrical motors, variable frequency drives, gear units, and couplings specifically for this industry to form Integrated Drive Systems. For example, Siemens Integrated Drive System offering is a good fit for pipeline compressor stations and pumping stations. Siemens can also offer load commutated inverter (LC-I) based drives for energy efficient operation for high-power and high-voltage applications. With this offering an LNG plant can become all electric and replace gas turbine driven compressors to provide safer and more reliable operation.

In addition to hardware solutions, Siemens Drive Technologies provides a comprehensive support structure, including preventive maintenance and
remote condition monitoring. In fact, the oil & gas industry has already moved to Integrated Drive Systems and is reaping the benefits.

Siemens is also able to offer a targeted solution with their Main Motor and Drive Contractor (MMDC®) model for oil and gas projects. Most projects require customized drive train solutions. The wide power range capability of Siemens broad product portfolio is the ideal fit for the needs of this industry. Also application expertise is available to support product selection and deployment.

**Cement Industry Benefits of Integrated Drive Systems**

The cement industry is a capital and energy intensive business that employs a relatively low intensity of labor. Capital investments in the industry average about $225 million per million ton of production capacity. With these levels of investments and highly cyclical demand, it is imperative to run operations efficiently, reliably, and economically throughout a wide range of production rates.

The drive trains in this industry typically range around 200 to 6000 HP or even much higher for some demanding application such as large mills and kilns. Siemens is able to leverage its expertise in mining in the development of cement solutions due to strong technical synergies in both markets. Since 1995, the energy costs associated with operating a cement plant have increased more than three-fold, along with other business challenges in the industry. While a large percentage of these energy costs are for heating the kilns by coal, pet coke or natural gas, a significant percentage of electrical energy is also consumed. Companies can improve their bottom line through the use of high-performance motors, more efficient production machinery, and an integrated drive train system. This allows production equipment to remain highly available.
The trend toward more energy efficiency and a higher rate of production demands a deeper integration of mechanical components with the power systems. Machinery that employs drives, motors and mechanical drives can be designed to improve both productivity and energy efficiency. Equipment availability is absolutely critical in these operations as the volatility in demand requires that orders be fulfilled with a relatively short response time. While product quality is largely dependent upon the raw materials being used, it is equally dependent upon the ability of the equipment to produce a consistency in the product. Specifically, the grinding of shale and limestone in vertical mills requires a system that operates within a wide range of variability in material characteristics. In some applications, equipment may undergo high vibrations and a wide range of torque disturbances. The drive train in this case is subjected to a tremendous amount of mechanical stress, but it is required to continue to operate smoothly and consistently in order to produce high quality products.

One of the most important factors to ensuring long-term operational efficiency in the cement industry is the specification and selection of production equipment. The high incidence of component failures in drive trains in cement operations is a recognized problem in the industry. Producers are under tremendous margin pressure, and high availability of the production equipment is an imperative. The challenge operators face is that the mean time to repair has not improved due to the inability to resolve problems between drive train component vendors. Determining the root cause of a problem in a drive train that is worth millions of dollars and has multiple vendors can be a huge challenge for all of the stakeholders of the equipment.

Design flaws and aging of the equipment may require operators to lower production rates to reduce the number of incidences of failure. As discussed throughout this report, Siemens Integrated Drive System offering is a strategy that offers a tremendous opportunity to operators in the cement industry to improve production efficiency. A single vendor for the drive, motor and mechanical drive can tailor solutions that match the specific characteristics of the process, raw materials, and environment. However, OEM machine builders have relied upon specifying individual components of the drive train of grinders, crushers, conveyors, kilns, and mills. The business needs to change to incorporate a systems engineering approach. Operators in the cement industry relying upon OEM machine builders to design and engineer all aspects of the equipment should specify an Inte-
integrated Drive System when working with OEMs to ensure optimal performance.

Siemens has years of experience in the cement industry with an extended portfolio of both large horsepower motors and large drives and application-specific mechanical drive solutions. Thus, there is a large installed base of custom-engineered systems in the cement operations. The addition of the Flender brand of mechanical drives and couplings is now providing Siemens customers an opportunity to streamline the entire process of purchasing high power drive train systems that cover all facets of cement production.

Siemens has already begun to develop drive train solutions for the cement industry which include the EMPP (electrical motor and two planetary gears) vertical mill drive concept specially developed for large vertical roller mills. The EMPP is an integrated drive system that uses a motor specifically engineered to meet the demanding requirements of vertical mills up to 15 MW. The EMPP uses a brushless permanent magnet motor with a sleeve bearing (also known as sliding bearing) driving a two stage planetary gearbox, all integrated into the housing of the vertical roller mill. This increases efficiencies while reducing vibration, wear, and maintenance due to the simplified design. To take this concept further into the cement industry applications, Siemens Operation and Engineering Center has been established to help the industrial machinery builders and engineers define requirements for integrated drive systems that are unique to a specific industry’s requirements. Systems can now be optimized for performance, operational reliability, and energy savings based on the characteristics of the operation. Furthermore, when a system requires service or routine maintenance, the drive train system is supported throughout the entire life cycle with Siemens.
Siemens announced the global formation of industry focused organizations in 2011 to better serve its industrial customers. This industry focus concept requires an acute understanding of the business issues, manufacturing challenges, technical challenges, and regulatory environment that customers within these industries face.

Integrated Drive Systems (IDS) is a result of this industry concept and offers very high value to mining, cement, oil & gas, and other industries. Siemens already has a long and successful history of serving its customers in their specific markets.

Siemens’ broad range of integrated field and support services helps its customers fully maximize the uptime, reliability, and cost control of their drive components and systems. As the service provider who knows its Integrated Drive Systems the best, Siemens leverages its extensive global network of field service and repair professionals, spare parts stocking and distribution capabilities, and user-friendly, online and technical support to minimize plant downtime, and optimize production and ROI.

Siemens also helps its customers extend the lifecycle of their plant’s equipment. Repair services for legacy products and state-of-the-art systems are offered along with customized service contracts. Other service programs include integrated plant maintenance, condition monitoring, industrial security, energy and environmental, and SITRAIN technical learning.

Siemens integrated drive systems help to simplify the vendor process to optimize existing design specifications, yet ensure that projects are engineered most cost-effectively and finished in time. Additionally, Siemens Integrated Drive System approach increases the speed and implementation of project development and commissioning, enhances design efficiencies, and ensures the selection of the most appropriate components throughout the system. Siemens is unique in offering IDS solutions, with the full range of couplings, gearboxes, motors and drives as well as control systems. Siemens expects the Integrated Drive System offering will markedly improve responses to customer needs and aims to put distance between itself and its competitors.
Analysts: Himanshu Shah, Salvatore Spada

Acronym Reference: For a complete list of industry acronyms, please refer to www.arcweb.com/research/pages/industry-terms-and-abbreviations.aspx

AC Alternating Current
ASD Adjustable Speed Drive
DC Direct Current
EMPP Electrical Motor and Two Planetary Gears
EPC Engineering, Procurement and Construction
HP Horse Power
HVAC Heating, Ventilation, Air Conditioning
IDS Integrated Drive System
LC-I Load Commutated Inverter
LNG Liquid Natural Gas
MMDC Main Motor and Drive Contractor
MV Medium Voltage
MW Mega Watt
OEC Operations & Engineering Center
OEM Original Equipment Manufacturer
PLM Product Lifecycle Management
ROI Return on Investment
RPM Revolutions per Minute
SITRAIN Training for Industry
TCO Total Cost of Ownership
VFD Variable Frequency Drive
VSD Variable Speed Drive

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ARC Advisory Group, Three Allied Drive, Dedham, MA 02026 USA
Tel: 781-471-1000, Fax: 781-471-1100
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