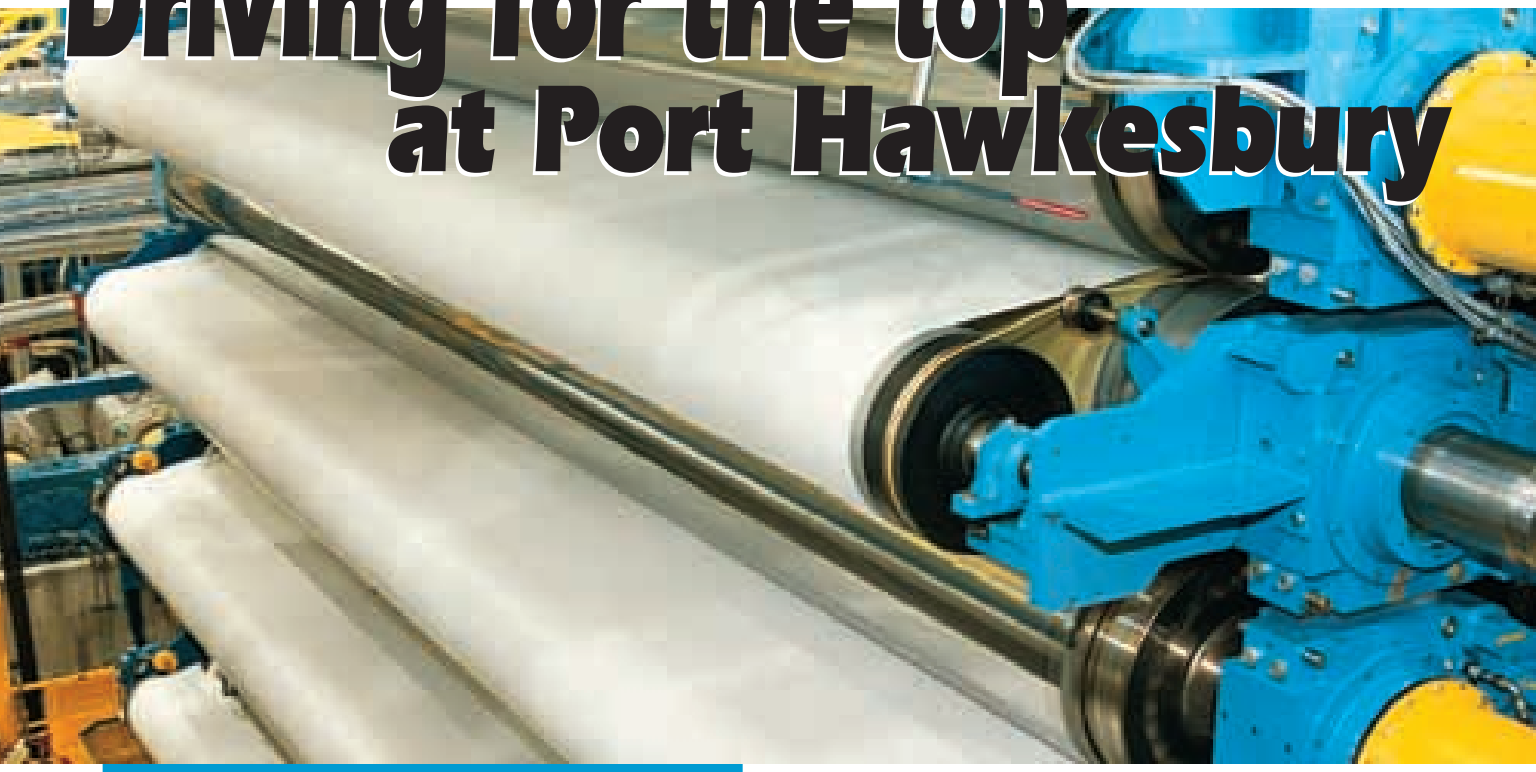
Driving for the top at Port Hawkesbury



MARTIN KOEPENICK

Super calendered A and A+ production at Port Hawkesbury marks the beginning of a new chapter in North America. The 10 roll supercalenders run at speeds up to 1500 m/min.

When Stora Enso started up PM No. 2 in April 1998 at Port Hawkesbury, NS, Canada, company executives began with a mission in mind. The 10.15-m-wide, 146-m-long, 1800-m/min machine was instantly the largest supercalendered paper machine in the world. Designed to produce 350,000 metric tons/year and aiming for 270,000 metric tons for 1999, this machine, producing supercalendered (SC) A and A+ papers, marked the beginning of a new chapter in North America, where magazines, catalogs, and mailers will increasingly shift to SC. A critical element in making this happen was steady, reliable production that was in part made possible by the variable-speed drives, which were constructed with the latest AC technology, and the control and automation systems to run the drives.

VARIABLE-SPEED, AC-POWERED DRIVES PROVIDE RELIABLE, LOW-MAINTENANCE OPERATION FOR PM NO. 2.

According to Tor Suther, vice president of production, "To reach our targets, the drive system had to be reliable so that planned maintenance could take place on scheduled shutdowns. It had to be accurate so that it would not disturb paper production at high speed, where the paper is sensitive to tension variations. It needed to be easy to troubleshoot and simple to repair when something happens during operation."

Being highly selective was considered essential to Suther, who indicated, "Certain small risks might be taken in paper quality–related technologies for these kinds of projects. However, when it comes to drives, proven technology is a must."

Adds Jack Dobson, electrical/instrumentation superintendent, "In addition to a specification for near-perfect availability, the drive system was required to support machine speeds up to 1800 meters per minute. This was accomplished, and has already been exceeded on occasion, as well."

Rod Hillier, SC line electrical/instrumentation maintenance superintendent, reflecting on drives, sees it this way: "Startup expertise made a big difference, because the supplier's personnel have expertise in the paper machine, calenders, and winders that they commissioned. Starting up a system of this size also meant they had to be well supported by their organization, which they were."

On a practical level, Hillier considers the fact that the drive motors do not require external fans for cooling to be an advantage for smooth, continuous operations. "All motors are TEFC (totally enclosed, fan-cooled)—to our knowledge, the largest drives delivered at 600 V for a sectional drive application. We are one of the earliest applications of the Siemens AFE (active front end) on such large drives."

DEMAND ON DRIVES FROM STARTUP

Hillier says that right from the start, expectations of the drive system were quite high. After completing the test run, a 98.5% degree of availability was expected for the first three months. Interruptions of operation caused by the drive system could not exceed 33 hours during the 90-day (2160-hour) period. Furthermore, the number of shorter interruptions should not exceed nine hours during this period. After the expiration of the three-month period, a 99.7% degree of availability was required for the next nine months. In that timeframe, interruptions of operations caused by the drive system were not to exceed 20 hours during a 275-day (6600-hour) period. In addition, the number of shorter interruptions should not exceed 18 hours during this period. In fact, the drive system exceeded the demanding expectations.

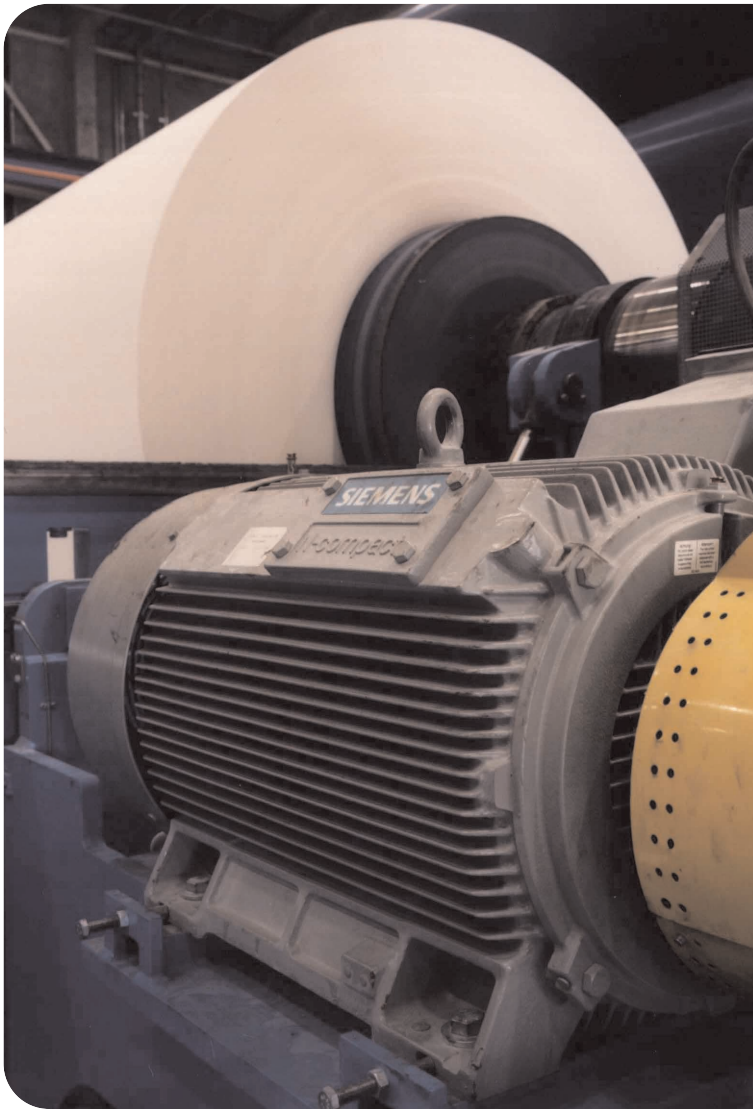
Suther stresses that availability for drives must be thought of in the context of overall machine efficiency. Obviously, when the machine is down for other reasons, the drives can't be penalized. Suther confirms that high speed in parallel with high efficiency is of utmost importance when making an investment like the one in Port Hawkesbury. Overall, total efficiency is expected to be close to 90% when everything is fine-tuned a few years after startup.

THE UNIVERSAL DRIVE SYSTEM

The variable-speed drives are constructed with the latest AC technology. Self-cooling motors, insulated gate bipolar transistor (IGBT)–type converters with optimized pulse pattern, and fully digital open- and closed-loop control engineering are the most important features of this drive equipment. All motors are standard induction motors, supplied with power by drive inverters. The motors of all power ranges are self-ventilating and can be operated at 70% of their rated torque without external fans, even at low speeds and down to a standstill.

The brake generators on the slitter winders and calenders are also self-ventilating, three-phase motors. A special control technique in the associated converters permits smooth running characteristics, which allow problem-free operation down to the lowest speeds. The nondriven (ND) end bearings of the motors are insulated to avoid shaft currents in the bearings.

The drives are voltage-source DC link inverters. They consist of a line-side rectifier, which produces a constant DC voltage in the DC link, and a motor-side inverter, which converts the DC voltage in a three-phase system of variable frequency and voltage. The converters operate according to a special principle of modulation with which the control signals for the pulse width modulation (PWM) inverter are generated. Optimized pulse patterns ensure that the curve of the motor current is almost sinusoidal. This minimizes torque pulsations and harmonic losses, increases the life of the motor, and reduces noise.



The brake generators on the slitter winders and calenders are self-ventilating three phase motors.

AC drives allow considerable savings in operational and maintenance costs. The principle advantages over DC drives include:

- greater overall efficiency, resulting in energy cost savings

- no consumption of reactive power, resulting in savings of the initial investment and operating costs
- no commutators and therefore no costs for commutator maintenance and brush changing.

LESS MAINTENANCE BY DESIGN

Because the motors and drives have been designed to require less maintenance, this maintenance is different than it would be for traditional drives. Even so, Suther notes, "Follow-up and service was a big concern initially. To mill operation and maintenance, this type of drive represents a giant step in technology compared to existing DC drives for newsprint machines. Several meetings took place before and during the project to establish a satisfactory service and follow-up system."

Adds Suther about the change from DC to AC technology, "AC drives normally demand less maintenance than DC drives. We have built up a preventive maintenance program where IR (infrared) scanning of components, cleaning of components, vibration checking of motor bearings, and temperature control of drive rooms have the highest priority. This has been working out satisfactorily so far."

Concerning spare parts, of which less are required compared to DC drives, Dobson points out, "Recommended spare parts lists were modified to reflect our requirements. The geographical storage location of spare parts and the logistics of having the parts delivered to Stora Enso Port Hawkesbury (SEPH) were a major consideration."

THE DRIVES AND CONTROL SYSTEM

In the Port Hawkesbury mill, 5–2000-kVA converters are used. The largest drive output levels are 2×1800 kW, installed on the center roll in the press section of the paper machine and the headbox pump. For the converter system, a DC link bus was used. The inverter motors, which are connected to a shared DC busbar, are supplied in this way. Owing to the enormous amount of power required for PM No. 2, several blocks—consisting of infeed, busbar, and inverters—were supplied, constructed, and designed from a process-oriented viewpoint.

For the supercalenders and slitter winders, the new AFE devices were used instead of conventional power supply systems with thyristors. These devices are designed with IGBT technology, ensuring that fuses do not blow in the event of a power failure. The converters are also equipped with the software option of kinetic buffering. This prevents the converters from being switched off as a consequence of short-time faults in the power system.

The fully digital open- and closed-loop control system of the drives ensures that the set values are highly accurate and reproducible. Due to the closed-loop vector control system with inner-phase current control loop in the converters, it is possible to achieve smooth running characteristics, even at the lowest speeds. This enhances paper characteristics—especially in the case of calenders, winders, and slitter winders—from threading speed

Roll wrapping through labeling is totally automated.

to full production speed. The speed, load distribution, and current controls are implemented in the individual converters. Calculation and specification of setpoints, as well as closed-loop tension control loops, are incorporated in the higher-level, closed-loop control system, referred to as a Simatic PCS 7.

Higher-level operator control and visualization are performed in the central control room. The two stations of the operator control and visualization system provide the team of operators with an overview of the paper machine. The web speed, motor speeds, and loads of the individual drives are displayed as instantaneous values and as historical values with a selectable timeframe. The easy-to-use data management system enables detailed analysis of web breaks, too. Data are gathered at each inverter. Individual blocks of data—for 20 seconds before the web break to 10 seconds after the break—are transferred to the operator control and visualization system for display and analysis. A real-time signaling system with a color printer supplements the man–machine interface.

Drive-specific operator control and visualization are enabled by operator stations, which are built into local control panels. Here, operating modes can be selected, setpoints are entered, and operating data can be displayed. The operators are able to react immediately to influence starting the machine locally and to correct setpoints with visual contact to the individual drive groups.

Jim Mantooth, who directs pulp and paper systems for Siemens in North America, adds, "Operators can separate 'vital' operating functions from control and visualization functions, resulting in increased security with regard to operations control. An open communications system enables flexible expansion and integration of additional new machinery or systems from other manufacturers."

SIMPLER DRIVES

According to Dobson, "The drive concept also results in a reduction of elements, which caused difficulties in the past. The use of self-cooling, three-phase motors eliminates the need for a ventilation system. ND-end insulation of the motor bearings prevents bearing currents and damage to the bearings. Standard bearings require no extra costs for storing spare parts."

Converters with optimized pulse patterns result in a higher output yield for the motors, longer life, and a reduction of motor noise. A converter system with a DC busbar enables energy exchange on the DC bus.

In the view of Christian Hofer, Siemens project manager at Port Hawkesbury, "Feeder module active front end means there are no longer any line-typical harmonics. Fuses don't blow in the event of a power failure, even in generator mode." Confirmation of this fact was the con-

TMP is supplied by the first greenfield RTS plant.

tinuous availability of the drives when shutdowns and a power outage occurred at the mill over the past year.

Hofer continues, "Service and later expansion are simpler, because closed-loop control is structured between drive-specific tasks and higher-level technology functions. Routine tasks are handled at the drives level. There is enough functionality at the drives for on-the-spot service and modifications, such as a press section change, for example."

FULL STEAM AHEAD

Hillier points out that follow-up service and support are important to Port Hawkesbury. "SEPH will have a Siemens service engineer on site for two years. The drive engineer's role is to perform sectional drive system optimization, provide technical support, and train mill personnel."

For continuity, the drive technicians from New Brunswick and Ontario that assisted the commissioning/startup engineers during the project now provide relief coverage for the site engineer.

Looking to the long-term tracking of success, Suther concludes, "Internal competition and benchmarking are good for the company and the industry. We will benchmark the drives as all other efficiency parameters within Stora Enso." **TJ**

Koepenick is a writer at Innova International, 4705 Paran Valley NW, Atlanta, GA 30327.

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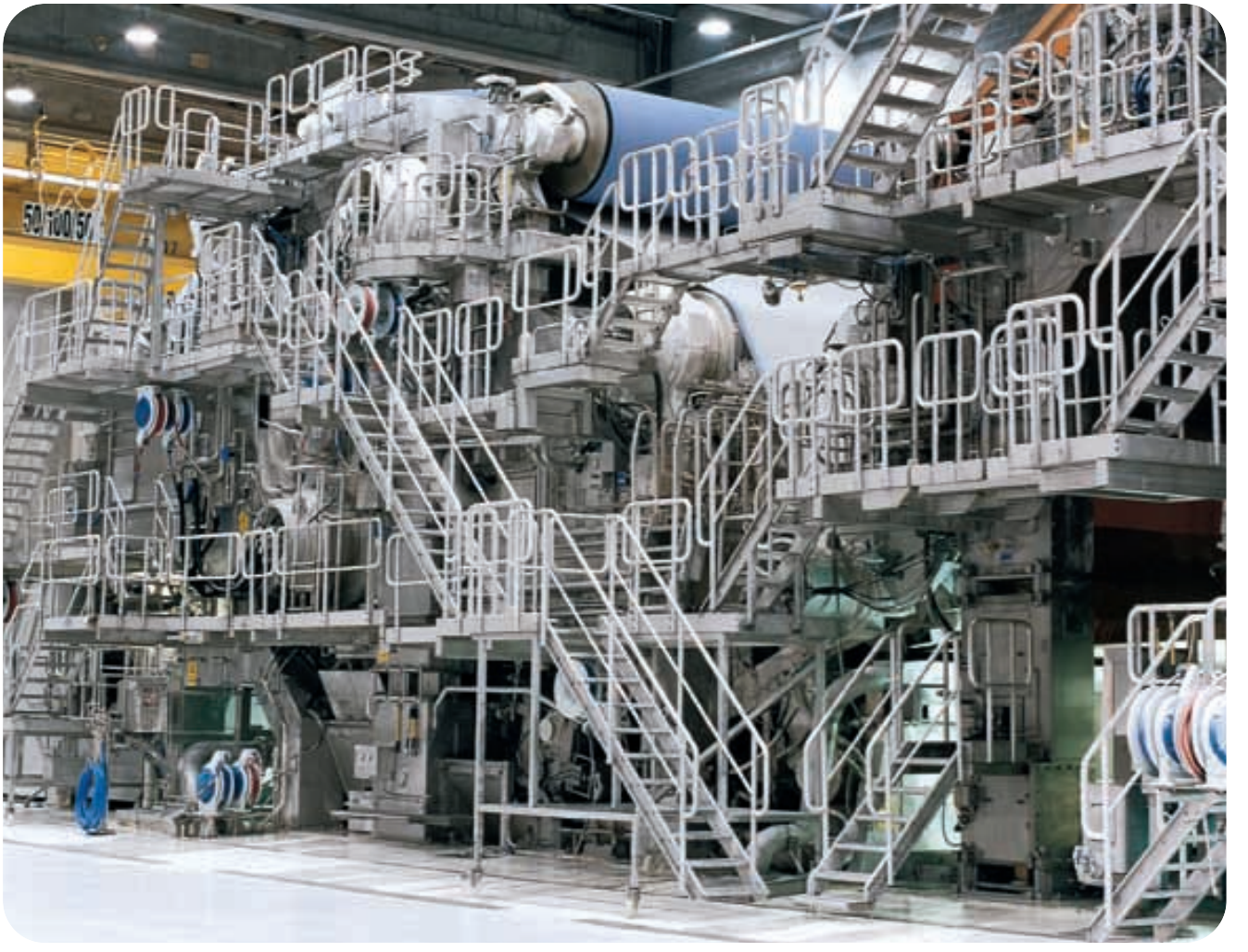

Reliable production for the largest, fastest SC paper machine in the world is made possible in part by variable speed drives, and the control and automation systems which run them. The largest drive output levels are 2 x 1800 kW, installed on the center roll in the press section of the paper machine.