Photo credit B. Cleary.

Long-Awaited Int'l Standard

FOR WIND TURBINE GEARBOXES INCHING CLOSER TO COMPLETION

Jack McGuinn, Senior Editor

It's hard to imagine a world without manufacturing standards, although in fact the concept is relatively new when one thinks about it. Some history: The record states that international standardization began in the electro-technical field with the creation in 1906 of the International Electrotechnical Commission (IEC), and was further advanced in 1926 by the creation of the now-defunct International Federation of the National Standardizing Associations (ISA), whose emphasis was mechanical engineering. It was in a post-war meeting in 1946 that delegates from 25 countries created a new international organization that would "facilitate the international coordination and unification of industrial standards," i.e.—the ISO.

AGMA entered the picture in 1916 as an evolving gear industry was striving to meet the auto industry-driven demand for gears with quiet operation, particularly for tim-

ing gears. AGMA began when the R.D. Nuttall Company brought together several gear manufacturers to discuss developing such standards. From Day One, AGMA standards development has been predominantly market-driven, beginning in 1919 with the first rating standard, and the first gear quality standard was established in the late 1930s.

Today, international standards serve as the manufacturing rule of law, if you will, regarding guidelines or definitions of characteristics to ensure that materials, products, processes and services are fit for their purpose.

All of which brings us to the issue at hand—the status of publication of ISO/IEC 61400-4, otherwise known as a new standard for wind turbine gearboxes.

Faithful *Gear Technology* readers may recall that our July 2009 issue contained an update of the deliberations provided by Bill Bradley (*Ed.'s Note: Bradley, a Gear Technology technical editor, is also a consultant within the gear industry from Longmont, CO with over 45 years' experience. As a member of the American Gear Manufacturers Association, he is active on a number of standards committees, including—Wind Turbine, Helical Gear Rating and Gear Accuracy. As an AGMA VP, he was responsible for facilitating national and international standards development until he retired in 2007*).

Now, almost two years later, there is an ISO/IEC wind turbine gearbox standard out for draft international standard ballot (ballot closes 2011-05-17), with an AGMA meeting in Denver (March 16–17) convened to decide the U.S. position on its wording.

Bill Bradley

With that, we contacted Bradley again, along with two additional authorities on the subject, to see where things stand on its ratification and to determine what, if any, effects the standard will actually have on gear industry players.

Where we're at, according to Bradley: "The activity on the ISO/IEC wind turbine project 61400-4 since July 2009 includes ballot of a committee draft (CD) between October 2009 and January 2010, which resulted in over 900 comments (about 50 percent were deemed editorial). Two meetings of the Joint Working Group (JWG) for resolution of the comments were held in Copenhagen (March 3–5, 2010) and Hangzhou, China (April 26–28, 2010). In these meetings, over 300 substantive (non-editorial) changes to the document were agreed to, and the resulting document had at least 30 major changes in the technical requirements. Contrary to normal ISO procedures, it was agreed to send the resulting document for draft international standard (DIS) ballot, rather than another CD. The DIS ballot opened December 17, 2010 and will close on May 17, 2011. There is an AGMA meeting scheduled for March 16–17 to decide the U.S. position on this document for which about 100 U.S. committee members submitted

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N.K. "Chinn" Chinnusamy

comments to be reviewed.

"In my more than 30 years' experience in ISO standards development, this project has been the most difficult; i.e., to maintain a reasonable schedule; for the ISO/IEC JWG members to develop a consensus document; and for the chairman and document editors to maintain neutral positions. This is probably due to vested interests of individuals and companies who are involved in the JWG."

Just keeping the acronyms straight seems like a big enough task, much less passing the thing.

The next, and obvious question for Bradley—When will the development of this standard come to fruition? Melville probably wrapped up "Moby Dick" in quicker fashion than this years-in-the-making standard, with work on it beginning in the 1990s.

"It is very difficult to predict the time to completion of this document," he says. "Based on past performance, where twice the usual time has been taken by the JWG to accomplish its tasks, I think it may take one to two years to be published, if it is to be a standard. After the May ballot closure, there should be a JWG meeting scheduled to resolve comments. After the resolution meeting(s), there is normally a 3–4 month edit period, which has taken twice that amount in the past. If there are any substantive changes, another three-month re-ballot is required. Then another resolution and edit period is required."

Clear on that?

Aside from actual passage of the standard, it is useful to know—once it becomes operational—what effect it will have in the real gear world. After all, standards are created resulting from, according to ISO, consensus agreements reached between all economic players in that industrial sector—suppliers, users and often governments. They agree on specifications and criteria to be applied consistently in the choice and classification of materials, the manufacture of products and the provision of services. The aim is to facilitate trade, exchange and technology transfer through:

- Enhanced product quality and reliability at a reasonable price
- Improved health, safety and environmental protection, and reduction of waste
- Greater compatibility and interoperability of goods and services
- Simplification for improved usability
- Reduction in the number of models, and thus reduction in costs
- Increased distribution efficiency and ease of maintenance

As for this standard's particular effect, consider profitability, for example. Says N.K. "Chinn" Chinnusamy, president of Roscoe, IL-based Excel Gear, "I doubt that it will

provide a more level playing field. The AGMA standard is a good reference, but everything is not set in stone and many factors are left to the experience of designers."

"It's hard to say," says Chuck Schultz, chief engineer for Beyta Gear Service and a *Gear Technology* technical editor. "Better gearboxes will reduce warranty expenses, and that certainly goes to the bottom line."

Says Bradley, "An international gearbox rating standard is not worth having unless it provides minimum requirements for a defined operating environment and life. The requirements should result in 'a more level playing field' for its users. A company's profitability could be positively affected if it typically has provided more than the minimum requirements. A company's profitability could be negatively affected if it typically has provided less than the minimum requirements."

And then the question arises whether the new standard might be sufficiently stringent and unforgiving to the point that smaller players may be left on the sidelines.

"Smaller job shops, to the extent they compete today mostly as sub-contractors, will not be precluded from competing by the standard, provided they meet the minimum requirements," says Bradley. "To my knowledge, many can meet these requirements."

Exel's Chinn agrees. "No, I do not think so. There are already AGMA guidelines for wind turbine gearbox design and manufacture."

Beyta's Schultz has a more cautionary take. "The barriers to market entry are equipment, knowledge and test stands," he says. "The testing requirements will certainly make it harder for smaller players. Putting over a million dollars into non-chip-producing assets is a very difficult business decision for most companies."

Chuck Schultz

And what about the seemingly never ending upgrades in grinding, gashing, cutting tools and machinery? Is anticipation of the new standard driving the innovation?

"I think that is an overstatement. Standards don't normally drive advancements," Bradley flatly states.

At Excel, "Yes," says Chinn, in agreement with Bradley. "Gear gashing is mainly for wind turbine gear manufacturing and gear gashing is very cost-effective for large internal and external gears."

But, says, Schultz, "The equipment builders are constantly improving their products for all users. The wind turbine gearbox designer is just as likely to exploit those improvements as the automotive or industrial gearbox designer. We would not see some of the intricate modifications if the machines were not capable of producing it, however.

"In my personal opinion, you cannot 'modify' your way out of a poor overall design. Modifications optimize for one

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load condition and sub-optimize for all other load conditions. If you don't know what your operating loads are, you can modify yourself into more trouble."

As for the question, which comes first—market demand or the standard?—all responders were in agreement.

"A market demand normally exists before efforts to standardize," says Bradley. "Standards try to catch up to the demands."

"I think market-driven demand comes first," says Chinn.

Schultz agrees as well, but with a slight distinction. "The standards reflect market demand."

But one wonders, given the lengthy deliberation process, is there a possibility that innovation could soon make the standard somewhat "old school"?

For starters, "Siemens has developed new generators that may not require gearboxes for small wind turbines," says Chinn.

"There is renewed talk and efforts to eliminate the gearbox in wind turbines," says Bradley. "However, efficiencies and cost still seem to make a gearbox more desirable for the large megawatt wind turbines. What might blunt the impact is that by the time (the standard) is finished the industry will already be practicing its requirements. Also, in the end, its requirements may not be much different than today's standard requirements or practice."

Adds Schultz, "The standard will continue to evolve and incorporate new methodology, especially in the heat treat area."

Schultz, as the following makes clear, is fully behind the standard's implementation.

"More effort is needed to understand the loads on the turbines," he says. "The gearboxes continue to underperform and all the torque load testing doesn't seem to be resolving the problem. We know there are deflections of the housing and chassis that affect gear and bearing alignment, but it is very difficult to know which of these loads to test with and how to model them.

"Anyone who claims to know what loads and accelerations the gearboxes will actually see in service is less than truthful. Control systems and condition monitoring are in need of much improvement. Predictive maintenance will be an active area of development."