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HELPING POWERING CANADA'S ENERGY AND ECONOMIC FUTURE THROUGH THE WORK OF ISO/TC 192

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Abstract

For more than 60 years gas turbines have provided electrical power, mechanical power and heat to a number of industry sectors. Today's gas turbines are recognized as efficient, reliable and safe., making them a key asset in a number of energy generation solutions supporting the energy transition, e.g. flexible power, pipelines, a move away from coal, or fuel flexibility

To support and promote the growth of this industry a technical committee (TC) of the International Organization for Standardization (ISO), namely ISO/TC 192 on gas turbines, actively maintains about 20 international standards on the safety, procurement and performance of relevant technologies. These activities are accomplished through various working groups.

The committee is currently focused on improving the existing standard ISO 21789 Gas turbine applications – Safety so that it becomes more internationally relevant and up-to-date. In a near future, the TC will also look at addressing the upcoming innovations (hydrogen, liquid fuels, bio-gas, etc.) and the contribution that gas turbines can provide to the increased use of renewable energy.

This paper will provide an update on the ISO/TC 192 work and discuss the importance of international cooperation in the development of these international standards and discuss how Canada and Canadians can play an important role and benefit from this work.

1. ISO Technical Committee 192 – Gas Turbine

The ISO Gas Turbine technical committee was convened in 1988 with the scope of standardization in the field of all aspects of gas turbine design, application, installation, operation and maintenance, including simple turbine cycles, combined cycle systems, definitions, procurement, acceptance, performance, environment (on the gas turbine itself and the external environment) and methods of test.

It is responsible for preparing horizontal standards for all types of gas turbines. Development of standards for aeronautic gas turbine engines are undertaken in liaison with those technique committees having the primary responsibility (mainly this is performed by ISO TC/20).

17 countries are participating members of TC/192:

Armenia, Canada, China, Czech Republic, France, Germany, India, Italy, Japan, Republic of Korea, Netherlands, Norway, Russian Federation, Sweden, Switzerland, United Kingdom, United States.

Participating countries have voting rights on ballots of standards and the ability to send experts to the various work groups (WG) within the technical committee. It is these WG that are raised to complete specific standards as requested by the TC as part of the overall standardization planning, emanating from industry needs. Once the planned activity is completed, WG are often disbanded. They can be reconvened, with new call for experts raised, when a revision is required.

There are also several observing countries. Although these are not contributing experts to the working groups of the technical committee nor can they vote on the standards ballot or any other proposal, they can see the internal documents and activities of the TC.

National Standardization bodies are the official member of the International Standard Organization and therefore the actual “member” of the technical committee. In Canada, the Standards Council of Canada is this national body. The SCC creates advisory committees to gather the expertise to participate in the activities of the ISO TC it is a member of. Therefore, the existence of CAC/ISO TC/192, the Canadian advisory committee, is allowing a Canadian voice in the international technical committee.

This Canadian mirror committee is currently chaired by the author of this paper, has 13 members and is in recruitment for experts.

2. Business Plan

The business plan of the technical committee has recently been revised in 2019. It specifies the aim to prepare standards that will facilitate the application, testing, and servicing of gas turbine powered equipment. It is important to notice that currently, the creation of specific design standards is not an objective of the committee.

Principal stakeholders in the industry are the manufacturers of the gas turbines, those associated with Long Term Service Agreements, suppliers, purchasers, owners/users, operators, engineering/constructor/assemblers, service providers, system designers, regulators, and third-party testing, inspection, and certification bodies. TC 192 encourages the engagement, participation, and input from all stakeholders.

The technical complexity and sophistication of gas turbines, while instrumental in achieving the advantages mentioned above, do present some challenges that TC 192 has addressed and will continue to address. Among these are test procedures, systems safety, condition monitoring, sound and exhaust emissions, and procurements standards.

Of the challenges faced by the technical committee, significant ones are identified. It is known that during the past several years, the gas turbine industry has consolidated to fewer manufacturers, which has resulted in a consolidation of experts and participants from predominately larger organizations.

The committee will ensure that the international standards that it has developed remain applicable in the current market. In particular, the following aspects are to be kept as priority: - Safety, revision of relevant standards horizon 2019-2020 - Procurement, revision of standards horizon 2018-2019 - Power Generation, standards maintenance horizon 2020.

Additionally, with the downturn in the overall global economy over the past decade, it is more challenging to attract more variety of stakeholders to participate, which has resulted in a predominantly ‘manufacturer-driven’ participant membership.

Also, standards development processes and timelines are being challenged due to lack of funding to support meetings both in person and on-line using web and teleconference tools.

Lastly, expert attrition, continuity, and stakeholder diversity continues to be major concerns in development more relevant and balanced standards. ISO TC 192 relies on National bodies to help attract more diversity in stakeholder participation and to manage continuity of experts.

3. Active Working Group within ISO TC/192

Within the technical committee, there are currently 3 active working group:

- WG10, focusing on Safety and the revision on ISO21789. Canada is contributing 2 experts;

- WG4, focusing on procurement and the revision of ISO3977. Canada is contributing 3 experts in addition to the convenorship;

- WG16, focusing on Exhaust and Heat Recovery units and the issuing of ISO21905. Canada is contributing 2 experts.

4. Published standards of ISO TC/192

The list of published standards from the technical committee is as follow:

Table 1: Published Standards.

Reference number	Title
ISO 2314:2009	Gas turbines -- Acceptance tests
ISO 3977-1:1997	Gas turbines -- Procurement -- Part 1: General introduction and definitions
ISO 3977-2:1997	Gas turbines -- Procurement -- Part 2: Standard reference conditions and ratings
ISO 3977-3:2004	Gas turbines -- Procurement -- Part 3: Design requirements
ISO 3977-4:2002	Gas turbines -- Procurement -- Part 4: Fuels and environment
ISO 3977-5:2001	Gas turbines -- Procurement -- Part 5: Applications for petroleum and natural gas industries
ISO 3977-7:2002	Gas turbines -- Procurement -- Part 7: Technical information
ISO 3977-8:2002	Gas turbines -- Procurement -- Part 8: Inspection, testing, installation and commissioning
ISO 3977-9:1999	Gas turbines -- Procurement -- Part 9: Reliability, availability, maintainability and safety
ISO 10494:2018	Turbines and turbine sets -- Measurement of emitted airborne noise -- Engineering/survey method
ISO 11042-1:1996	Gas turbines -- Exhaust gas emission -- Part 1: Measurement and evaluation
ISO 11042-2:1996	Gas turbines -- Exhaust gas emission -- Part 2: Automated emission monitoring
ISO 11086:1996	Gas turbines -- Vocabulary
ISO 18888:2017	Gas turbine combined cycle power plants -- Thermal performance tests
ISO 19372:2015	Microturbines applications -- Safety

ISO 19859:2016	Gas turbine applications -- Requirements for power generation
ISO 19860:2005	Gas turbines -- Data acquisition and trend monitoring system requirements for gas turbine installations
ISO 21789:2009	Gas turbine applications -- Safety
ISO/DIS 21905	Gas turbine exhaust systems with or without waste heat recovery (Under Development)
ISO 26382:2010	Cogeneration systems -- Technical declarations for planning, evaluation and procurement

5. ISO21789 Gas Turbine Safety Revision

The revision of ISO21789 is currently in its Committee Draft stage (20.20) after a revision of the received comments that lasted 3 years. In this stage, member countries are welcome to comment on the CD through their own national committees. This draft stage is expected to be completed with further comments received and addressed by early 2020. A following Draft International Standard stage (30.00) will then occur to allow for a round of proposed editorial changes. Issuing of the Revision 2 is expected in late 2020-early 2021 depending of the amount of comments to address.

In addition to the standards changes proposed in this revision, an effort is made to align this activity with the EU CEN Gas Turbine group to harmonize the standard to the Machinery Directive 2006/42/EC.

A few of changes in the revision are listed below:

- **Scope**

The scope of the standard has been revised to ensure that there is no confusion as to which part of the overall installation is meant to be covered by it. And further defines that in some instances, although safety integration aspects are covered when relevant to the overall operation, the specific design criteria of an equipment (e.g. exhaust chimney) are excluded.

It is proposed to apply to mechanical, electrical, and pressure equipment components and systems necessary for the functionality of the prime mover. For example, but not limited to, a core gas turbine auxiliary gearbox, an output transmission gear box, combustion system, air filtration, gas turbine controls, oil systems, and fuel system.

It details the anticipated significant hazards associated gas turbine prime movers and specifies the appropriate preventative measures and processes for reduction or elimination of these hazards. It only addresses the risks of injury or death to humans and risks to the environment. Equipment damage without risk to humans or the environment will not be covered.

The following items are explicitly excluded:

- ─ Exhaust system structural design;
- ─ Driven equipment;
- ─ Micro turbines as covered by ISO 19372;
- ─ Gas turbines used primarily for direct and indirect propulsion;
- ─ Gas turbines used for mobile applications;
- ─ Special heat source applications;
- ─ Gas turbines in research and development programs;
- ─ Compressed-air energy storage plants.

- **Risk Assessment**

  Due to the importance of the concept and actual completion of safety risk assessment, significant changes pertaining to it have been incorporated. Explanation of the expected level of risks that should be targeted during design is now provided.

  The standard is meant to be more of a performance-based standard instead of being prescriptive focused.

- **Residual Risks**

  The requirement to communicate the information covering any residual risk, which may be dependent on the correct installation and operation of the gas turbine together with its auxiliaries, to the operator by detailed documentation including applicable recommendations, is clarified.

  Residual hazards shall be reported to users indicating whether it is necessary to take appropriate special measures to reduce the risks at the time of installation and/or use.

6. ISO3977 Procurement Revision

ISO3977 is a series of procurement standards in 8 parts. The standard parts have exceeded the scheduled revision interval for a significant time and are overdue for revision. Latest revision date from 2004 with some parts dating 1997. This exceedance is an indication of the issues highlighted above on the resource availability of experts to perform these revisions.

After revision of the standards content, 2 of these parts have been proposed to be withdrawn. Their content was deemed not sufficiently relevant anymore and of limited usage. These are Part 5 on the application for petroleum and natural gas industries and Part 7 on technical information. A round of comments in support of this withdrawal was completed in Sept 2019.

The remainder of the standards are planned to be revised on a 48 months schedule, starting in late 2019 with Part 2 on Standard Reference Conditions and Ratings as the first revision to be initiated.

This activity will see a clean up of the various definition contained in the various parts to move within a single location in ISO11086 which will be the location for all definitions.

7. Importance of standards development and expert's participation

In the Gas Turbines industry, there are several points in which a greater agreement between the interested parties would most likely benefit the whole of this sector. Project requirements, commissioning and operational requirement along with communication and transferal of identified risks are just a few of these.

As highlighted earlier, the current experts participating in the working group of ISO TC/192 are mainly from the OEM side. The operational experience of the customers is highly sought to ensure that their perspective and issues are properly understood and addressed in the various standards revision. Without a broad participation by operators in different part of the world, there are risks that particular legislative approaches are seen as being global state of the art, or at least perceived as de-facto state of the art.

On another front, it is believed that it would be beneficial if the general approach to residual risk transferal be standardized. Having clear level of risks communicated and understanding of how they are taken during operation and who can be considered to own the mitigation can only help the transparency and ultimately the efficiency and safety of an operational site. Is it the OEM, through design and instruction or the operator via specific inspection or behavior? Only through a partnership in standards development by all the stakeholder can this be goal be achieved.

In the longer term, the main benefits for stakeholders are to provide the world guidance on safety, design, manufacturing, testing, installation, operation, and purchasing practices to help improve global access. Additionally, the standards developed by TC 192 also provides valuable educational benefits by establishing a core level of understanding of the technology, uses, calculation examples, etc. which helps when working with regulators, users, producers, etc.

8. Conclusion

The activities of any standardization body rely on the participation of experts, ideally from the broadest possible range of experience with regards to a given topic. The ability to deliver meaningful standards that will benefit the most is dependent on this collaboration.

CAC/ISO TC/192 is currently awaiting contributors from all part of the Canadian Gas Turbine industry in order to ensure that we secure Canada's energy future through meaningful, value-adding standards.

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