Capability Statement

Supporting Standards in Gas Turbine Safety

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Background

Gas turbines are routinely used for power generation and other non-motive applications, such as offshore natural gas compression. Health and safety requirements for turbine installations are extremely stringent, with operators required to demonstrate that they have done everything possible to comply with regulations.

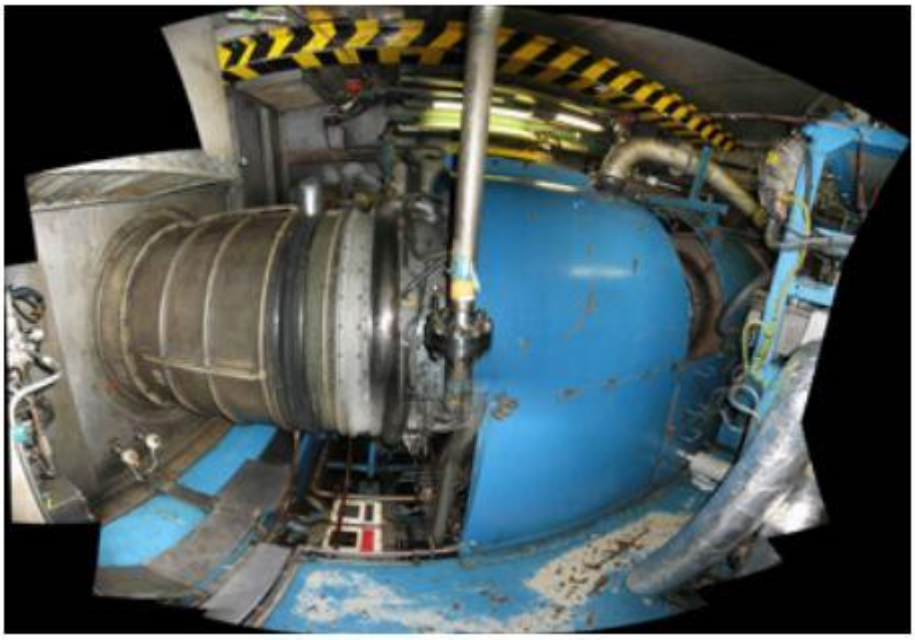
Safety Standard

The current international standard for non-motive gas turbine safety is BSI ISO 21789. This document contains a set of recommendations for the safe operation of gas turbines, which if followed, gives the operator confidence that they have done everything required by the law to operate safely. The standard is based in part on a previous HSE guidance note (PM84) and provides guidance for inspectors of the Health and Safety Executive (HSE) in the UK.

One of the most challenging aspects to comply with concerns explosion protection. In the event of a gas leak, it is possible for a flammable gas/air mixture to build up inside the turbine enclosure. This is a highly undesirable scenario, since ignition by a hot surface on the gas turbine could lead to an explosion. BSI ISO 21789 states that leak detectors should be employed within the turbine enclosure in order to detect a build up of flammable gas. The standard also stipulates that high quality ventilation should be incorporated into the turbine's design, so as to dilute any build up of gas while cooling the turbine surface.

In order to effectively design ventilation and accurately set leak detector levels, it is necessary to understand the characteristics of ventilation flow in any given enclosure. Assuming bulk mixing characteristics is too idealistic an approach, as it ignores the possibility of recirculation regions or dead zones where gas pockets can build up. The is why Computational Fluid Dynamics (CFD) modelling or other quantifiable techniques are required to validate the effectiveness of the enclosure's ventilation system.

The image to the left shows the typical view inside a gas turbine enclosure. As can be seen, there is very little space between the gas turbine itself and the enclosure walls. Therefore, in order to create such an image, it is necessary for a number of photographs to be 'stitched' together. This explains why the lines in the opposite image are bent rather than straight - it is due to the stitching process (clearly visible in the lifting beam).



Our Experience

At MMI, not only do we understand the operating environment a gas turbine faces, but we also recognise the possible pitfalls in ventilation design and the complex physics of flow in the enclosure. This is why we are uniquely positioned to help clients meet the requirements of the BSI ISO 21789 (PM84) standard. In order to ensure that operations are in total compliance with PM84, MMI offers a complete modelling and validation package. Typically, MMI Safety Engineers will spend a week on-site measuring the conditions inside the turbine enclosure. Infra-red thermal imaging, anemometers and thermocouples are used to gain an accurate representation of the velocity and temperature fields under different ventilation conditions. This is required by the standard to understand the flow characteristics of the enclosure and validate CFD modelling results.

CFD modelling is then carried out using ANSYS CFX, which is capable of representing the highly detailed geometry of the enclosure. It also accurately simulates complex physical characteristics of the flow field, such as natural buoyancy, turbulence and gas mixing in the forced ventilation environment. Once the flow field has been validated, leaks of various sizes can be simulated in order to assess the likelihood of explosive volumes being built up. A key part of the analysis is to determine the required gas detector settings to prevent excessive flammable gas volumes from accumulating in the enclosure. If ventilation is not deemed to be adequate, it can be redesigned and tested using results from further CFD modelling. The diagram to the right illustrates the results from a CFD model, showing the initial ventilation paths with vents directing flow down on to the gas turbine surface and a flammable cloud resulting from a leak in the gas turbine fuel manifold.

Ongoing Expertise

MMI has over five years' experience in supporting high level gas turbine safety. We have an ongoing commitment to help clients in the oil and gas industry maintain high safety standards and ensure compliance with BSI ISO 21789 and HSE guidance note PM84.