# Understanding Airborne Contaminant Risks In Offshore Oil and Gas Environments

**Offshore is the growth engine of the global oil and gas industry. Having accounted for a clear majority of new extraction projects in 2024, these marine environments are poised to play an ever more vital role in meeting international energy demand as the industry transitions to a lower-carbon future.**

In practical terms, delivering on this promise depends on the ability of offshore environments to run efficiently and effectively, which in turn depends on the humble – yet critical – gas turbine. Often referred to as the beating heart of offshore oil and gas operations, gas turbines function as both a power source and the mechanical drive for essential systems.

But while they might be well understood in terms of the benefits they deliver, less consideration is typically given to the pressures and demands that turbines are exposed to throughout their lifecycle. Specifically, attention is rarely applied to the impact that incredibly harsh marine environments can have on factors such as operational efficiency and maintenance frequency, which themselves have important implications for costs in the short, medium and long term.

In this article, we provide an overview of the various airborne contaminants that can negatively affect gas turbines in offshore environments, zeroing in on three main areas of risk. In doing so, we aim to help engineers develop their understanding of these contaminants and put in place strategies that ensure gas turbines, and constituent components such as filters, are optimised in terms of productivity and cost effectiveness.

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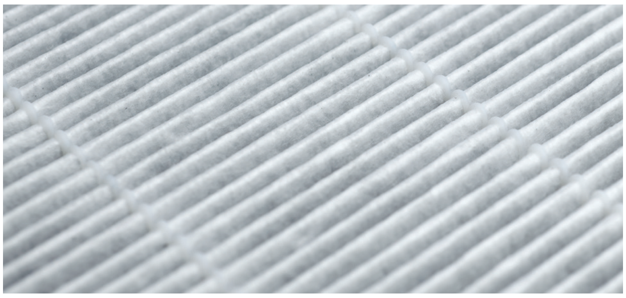
# Filtration: The First Line of Defence

While onshore installations are certainly not immune from external sources of degradation and damage, offshore platforms and Floating Production Storage and Offloading (FPSO) units are prone to far more extreme atmospheric conditions and a far broader range of contaminants and pollutants.

When operational, gas turbines are drawing in huge volumes of air that are thick with these elements. Indeed, with an estimated 29 million particles per cubic metre and air intake often over 70 cubic metres per second, it is easy to see how, at this scale, problems can quickly arise.

Filtration systems provide crucial frontline protection in the face of these risks, extracting harmful particulates and limiting their potential to stimulate corrosion. Without effective filtering in place, the operational efficiency of the turbine can be diminished, increasing demand on the level of fuel consumption required to generate the same power output. This not only carries a higher financial cost but also an environmental cost through increased emissions.



Contaminants are also the source of weakened turbine reliability, leading to more frequent – and potentially more substantial – maintenance operations. If, ultimately, this leads to an increase in downtime, this can be directly translated to lost production output with a cost that can potentially run into the millions of pounds.

Managing airborne contaminants through an effective filtering system is, therefore, crucial for optimising performance, minimising downtime, and reducing total cost of ownership over the course of the turbine's full lifecycle.

## Three Critical Culprits

### Salt

Salt, predominantly made up of sodium chloride, is a defining element of offshore environments. Put simply, it is inescapable at sea – in seawater itself but also in the air, both suspended as fine airborne particulates or dissolved in microscopic airborne water droplets.

In the presence of oxygen and moisture, salt accelerates electrochemical reactions when in contact with metals such as steel. This speeds up oxidation and results in corrosive damage.

For turbines, airborne salt is the primary contaminant risk. Sea spray generates sea salt aerosols in a range from ~0.05 to 10 μm in diameter, and filters are crucial for capturing this ubiquitous and pervasive risk.

### Hydrocarbons

The release of hydrocarbons into the atmosphere is inherent in any oil and gas production process. As such, offshore equipment and machinery must contend with the inescapable presence of very fine hydrocarbon particulates in the atmosphere, in both a wet and dry state.

This might take the form of soot generated through flaring and incomplete combustion or oil mist derived from leaking seals. Over time, these hydrocarbons result in fouling of compressor blades and air filters, compromising turbine performance.

Particle size can vary from the coarse (2.5-10 μm) to the ultrafine (<0.1 μm), with hydrocarbons at the smaller end of the spectrum exposing the limitations of less advanced filtration systems.

### Moisture

In pure form, water does not present a major corrosion risk. In offshore environments, however, water is far from pure and ever-present in the atmosphere, making it a far more significant concern for gas turbine health.

Moisture in the form of fog and mist act as carriers for a range of impurities. While this includes salt (see above) it also includes chemical vapours and dissolved gases, such as carbon dioxide and oxygen, making it slightly acidic.

These factors can all lead to corrosion, increasing the load placed on the filtration system to keep them at bay.

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# The Long-Tail of Contaminant Risks

While the three sources listed above are the primary concerns for gas turbine filtration in offshore environments, they are not the only airborne contaminants to compromise sustained operational performance.

Dust from metals, material fibres, solvents and various other process-related emissions can all accumulate over time, adding to the filtration load. Well operations, for example, can generate drilling mud and cement dust, forcing filters to contend with coarse and potentially larger-scale particulates (1–100 µm) that are highly abrasive. At the other end of the spectrum, sulphur compounds can condense into fine aerosols (0.05–2 µm). A particular consideration in sour gas fields, these particles can form highly corrosive acids when in contact with moisture.

Naturally occurring organic matter, such as sea-based microorganisms and airborne spores, also present a risk, particularly in warm and humid conditions. Meanwhile, in certain parts of the world, seasonal winds can result in offshore environments being coated in dry sand and dust, as exemplified by the northeasterly Harmattan winds that impact on the Gulf of Guinea between November and March.

# Filtration's Essential Role in Contamination Control

The variety and significance of the risks described above only serves to underline the challenges present in offshore oil and gas environments. Not always visible, these airborne contaminants pose a constant threat, and it is only by understanding the factors at play, and the filtration solutions that are designed to address them with efficiency, that engineers can optimise long-term gas turbine performance and limit ongoing costs.

**AAF International are global leaders in filtration technologies for offshore oil and gas environments.**

For more information on how our innovative retrofittable N-hance Performance Filtration solution delivers maximum protection against airborne contaminants while minimising offline events, get in touch with our team today.
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