Low oxygen fire prevention systems are an emerging technology and are being considered by companies for use in certain buildings containing a high value of goods sensitive to smoke and water damage or occupancies that present a severe challenge to other, more traditional, forms of fixed fire protection. Manufacturers are designing low oxygen systems for installation as an alternative to traditional fire protection methods in a range of building occupancies, including cold stores, IT facilities, libraries and document archives, museums, warehouses, manufacturing facilities and nuclear power plants. Manufacturers and installers report that, in the right type of building and occupation, low oxygen systems can provide effective protection and by doing so avoid damages by smoke, water and/or other fire extinguishing agents.

However, careful consideration needs to be given to the health and safety and property protection issues, including the type of building, the building environment and the on-going running costs.

HOW LOW OXYGEN SYSTEMS WORK
Low oxygen systems reduce the oxygen concentration from normal atmospheric conditions (approximately 21.9%) to a concentration below which ignition of combustible materials cannot occur by removing one of the elements of the ‘fire triangle’, which requires three elements as follows:

1. The presence of a combustible material.
2. An ignition source with sufficient energy to start combustion.
3. The presence of oxygen.

The reduction in oxygen concentration within a building space is controlled by the injection of nitrogen. Lower oxygen concentrations decrease combustion rates and at a sufficiently low value can prevent combustion entirely. The production of nitrogen is relatively straightforward and utilizes an electrically powered nitrogen generator. Generally, dry nitrogen is injected into the building space to maintain the required oxygen concentration.
ISSUES TO BE CONSIDERED
Manufacturers and installers, of low oxygen systems, report a number of benefits. However, there are a number of concerns, from both a health and safety and property protection perspective, including:

• Managing the health and safety of personnel in building spaces that are below normal atmospheric oxygen conditions.

• Ensuring that the design of low oxygen systems is effective in protecting the business assets.

• Ensuring that the building design and internal environment are such that a low oxygen system will provide effective and cost-efficient fire protection.

These concerns need to be satisfactorily addressed to ensure a robust fire prevention and protection concept for any particular facility. This has to be acceptable to all stakeholders including owner, occupier, regulator and insurer.

POTENTIAL IMPACT ON HEALTH AND SAFETY
Low oxygen systems reduce the oxygen concentration. As such, there are important health and safety considerations and systems may also be subject to local regulatory requirements or restrictions. Regulatory requirements vary from country to country.

POTENTIAL IMPACT ON BUILDING DESIGN AND INSTALLATION
Buildings need to be specifically designed with low oxygen systems in mind. Installing these types of systems in existing buildings is likely to be more challenging and may prove not to be viable. Issues to be considered include:

• System standards
   Whilst a small number of local specifications or guidance documents have been prepared, suitable global standards are not yet available. These have to cover the design, installation, operation, inspection, testing and maintenance of the systems.

• Equipment, components and control reliability
   At the present time, it is not possible to source equipment, components and controls certified by a recognized, independent testing laboratory, for example, TÜV, VdS, CNPP, LPCB or UL.

• Building integrity
   Low oxygen systems depend on building integrity to minimize oxygen infiltration and limit nitrogen loss. Inadequate building integrity can increase operating costs and potentially exceed the capabilities of the low oxygen system design. This includes factors such as entry and exit points for personnel and stock, protection of the building from external fire, impact and collision damage, management of change as well as routine maintenance requirements.

• Plan review, acceptance and commissioning
   Low oxygen systems are active systems like sprinkler protection or special hazard interlocks and controls. A programme of plan reviews, acceptance tests and commissioning practices are needed to verify the proposed system is designed and installed in compliance with recognized standards.

• Impairments
   Detailed analysis should be given to understand potential failure modes and what actions should be undertaken to manage system impairments.

• Monitoring
   Maintaining the correct oxygen concentration is essential for a low oxygen system to provide effective protection. The oxygen monitoring needs to be fully reliable and tested to verify that the design is correct for its intended applications.

NEXT STEPS
At this stage, the introduction of low oxygen fire prevention systems is being monitored carefully by Zurich Risk Engineering. Zurich strongly recommends that customers discuss any proposals to install low oxygen systems at the earliest opportunity.

Zurich welcomes the development of new, innovative fire protection systems and there is increasing interest in low oxygen systems from customers, regulators and insurers. However, for the moment, caution is recommended pending the completion of further research into the issues described in this document. This will enable more informed decisions to be taken regarding the installation of low oxygen systems in occupied building spaces.