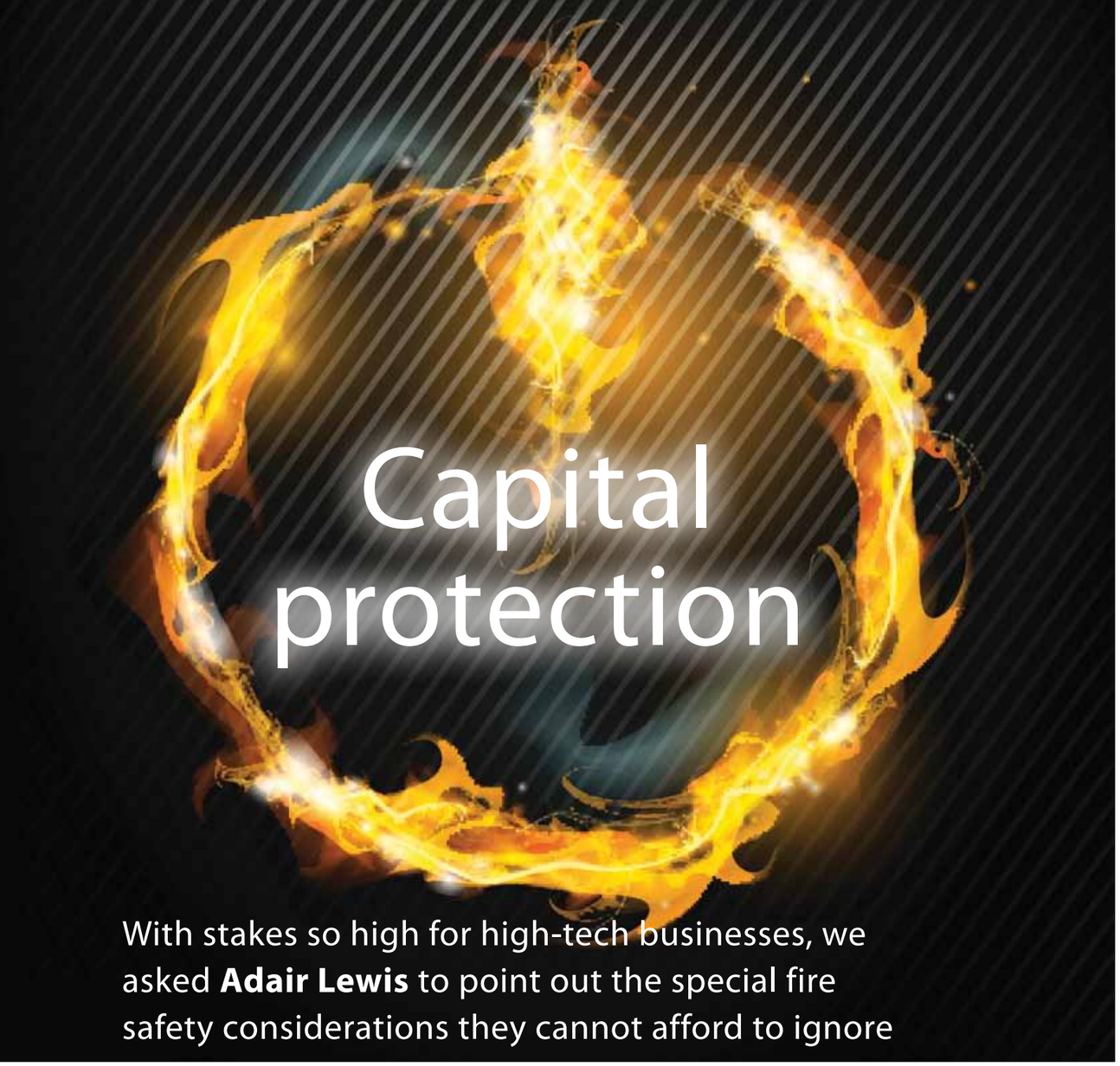

Capital protection

With stakes so high for high-tech businesses, we asked **Adair Lewis** to point out the special fire safety considerations they cannot afford to ignore

IN SOME businesses a small fire can just be a bit of a nuisance, with a temporary disruption to normal activities and some welcome banter among staff as they walk to the assembly point when the fire alarm sounds. In other circumstances, even the smallest of fires can be a complete disaster to the business. A fire in the food industry, for example, can result in losses measured in hundreds of thousands of pounds and in the electronics industry they can easily reach tens of millions of pounds.

The reason is not the threat to life, but in high tech businesses in particular it is property losses and – to an even greater extent – business continuity losses that cause the problems. In the electronics industry, a small fire can have a disproportionate effect on the business, even if it occurs in a relatively inexpensive piece of equipment. If it occurs in a critical piece of equipment or in a clean room, it can result in severe disruption over a prolonged period, with associated loss of jobs, income and status in the marketplace.

Forward planning

Many items of modern equipment in large scale manufacturing processes are increasingly expensive, with the associated economics dictating that they be used to the maximum benefit. This will include automatic running during the night and over weekends when no, or very few, staff are present in the immediate vicinity. When such operations are being planned, careful consideration must be given to fire and safety implications. Further advice in the case of unattended processes is set out in RISCAuthority Recommendations RC 42[1].

As in the case of all organisations, an effective and well tested emergency plan is the key to recovering from a potential disaster. The emergency plan for electronics companies should include details of specialists that can respond promptly in the event of a fire to advise regarding any necessary action to minimise the effects of contamination to components, equipment or finished products caused by corrosive smoke in a clean room. The plan should also detail the sources and availability of spare parts, and even complete replacement items of equipment, together with the lead times for delivery and installation.

Alternative sources should be documented wherever possible, not only for parts and equipment but for vital specialist raw materials. This will also serve to guard against a supplier having a disaster and being unable to maintain routine supplies of raw materials or components.

Fire safety management

Effective fire safety management of conventional manufacturing and fabrication areas, as well as clean rooms, requires that potential ignition sources and combustible materials both be minimised. This philosophy may be easier to enforce in a clean room, because maintaining the environment necessary to ensure the accuracy and purity of the components dictates that items that cross the barriers between the different functional areas of the workplace be minimised and controlled. These items include:

- routine personnel and supervisors
- personal effects
- raw materials and other products
- packaging
- plastic boxes containing electronic components
- visits by management, inspectors and visitors
- service engineers
- test equipment
- servicing tools and materials
- cleaning equipment
- waste materials

Equipment should be constructed from non-combustible materials where the processes will allow. This even includes ancillary items such as waste bins, which should be of metal.

Wherever possible, documentation should be undertaken outside the clean area; this not only prevents paper fibres from causing contamination of the products but removes potential fuel from the clean room. Where this cannot be avoided, workstations in clean areas should be of non-combustible construction.

Design and construction

However, the need to minimise combustible materials is not confined to equipment and workstations; during the design process, every effort should be made to reduce or eliminate the use of combustible materials in

the new facility. All elements of buildings, cabins and temporary structures should be non-combustible.

The cost and vulnerability of clean rooms is such that careful consideration needs to be given to the design of the areas and the materials from which they are constructed. This may be dictated in part by the need for surfaces that may be easily cleaned or sterilised, but this must not be allowed to take precedence over a need for surfaces of the lowest combustibility and surface spread of flame.

Suitable materials for clean room partitions will be non-combustible and include aluminium honeycomb, epoxy coated steel panels, stainless steel and gypsum board. Any prefabricated panels incorporated into the structure must have non-combustible cores. Vision panels should be of glass; the use of acrylic and polycarbonate plastics should be limited as far as practicable.

Clean areas should be subdivided where the process allows, so as to minimise the spread of heat, smoke and noxious gases. Machinery and instrumentation that are particularly expensive or intolerant to air pollution should be separated from the remainder of the facility by fire resisting construction to provide at least 30 minutes' fire resistance. In many cases, clean rooms will need to be pressurised to prevent contamination entering from elsewhere in the plant.

Clean rooms may be classified as having 'soft' walls or conventional walls. Soft wall clean rooms are normally constructed from coated mild steel or stainless steel, with PVC strip curtains or clear acrylic infill panels. Tent like structures formed of a frame covered with PVC sheeting are also available.

Where plastic materials are employed, they should be inherently fire retardant or treated with fire retarding material so as to comply with ANSI/FM 4910[2] and not to propagate fire beyond the immediate area. Such materials should produce only limited quantities of smoke. Products used should be selected so that any smoke produced has limited corrosive properties.

Clean rooms may be permanent structures, but can also take the form of portable cabin arrangements; the availability of such a resource may be valuable

to allow production to resume with the minimum of delay following a fire. The availability of suitable cabins should therefore feature in the company's emergency plans. Portable clean rooms can be supplied as a pod, complete with all necessary services to sustain a clean environment. Although this may be to provide a permanent facility or one that is available while refurbishment work is being undertaken, a portable clean room may also be valuable to allow for increased capacity on a temporary basis.

When designing facilities for manufacturing high value products, the layout should minimise the potential for an incident in one area to affect another through the direct effects of heat, smoke, firefighting water or hazardous chemicals used in the processes.

Appropriate systems

Because of the high capital value of the equipment and the importance of the facility to the continuity of the business, the fire risk assessment should assess the need for suitable automatic fire detection and suppression installations for the protection of the property and process equipment, as well as for life safety purposes.

Where equipment that presents an abnormally high fire hazard is present (such as ion implanters and furnaces), it should be subject to a specific fire risk assessment to ensure that suitable measures are provided to protect against fire or explosion.

The clean room, ducts and voids above the ceiling and below the floor should be protected by an automatic fire detection and alarm system, designed and installed by an engineer certified by an independent, UKAS accredited, third party certification body. The installation should be to a recognised category of installation, in accordance with BS 5839-1[3] or to BS 6266[4], as determined by a risk assessment and/or in consultation with the insurer. In some cases, air sampling smoke detection methods may be appropriate and effective in minimising any delay in raising the alarm in the event of an incident. The system in the clean room should be linked so as to shut down process machinery, pressurisation and ventilation systems, and also to close any transfer hatches in order to prevent the spread of smoke and gases.

Because of the value of the equipment and the facility to the continuation of the business, serious consideration should be given to installing an automatic fire suppression system. Where sprinkler systems are to be installed, they should be designed, installed, commissioned and maintained in accordance with the LPC Sprinkler Rules incorporating BS EN 12845[5] by engineers certified by an independent, UKAS accredited, third party certification body.

Liaison should be maintained between the designers of the clean room and sprinkler engineers to ensure that clean room sprinklers are designed and installed so that they are not obstructed by light fittings, laminar flow air curtains or other equipment that will be installed in the completed facility.

In the case of fixed fire suppression systems other than sprinkler systems, these should be designed, installed, commissioned, maintained and tested in accordance with the relevant British Standard and/or supplier's specification by a competent engineer. Third party test reports should be provided to demonstrate the effectiveness of the system in the event of the worst case scenario on the end use application.

Gaseous fire suppression systems should be set to operate automatically when the areas in which they are installed are unoccupied. Following a release of extinguishing agent, all forms of automatic fire suppression system must be reinstated before operations within a clean room are restarted.

Further advice regarding fire safety in the electronics industry is set out in RISCAuthority Recommendations RC40[6].

Positive benefits

Recently, just before midday, a fire occurred in the research, development and manufacturing facility of a high technology printed circuit board manufacturer. The accidental fire, involving a combustible surface, caused one sprinkler head on a wet pipe installation to operate in the affected area. Fire damage to the value of £10k is reported to have been limited to one specialist machine; fire damage was confined to about $1m^2$. None of the 30 staff in the 100m x 50m x 15m building at the time of the fire was injured. The local fire and rescue service action was confined to clean up operations, as the fire was reported to have been 'out on arrival'.

There is no report of the extent of the business interruption but, had the factory been lost to the fire, it is anticipated that the total loss could have been as high as £1.5 billion.

Noone would say that high quality, properly specified and installed fire protection systems are cheap, but the investment is often not just to protect one small area of the factory or piece of equipment – it is there to protect the whole business, the jobs of the staff and just maybe technological developments that in the future could have an impact on hundreds of lives ■

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For more information, view page 5

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