Industrial fryer* hazard controls.

Many processed foods that we buy in the supermarkets will have been deep fried or flash fried in hot oil as part of the preparation, to seal in flavour and give a golden coating. Industrial fryers are widely used in factories to prepare foods such as crisps and snacks, doughnuts, potato products, onion rings, burgers, meat balls and chicken nuggets.

With frying oils being heated to very high temperatures, often close to 200˚C, there is an inherent fire risk. Several household names in the food manufacturing industry have suffered industrial fires in recent years. To add to the fire risk, composite insulated sandwich panels with a combustible core may have been used to construct partitions and ceilings around fryers, leading to a significant fire spreading risk.

Fire suppression systems are usually installed on industrial fryers, but their reliability and effectiveness can be dependent on human factors.

*Scope: Industrial fryers (not including fryers in commercial kitchens).

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A risk management checklist

Having thorough risk management processes in place can help to minimise the risk of fire.

- Carry out comprehensive pre-start-up fryer checks and inspections to ensure all process controls and fire systems are in service and operational.
- Have low-level oil and over-temperature switches interlocked to shut down the fryer heating, oil recirculation and extraction, and have daily/weekly test regimes to confirm that the fryer heating cannot be started if the switches are triggered. These should also be backed up by monthly maintenance tests to verify the switches are functioning correctly.
- Ensure non-combustible construction in walls/partitions and ceiling for 6 metres from the fryer, or for 3 metres from the fryer if it is inside a dedicated 1-hour fire resistant enclosure. Carry out monthly testing of fire shutters if installed in a dedicated enclosure.
- Any fire suppression system should be kept permanently in automatic mode and should be interlocked to prevent the fryer heating system operating if the system is in Fault mode or if switched to Manual/Isolate.
- The fire suppression system should be verified to be in automatic mode on every production shift before the fryer is started. Also, weekly inspections should be done to verify the fire suppression equipment is in good condition, any valves are in the correct position, cylinders are pressurised, tanks are full etc.
- It's recommended to have quarterly maintenance inspections of the fire suppression system carried out by qualified contractors. And an annual inspection to include full discharge tests of the system.
- Consider having manual activation buttons installed adjacent to the fryer and also away from the fryer to enable manual activation if required.

Emergency response plan

Should the worst happen it's important that everyone knows what to do in the event of a fire.

- A comprehensive emergency response action plan should be drawn up and posted on the wall close to the fryer and also at a safe distance from the fryer. This should include photographs and images of the key components with clear instructions of what should be done by operators and emergency responders in the event of a fire and/or fire suppression system discharge.
- All operators and emergency responders should be trained on emergency response procedures and a training needs/training record matrix kept up to date with refresher training dates pre-scheduled.
- Consider installing CCTV to cover the area around the fryer to aid emergency response and monitoring of a fire situation as well as the status of the fire suppression discharge as it occurs.

Detailed Risk Management guidance.

Fryer controls

> The fryer must not be operated on a timer that would allow pre-start warm-up whilst the fryer is unattended. Attendance by Operators is required at the fryer at all times when the fryer heating is turned ON, during warm-up as well as during production.

> Fryers must be fitted with at least one low-level oil switch/probe, preferably two for added reliability. These must be positioned within the fryer body or side-chamber ABOVE the level of the over-temperature detector probe(s) and ABOVE the level of the probe(s) connected to the temperature control thermostat. This ensures the temperatures controls are ALWAYS within the fryer oil when the fryer heating is ON. The low-level oil switch(es) should be interlocked with the fryer heating system to prevent it operating if low oil level is detected.

> Fryers must be fitted with at least one over-temperature switch/probe, preferably two for added reliability. These should be set no more than 15˚C above the normal operating range of the fryer e.g. 200˚C for fryers operating between 185˚C and 190˚C. The over-temperature switch(es) should be interlocked with the fryer heating system to prevent it operating if over-temperature is detected.

> The control panel for the fryer should provide positive indication that the low-level oil switch(es) and the over-temperature switch(es) are powered and are operational. If not, the switches themselves should be fitted with status lights so that an Operator can visually verify that they are powered ON (usually a GREEN indicator) and whether they have been TRIGGERED (usually a RED indicator).

> The control panel for the fryer should provide positive indication of a low oil level or an over-temperature being detected and confirm lock-out of the heating system, whether gas, electric or thermal oil. A process alarm should be raised via sounders and beacons to ensure Operators are made fully aware of the presence of the fault alarms and the process shut-down.

> The fryer heating system should also be interlocked with the fire suppression system such that the heating cannot start-up or is shut-down if the fire suppression is in Fault mode or is switched to Manual or is Isolated.

> The heating system interlock must not be self-resetting. Full investigation and rectification of any unsafe conditions must be verified by Operators before the heating system lock-out can be reset manually.

Inspection and maintenance

> Daily visual inspections should be done on the fryer and any visible wiring to low-level oil switches/probes and temperature controls. If the switches have status lights on them, these should be checked to be ON but not TRIGGERED.

> Daily pre-start checks by Operators should include testing the fault-detection devices if the control panel is set-up for this. Verification must be done that the fire suppression is in Automatic mode before attempts are made to start the fryer. This should be tested by trying to start the fryer with the fire suppression in manual or isolated mode (some fire systems don't have a manual mode). If it is possible to test the low-level oil switch or over-temperature switch from the control panel this should also be done.

> At least weekly testing should be done on the low-level oil switch when the fryer is empty of oil by verifying that the fryer heating cannot be started in this condition. At least monthly maintenance tests should be done on the low-level oil switch to verify it is functioning correctly. The checks by Maintenance/Engineering should be scheduled in the PPM system so they can be pre-planned and the results recorded.

> At least weekly testing should be done on the over-temperature switch by turning the over-temperature setting down if this is possible and proving that the fryer heating cannot be started. If this can't be done, at least

monthly maintenance tests should be done on the over-temperature switch to verify it is functioning correctly at the expected fixed temperature. The checks by Maintenance/Engineering should be scheduled in the PPM system so they can be pre-planned and the results recorded.

- Operation of any fire shutters should be done weekly to verify they fall under their own weight to close fully and are not hindered or blocked. Verification should be done that they are triggered by the fryer fire detection at each maintenance inspection by the Contractor. These should be scheduled in the PPM system so they can be pre-planned and the results recorded.
- At least 6-monthly Contractor maintenance inspections should be done on the fryer to verify that all aspects of the fryer controls and interlocks are functioning correctly. Additionally, 6-monthly inspections should be done on the heating system whether electrical, gas fire or thermal oil heated to ensure that these are operating safely and as expected. These should include statutory inspections where applicable (e.g. the gas burners) and infra-red thermography on electrics (e.g. the fryer power supply and control panels, with the panel doors open). These inspections should be scheduled in the PPM system rather than relying on the Contractors remembering to make contact.
- On an annual basis discharge testing of the fire suppression system is required. This should prove the heat probe activation mechanism, also that the interlocks with the fryer operate as expected and the alarms/beacons function correctly. The test should be videoed wherever possible and kept on record. For water mist systems, the discharge test should be run for at least 5 minutes to allow the nozzles and interlocks to be checked. For wet chemical emulsifying agents, it is acceptable to use a small water filled canister/cylinder temporarily to permit the test to be done without needing the full clean-up period afterwards. For other types of fire suppression, smaller volume cylinders of agent can be used to reduce the re-fill costs.
- The annual discharge tests should ideally be done with the fryer empty or on cooled oil or at the end of a weekly run when the hot oil is to be discarded anyway. Discharging onto hot oil is more realistic for water mist as the droplets will be evaporated by the oil much like in a real fire, whereas on cold oil or an empty fryer the water mist will collect and puddle in a way that is not representative of a real fire situation.

Construction and enclosure

- Ideally a fryer should be located inside a dedicated enclosure constructed of non-combustible material such as mineral wool insulated composite panels. LPCB Approved composite panels can be accepted if Kingspan Quadcore but standard PIR panels and ‘old-style’ PUR panels are not acceptable due to the intense toxic smoke they generate.
- Such an enclosure might need to be fitted with automatically closing fire shutters if open at the sides, activated by the fire detection on the fryer with no more than a 30 second delay to allow Operators to clear the area. The fryers in-feed and out-feed openings should also be fitted with automatically operating fire shutters to render the gaps less than 0.3 sq.m in size, unless the openings are already less than 0.3 sq.m in size.
- If a non-combustible enclosure is provided, the ceiling panels outside this enclosure must be mineral wool or Quadcore panels for at least 3m in all directions. Any partition walls within 3m of the enclosure must also be non-combustible brick/block/concrete or mineral insulated wool panels or Kingspan Quadcore composite panels.
- If the fryer is not located inside a dedicated enclosure, the walls and ceilings within 6m of the fryer must be non-combustible brick/block/concrete walls or composite mineral wool insulated panels or Kingspan Quadcore composite panels. Uninsulated metal panel walls or non-combustible fibreboard ceiling tiles covering a roof void above are acceptable as they do not add to the fire load in the fryer area.

- Standard LPCB Approved PIR composite panels are acceptable as ceiling panels and wall panels provided they are over-sheeted with steel panels of 4mm or greater thickness laid in the opposite orientation to minimise the risk of panel delamination during a fire. EPS/XPS (Expanded/Extruded Polystyrene) or non-Approved PUR (Polyurethane) composite panels are not acceptable within 6m and need to be replaced.
- If the extract ductwork passes vertically or horizontally through additional ceilings/roofs that are classed as combustible (e.g. EPS/XPS or PUR or timber) these must also be rendered firesafe by replacing the combustible insulation with a 500mm mineral wool collar or a non-combustible ceiling/roof panel for at least 500mm around the ductwork.

Fire suppression

- Automatic fire suppression is required for all industrial fryers. This should be automatic water mist fire suppression in preference to other types of protection. The system, the supplier and the installer should have valid approvals and certifications to verify suitability of the selected water mist system for use on industrial fryers and the competency to supply/install/maintain the system itself.
- Manual fire suppression is NOT acceptable. However, all automatic fire suppression systems MUST have manual operation buttons or pull-switches judiciously positioned around the fryer area both adjacent to the fryer and distant from the fryer. This is to enable manual activation should a fire be seen by an Operator BEFORE automatic discharge has been triggered.
- Automatic water mist system water supplies can be accepted using a dedicated skid-mounted pump and tank package designed for the explicit purpose, or using high pressure cylinders, or be supplied via approved fire pumps fed from a dedicated 'sprinkler' water tank or reliable process water tank with sufficient fire-water reserve.
- Fire pumps can be electric motor driven or diesel engine driven.
- Single fire pumps systems are acceptable because the fire suppression has to be interlocked with the fryer heating systems and the fryer can't be used if the single fire pump fails. Often dual fire pumps are installed for added reliability so the fryer does not need to halt production whilst the fire pump is repaired/replaced.
- For electric motor driven fire pumps, the electrical power supply must be connected BEFORE or in parallel with the factory isolation switch and the power supply cable must be protected by 1-hour fire rated encasement or equivalent for the full length of its run to the power supply switch.
- Activation of the fryer should be by means of heat/flame detection probes designed for the chosen system and approved/certified for the purpose. The heat/flame detection probes should be suitably located in the fryer hood and the extraction duct(s). These should be arranged on a double-knock (double coincidence) basis to avoid fault activations and should be installed no more than 2m apart within the fryer hood.
- Discharge nozzles should be positioned throughout in the fryer hood and in the extract duct(s) located above the extract fan. Additional nozzles should be positioned over oil pumps, side tanks and pre-heating/melting tanks which are often positioned adjacent or below the main bath of the fryer.
- On activation of the fire detection, interlocks should trigger to isolate the heating to the gas, electric or thermal oil system. Also, the fryer oil circulation pumps should stop operating and the fryer extraction should halt with any automatic duct fire dampers closing. The in-feed conveyor, the product band and the out-feed conveyors should also be halted. If there are fire shutters around the fryer, these should close automatically after no more than 30 seconds delay with sounders and beacons giving warning to Operators to clear the area first.
- Water mist fire suppression should be designed to operate to deliver sufficient density duration for at least 20 minutes from a pumped system. Full discharge testing should be done to verify this discharge period is achievable.

- High pressure water mist cylinder-based systems can be accepted with 12 minutes full discharge period to provide at least 10 minutes density duration if all other aspects of the system and the interlocks are fully compliant. Full discharge testing should be done to verify this discharge period is achievable. A second bank of cylinders must be permanently connected to the discharge header ready for Manual discharge or to be switched into Automatic mode. Spare cylinders must also be on-site ready for re-connection in parallel with the fryer being cleaned and readied for re-start, but they do not need to be permanently connected. Engineers must have the tools ready at hand and be trained on how to switch the cylinders and to ensure automatic protection is properly reinstated.
- Water mist systems supplied by skid-mounted pump and tank packages should have ballcock valves to permit automatic re-filling. This can provide an unlimited water supply or at least extend a 20-minute tank to 30 minutes or more. If automatic re-filling is not installed, the tank should be kept filled to a level that supplies full discharge density for at least 20 minutes. Means to manually re-fill the water tank should be installed nearby so this can be done quickly in parallel with the fryer being cleaned and readied for re-start. If any fire pumps are diesel fuel driven, the fuel tanks should be kept at least ¾ full to run for at least 20 minutes and a means to quickly refill them should be provided nearby in case the tanks are low or after a fire/water mist discharge has occurred.
- Weekly visual inspections should be done by the Operator on the fire suppression system to ensure the heat detection and discharge nozzles are clear and not blocked by solidified oil deposits, any nozzles caps are still fitted to the discharge nozzles (if applicable), the water supply equipment is in good condition with no signs of faults, water supply control valves are locked in the open position where they need to be, fire pumps are ON and not leaking, tanks (water and fuel) are filled, ballcocks operate, cylinders are showing as pressurized, the control panels are all showing the correct modes without faults etc. A bespoke fire system equipment inspection worksheet should be drawn up with photographic imagery of what 'good' looks like for each element of the fire suppression system.
- Monthly inspections should be done by Maintenance/ Engineering on any elements of the fire system that need testing such as interlocks and alarms, pump activation and flow tests, tank in-fill rates and low water level alarms, cylinder head operation, trace heating on pipework etc. A bespoke fire system maintenance and test worksheet should be drawn up and scheduled in the PPM system so that the work can be pre-planned and the results recorded.
- Quarterly maintenance inspection should be done by a qualified and approved water mist system Contractor to verify that all aspects of the fire detection, discharge nozzles, damper closure mechanisms, nozzle caps (if relevant), pipework, interlocks with the fryer controls, the water supply, the control panel and the alarms are functioning correctly.
- **Other Fire Suppression systems:**
  Wet Chemical: Other fire suppression media that can be accepted include wet chemical emulsifying agents designed for use on flammable oils/fuels.
- For such systems, the nozzles caps should be metal and held on by metal wire; however, they are often supplied as plastic caps which fall off much more easily (and they need to be on the Plastics Register for a foods business). Be aware that clean-up time can be over 24 hours after discharge of wet chemical emulsifying agents as they bake onto the equipment surfaces.
- Water mist needs minimal clean-up by comparison and reinstatement time is usually less than the time it takes to replace the contaminated oil and set the fryer up for re-start.
- CO2 (carbon dioxide): CO2 fire suppression is no longer an acceptable fire suppression solution for industrial fryers. It has been used for many years so has extensive historical presence in the foods industry. However, CO2 systems fail to operate correctly too

frequently to be considered reliable. Even if they operate as designed they have proven to be ineffective too often to be considered Adequate.

> Also, a CO2 system cannot be used to protect external oil sumps or pumps or side-tanks. For a CO2 system to be accepted for an interim period whilst replacement is being planned and the budget obtained, it must be fitted with a permanently connected reserve bank of cylinders or a second shot from a bulk tank, and the fryer should either have a fully enclosed hood or it should be installed within a one-hour fire rated enclosure with automatically closing fire shutters (if present).

> The fryer heating system MUST be interlocked with the CO2 fire suppression being in Automatic mode so that the heating can't start-up or it shuts-down if the fire suppression is in Fault mode or is switched to Manual or is Isolated. Experience shows that this interlock is difficult to achieve and to verify on CO2 systems and is also quite easy to defeat.

> Ultimately, CO2 fire suppression systems must be replaced with automatic water mist fire suppression systems and the timeframe for this replacement will need to be agreed with QBE on a case-by-case basis.

You can find out more about how QBE helps businesses to manage risk at https://qbeeurope.com/risk-solutions/

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