



RP 44-13

**FIRE PROTECTION FOR
POLYETHYLENE PELLET
WAREHOUSES**

September 1997

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SCOPE AND PURPOSE This BP Group Recommended Practice contains guidance for the selection of appropriate fire response measures for polyethylene pellet bagging, palleting and storing operations in warehouses. The document is to be considered as a guide only and further reference to the BP Fire Response Workbook will be necessary in order to achieve satisfactory fire protection and fire response levels. In addition, consideration should be given to using outside expertise to ensure effective and appropriate protection for the facility. The document assumes that only polyethylene pellets are handled and stored. No powder or other products are considered.											
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FOREWORD

Introduction to BP Group Recommended Practices and Specifications for Engineering

The Introductory Volume contains a series of documents that provide an introduction to the BP Group Recommended Practices and Specifications for Engineering (RPSEs). In particular, the 'General Foreword' sets out the philosophy of the RPSEs. Other documents in the Introductory Volume provide general guidance on using the RPSEs and background information to Engineering Standards in BP. There are also recommendations for specific definitions and requirements.

Value of this Recommended Practice

This Recommended practice contains guidance for the selection of appropriate fire response measures for polyethylene pellet bagging, palleting and storing operations in warehouses. The document is to be considered as a guide only and further reference to the BP Fire Response Workbook will be necessary in order to achieve satisfactory fire protection and fire response levels. In addition, Consideration should be given to using outside expertise to ensure effective and appropriate protection for the facility.

Application

This document may refer to local, national or international regulations but the responsibility to ensure compliance with legislation and any other statutory requirement lies with the user. The user should adapt or supplement this document to ensure compliance for the specific application.

Qualifications to Applicability

This Recommended Practice although a Group document has been prepared and developed by BP Chemicals and is specifically designed for use in Chemical Plants.

Feedback and Further Information

Users are invited to feed back any comments and to detail experiences in the application of BP RPSE's to assist in the process of their continuous improvement.

For feedback and further information, please contact Standards Group, BP International or the Custodian. See Quarterly Status List for contracts.



1. INTRODUCTION

This Recommended Practice contains guidance for the selection of appropriate fire response measures for polyethylene pellet bagging, palleting and storing operations in warehouses. The document is to be considered as a guide only and further reference to the BP Fire Response Workbook will be necessary in order to achieve satisfactory fire protection and fire response levels. In addition, consideration should be given to using outside expertise to ensure effective and appropriate protection for the facility.

The document assumes that only polyethylene pellets are handled and stored. No powder or other products are considered.

2. OVERVIEW OF PRODUCT STORAGE AND HANDLING FIRE HAZARDS

Polyethylene pellets have a high flash point and higher fire point, which means that they are not easily ignited and will not easily burn during normal bagging and storing operations. However, prolonged exposure to a heat source can cause pellet ignition and, once burning, the fire can quickly take hold and spread. This will occur when, for example, pellets are exposed to a fire involving paper, cardboard, wooden pallets or electrical equipment.

Once burning, pellets will be difficult to extinguish in their packaged and palletised form but may be dealt with more easily where residual/waste pellets have ignited around or under machinery.

Paper, cardboard, plastic bagging and pallet wrapping (shrink wrapping) are more easily ignited than the pellets and so it is good practice to ensure these materials are strictly controlled in and around the warehouse.

It is essential that ignition sources such as matches or fork-lift trucks are controlled and combustible materials which may be ignited by these sources are kept to a minimum within the packing, bagging and storage areas and also kept separate or at least at a distance from the potential ignition sources.

3. CONTROL OF IGNITION SOURCES

The following are typical sources of ignition in polyethylene pellet warehouses:-

Electrical motors, distribution or switchgear panels/cabinets, electric or gas fired bag sealing elements, electric or gas fired pallet shrink wrapping units, air compressors, fork lift vehicles, fork lift vehicle battery charging areas, road transport vehicles, smoking.



Effective control of these sources will reduce fire potential. This control is achieved by regular inspection and maintenance work and machinery and equipment checks and monitoring. Control is also achieved by ensuring that only plant and equipment which have proven reliability and safety and meet recognised national or international standards is employed in warehouses. Other controls are, for example:-

- (a) Battery charging for fork lift vehicles is undertaken elsewhere. Electric motors are located where easily observed.
- (b) Electric motors are frequently checked for dust and pellet accumulations.
- (c) Road vehicle engines are switched off when loading is underway.
- (e) The refuelling facilities for diesel or LPG powered forklifts are at least 50 metres from the warehouse.
- (f) Gas fired shrink wrapping units are equipped with an emergency gas shut-off valve at a safe location, preferably outside the building.
- (g) Air compressors are located outside the building and, if in the immediate vicinity, in a fire rated enclosure which will prevent fire spread into the warehouse via openings or ducts.

4. EXAMPLES OF FIRE INCIDENTS

The following are known examples of incidents which have occurred at polyethylene bagging and storing facilities:-

- (a) Electric heat seals for bags did not release during heat sealing. Overheat caused bag to melt and ignite fire confined to bag seal unit.
- (b) Electric motor insulation overheat and ignition. Fire confined to motor.
- (c) Air compressor located outside the warehouse caught fire and fire migrated into the warehouse via an opening in the wall, igniting cardboard cartons.
- (d) Heavy goods vehicle engine fire during loading at warehouse. Fire confined to vehicle.

These provide an indication of where fires may occur but they should not be considered the only possible cause of fire events.

5. FIRE PROTECTION POLICY

Facility fire protection must meet all relevant national or international legislation. In some countries legislation is still very prescriptive including, for example, the necessity to install sprinklers in all warehouses, whatever the contents being stored. In most European countries, however, legislation has become less prescriptive and a "risk based" approach is required. In this it is necessary for the facility owner to demonstrate that a safe operation is being run and that measures to prevent risk to life safety and the environment are in place and adequate.

This is undoubtedly the general trend of legislation and therefore it is necessary to ensure that the chosen protection strategy is justified and documented in order that it can be discussed and agreed with the relevant local authorities. Even when local legislation is very prescriptive, the local authority having jurisdiction should be consulted as it may be that they will accept less expensive solutions provided they still provide the same levels of protection. This will vary from country to country. Above all, the means of escape for occupants of the facility must be assured whichever strategy is adopted. Any additional fire protection thereafter should be risk based (i.e. appropriate to the level of potential fire frequency and consequences).

Like most buildings or facilities there are a number of options to consider for fire protection and use of the techniques employed in the BP Fire Response Workbook will assist in achieving a site specific, relevant level of fire response.

For any facility, in order of priority, fire response should consider:-

- (a) Regulatory Requirements
- (b) Life Safety
- (c) Environment
- d) Production Loss
- (e) Asset Loss.

One other consideration that may be important, especially in the case of Joint Ventures, is that of insurance. Local requirements or those of Joint Venture partners may demand insurance, which, in turn, is dependent on provisions of certain levels of protection.



There are essentially 3 options for polyethylene warehouse facilities as follows:-

5.1 Maximum Fire Protection

Fully automatic sprinkled facility, smoke detection in or over machinery and in storage areas, manual fire alarm call point system, passive fire protection throughout building and on the legs of silos or other high structures in the immediate vicinity of the warehouse which may be susceptible to collapse under fire conditions, separate storage buildings, separate bagging/palleting building. This could be applicable for highly critical facilities where there is no on-site fire response group or local authority fire brigade units for manual intervention and a fire in the facility would escalate to other areas.

5.2 Passive Protection and Manual Response

Manual fire alarm call point system, some dedicated fire detection system, building structure and silo legs and supports with passive fire protection, separate storage/bagging areas with a full time or well trained site fire response teams or local fire brigade units for manual intervention. This could be applicable in critical facilities where fire could spread to other areas but where it is known that the manual fire response was well trained and competent.

5.3 Controlled Burn-Down

Acceptance of building and contents loss by assuring life safety (means of escape) and a fire response which prevents fire escalation to other facilities. This would be applicable where the fire would not spread to other areas and the asset loss or production loss would not be such that operations could not be sustained, or restarted with a minimum disruption to customers. To prevent fire spread, it may still be necessary to provide water cooling from mobile monitors for adjacent downwind structures unless other buildings are more than 30m distant. In such cases, the availability, deployment and operation of such equipment should therefore be assured. It may be available from the local fire brigade. Reliable water supplies and hoses are required for monitor operation along with adequate training for those personnel who will use them.

This option should not be considered in cases where other unprotected critical facilities (essential service piping, controls alarm and communications cabling etc.) are within 10m of the warehouse.

6. FIRE PROTECTION AND FIRE RESPONSE CONSIDERATIONS

The selection of appropriate fire protection for the warehouse should take into account a number of issues which will have either direct or indirect influences on the levels of protection.

6.1 Manning Levels

If the warehouse is manned on a 24 hour basis then the need for automatic heat or smoke detection may be reduced since a fire event could be reasonably expected to be observed and the alarm raised. A manual fire alarm call point system may be sufficient in such cases. 24 hour manning also means that a manual response to a fire event is possible at all times and that the provision of portable fire equipment offers the potential for extinguishing incipient fires if personnel are trained in its use.

6.2 Means of Escape

In event of a fire in the facility, occupants must be able to reach a place of safety without being placed at risk. Whatever overall policy is adopted, means of escape must be designed into the facility to allow personnel to escape from a fire event without being exposed to the effects of heat or smoke whilst using the escape routes. (National or international legislative requirements for means of escape in buildings must be incorporated into the facility to assure life safety).

6.3 Passive Protection

6.3.1 Structural

Passive fire protection for the building structure may be considered such that the structure can withstand an internal fire duration for a specified time, typically 4 or more hours. This form of fire protection may save the building columns and beams but fire damage will occur to the roofing of the building and in most cases an unchecked fire will result in total loss of contents. The advantage offered by passive protection of the building structure is therefore in terms of refurbishment time reduction but this will only apply if the passive protection performs as intended under fire conditions.

6.3.2 Specific Equipment

The supports or the legs of silos or other high structures in the immediate vicinity of the warehouse which may be susceptible to collapse under fire conditions may need to be passively protected to prevent their collapse onto the affected building or onto adjacent or

nearby buildings. This becomes particularly important if a controlled burn down policy is being considered.

6.3.3 Fire Divisions

Ideally, for new facilities, bagging and storage areas should be sub-divided and if possible, storage areas should also be sub-divided. The use of minimum 4 hours fire resistance walls between the bagging and storage areas and the provision of normally open fire doors in the division openings would minimise fire spread and offer the opportunity of product salvage.

If storage areas can be similarly sub-divided or, ideally, separated from each other then further product salvage may be achieved.

6.4 Storage and Handling Practices

Only the minimum quantity of bag rolls, wrapping rolls and cardboard cartons should be kept in the bagging area and these should be kept in a designated, clearly marked area, away from electrical and other potential ignition sources. Cardboard should be kept separate from the bag rolls and the bag rolls separate from wrap rolls. This is to ensure that if ignition of any of these materials occur, only that stack or pack of material will burn in the initial fire stage, thus giving time for operators to respond with fire equipment.

Pallet or bag stacking height is governed by the nature of the product. Generally, two pallet loads are the maximum height for storing as more than this will mean bag/pallet slippage or movement and probable collapse.

If racks are to be used, no more than two pallet tiers should be placed on each rack level. Under fire conditions, pallet and bag collapse means released pellets into the fire area creating further rapid spread. A minimum space of one metre between the top bags and any light fitting on the building roof should be assured to prevent ignition by light fittings.

6.5 Fixed Automatic Fire Systems - Sprinklers

Automatic water sprinkler systems can be effective for detecting, creating alarm and controlling fires in warehouses but there are several points which must be considered in providing sprinklers for palletised loads. Whilst sprinkler systems may be particularly effective for facilities which are partly or wholly unmanned or where effective manual fire response is unavailable, the system will only be effective if the design considers the nature of fire spread in the stacking

arrangements and considers pallet collapse. The design of sprinklers should acknowledge the pallet stacking arrangement and also the inspection, testing and maintenance requirements of the sprinklers.

In particular, it is essential that water supplies are reliable and that the system is inspected and tested regularly, including checking the pipework and system flow capability. Such inspection/test requirements are onerous and require trained manpower and substantial commitment if they are to be carried out properly.

Whilst the practice of stocking only two pallets high may seem to reduce fire development, the pallets provide horizontal air spaces for fire spread against which sprinklers may not be effective. In addition, once palletised bags collapse on to other pallets, sprinklers may not be very effective in penetrating the bags to control the fire.

Using [BS5306](#) Part 2 as a general guide and using the “high hazard” classification, sprinkler heads should have a minimum clear space between top of pallet stack or rack of 1m. The deflector of a sprinkler head should not be less than 75mm below the underside of a roof and not more than 150mm. For rack storage > 3m height, in rack sprinklers should be provided. Maximum area coverage for sprinkler heads will generally be 9m² with maximum sprinkler head spacing of 3.7m. The minimum design application rate should be 12.5 lpm/m².

A reliable water supply and means of delivery is required for a sprinkler system. Typically, a minimum of 4 hours supply for the maximum water demand is required. Maximum demand will be based on largest fire zone or area of the system. In addition, sprinklers require a guaranteed water supply and a reliable means of delivery as well as a high standard of maintenance. This may not always be available.

Sprinkler installations require water drainage consideration. Generally, there are no drains in polyethylene pellet warehouses or bagging areas as drains frequently become blocked by pellets. A screen may be provided to hold back pellets but this will require regular inspection and cleaning. If sprinklers are to be provided the layout of the building should consider water run-off to external areas and possibly nearby buildings or facilities.

If a sprinkler system is to be installed, it must conform with a recognised standard such as U. K. Loss Prevention Council Rules for Automatic Sprinkler Installations (which incorporate [British Standard 5306](#) Part 2:- Fire Extinguishing Installations and Equipment on Premises, Specification for Sprinkler Systems).

6.6

Fire Detection and Alarm

Smoke from an incipient fire will rise to a warehouse roof and spread laterally over the roof. Thus there may be a delay before any roof mounted smoke detection actuates for an incipient fire event. Specific area/equipment smoke or heat detection rather than full area coverage may be more suitable for polyethylene warehouses.

The more probable sources of fire events are considered to be the heating elements involved in bag sealing operations. (Whilst there are other sources of ignition and therefore sources of fire events at warehouses (Section 4) it is not normally considered practical to provide detectors at each of these specific sources).

These heating elements may be monitored by smoke detection above the area of sealing operation. This would ensure an early alarm in event of sealing element overheat and incipient fire. If smoke detection is to be provided then a detector should be located directly above and preferably inside the sealing unit rather than on the ceiling or roof of the building structure. Care should be taken with selection of fire detection type where gas fired sealing/heating elements are used. Smoke detection may give regular spurious alarms due to gas fire flame presence. Flame detection would certainly give a regular spurious alarm due to gas flame. Consideration may be given to heat detection for gas fired units.

Manual fire alarm call points should be provided in the building in any event with call points at each building exit to allow occupants to raise the alarm as they leave the building. Alarm sounders should be such that they can be heard in all areas of building allowing for background noise levels.

It should also be remembered that some types of warehouse structures may include offices/control rooms/switchgear rooms for which smoke detection may be considered according to occupancy and criticality.

6.7

Firewater Supply and Fire Hydrants

A suitable firewater supply is essential for most protection strategies, even a controlled burn-down one. Typically, a minimum 4 hours supply will be required, based on the worst case fire scenario. The firewater supply should be always available and reliable in operation. Fire hydrants should be provided around the facility, spaced typically at 75 metre intervals. Fire hydrant outlet connections should be compatible with the on-site fire hose and fire vehicle connections and/or any local fire brigade or mutual assistance response group hose and vehicle connections.

6.8 Hose Reels/Fire Hose

Hose reels may be considered within the facility but it should be recognised that these are of limited length and may not reach all areas of a warehouse. The siting of hose reels on structure columns in between rows of stacked pallets is not recommended due to the dangers of pallet collapse under fire (and water) conditions. Whilst hose reels may be of benefit around the bagging and wrapping areas they are not generally considered suitable for use in storage areas.

Use of rolls of 45mm fire hose with hand held water nozzles to be used from internal hydrant connections offers greater flexibility than hose reels in internal firefighting but the same pallet collapse dangers will be present and therefore this option needs careful consideration in relation to life safety.

If hose reels and/or fire hose are considered, personnel in the area will require effective training on internal firefighting using such equipment.

6.9 Fire Extinguishers

Extinguishers should be provided at all facilities. The number, quantity and type should be based on a survey of the facility to assess potential fire scenarios. Extinguishers should be positioned adjacent to the equipment for which they are intended but on an escape route at sufficient distance from the equipment so that personnel are not put at risk when retrieving the extinguishers. These must be appropriate for the hazard. Water extinguishers offer cooling for fires involving cardboard, bags, wrapping and pallets. Carbon dioxide extinguishers are most effective for fires involving electrical equipment. Multi-purpose dry powder may be used as a single extinguisher agent but it should be noted that in using this type of extinguisher there is no post fire security. Personnel in the area will require effective training in the use of extinguishers and the extinguishers must be maintained regularly.

6.10 Site Fire Response Group/Local Fire Brigade

The existence of a site fire response group or local fire brigade offers the possibility of relying on only a mobile response, rather than having fixed automatic fire systems. However, in order to be effective, these groups must be well trained, competent and equipped with the resources required to control and or extinguish the worst case fire involving the facility. Conversely, the fire conditions within the warehouse may be such that personnel are placed in hazardous conditions in order to deal with an internal fire event. This aspect of

response should be given careful consideration and, if adequate trained response is not available, a controlled burn down approach accepted.

When assessing the competency/appropriateness of a local fire brigade the following aspects, in particular, should be addressed:-

- (a) Speed of response (over a full 24 hour period on a guaranteed basis).
- (b) Number of firefighters responding.
- (c) Equipment on board responding vehicles (condition and quantity).
- (c) Training of personnel in fighting industrial incidents, particularly those involving warehousing.
- (d) Recognition/Agreement of strategies to attack fire and the preplan to carry out the chosen strategy.

6.11

Controlled Burn Down

Allowing the facility to burn down may be an option if life safety risks are considered excessive for manual firefighting or firewater supplies and/or fixed fire systems are unreliable or not cost-justified.

It is necessary to control a burn down since not to do so may result in burning debris migrating to adjacent facilities or radiant heat causing fire spread to other facilities. Other concerns may be plant inter-connecting pipework or services external to the facility being damaged by fire or acting as a route for fire spread to other facilities. In particular, silos supports may need passive fire protection to prevent their collapse.

Uncontrolled burn down only applies to a warehouse which has no adjacent facilities within range of potential fire escalation and therefore fire response groups should have to attend this type of incident and should have the resources to carry out controlled burn down actions such as deployment of fire hose and water monitors for cooling adjacent or exposed facilities. If controlled burn down is a viable option then reconstruction costs and time should also be considered.

6.12

Pre-Fire Plans

Pre-fire plans are an essential part of any fire response. These provide essential guidance to responding personnel and can assist in reducing fire impact by listing critical actions which should be carried out and the



resources required to perform the actions. In addition, by formalising the chosen strategy, they can reduce risk to life safety by ensuring that all personnel are aware of the actions they must take in the event of a fire.

Pre-fire plans should be developed for the facility and regularly exercised to ensure personnel are aware of required response methods, procedures and actions.

6.13

Considerations for Final Response Choice

Whichever fire response option is eventually selected, it must be fit for purpose. To this end, the following should be noted before final decisions are made:-

- (a) Passive protection should consider the anticipated fire duration and be properly applied to structures if it is to achieve design intent.
- (b) Sprinkler system design should consider fire spread potential via the spaces in the wooden pallets, possible collapse of the pallets and water drainage.
- (c) Heat and smoke detection systems should consider locations offering the earliest possible alarm and the alarm should be raised in a manned area.
- (d) The fire response groups should have the resources and capability to deal with the “worst case” fire at the facility in accordance with the chosen strategy. If the local fire brigade is to be relied on as the only manual response then factors such as response times, personnel competence, resources etc., must be considered.
- (e) Manual fire response should consider the hazards of firefighting internal warehouse fires. Pallet collapse, bagging bursts, smoke density and structure collapse are examples of the very real dangers which firefighters will face if they decide to combat the fire from inside the warehouse. Breathing Apparatus will be required.
- (f) Fire training should be competence based and relevant to the facility.

7. APPLYING FIRE PROTECTION AND FIRE RESPONSE TO NEW WAREHOUSES

Once the warehouse project options and location decisions are taken, the appropriate fire protection and fire response combinations as listed in Section 6 above should be selected according to the circumstances, location and environment of the new warehouse. i.e. The overall policy should be selected (See Section 5) and the appropriate parts of Section 6 used to provide basic design information.



DEFINITIONS AND ABBREVIATIONS

Definitions

Standardised definitions may be found in the BP Group RPSEs Introductory volume.

Abbreviations

LPG	Liquefied Petroleum Gas
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LIST OF REFERENCED DOCUMENTS

A reference invokes the latest published issue or amendment unless stated otherwise.

Referenced standards may be replaced by equivalent standards that are internationally or otherwise recognised provided that it can be shown to the satisfaction of the purchaser's professional engineer that they meet or exceed the requirements of the referenced standards.

British Standards

[BS 5306](#) pt 2 Fire Extinguishing Installations and Equipment on premises,
Specification for Sprinkler Systems

BP Group Document

BP Fire Response Workbook
(Available from the custodian of this Recommended Practice)

