COMAH Competent Authority

Initial report on the findings of the oil/fuel depot safety alert review

June 2006

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Introduction

1 Following the publication of the Buncefield Major Incident Investigation Manager's first progress report to Buncefield Major Incident Investigation Board (available at www.buncefieldinvestigation.gov.uk), HSE issued a 'safety alert', also available at www.hse.gov.uk/comah) to all COMAH[1] operators. The alert asked operators of oil or fuel depot storage installations similar to Buncefield to complete a review of key design and operational aspects of their installations to ensure that they were complying with current good practice and relevant standards. The review was backed up with site inspections to ensure that any immediate safety concerns were being addressed.

2 COMAH operators have responded positively in their support to the safety alert. The Competent Authority[2] (CA), has received excellent co-operation for the review from trade associations and member companies.

The scope and nature of the review

3 The review sought information from bulk oil/fuel storage sites relating to the control of risk covering:

- location/layout of bulk tanks and equipment;
- design for primary containment;
- secondary containment/mitigation measures;
- operational control measures; and
- inspection and maintenance systems.

4 These aspects were further broken down into 53 individual issues that operators were asked to review and report upon. A copy of the review document for a COMAH top-tier site is given on www.hse.gov.uk/comah. Responses have been received from all 108 sites that the review relates to. This provided a considerable amount of information which needs to be analysed and assessed fully. A detailed report of the findings on the full range of issues will be published in the autumn on HSE's website. In the meantime initial findings against the key issues relating to the control of tank overfilling and loss of containment are presented in this report. These issues are:

- provision of fire-safe tank isolation valves;
- clear identification of tank capacities;
- provision of remotely operated shut-off valves (ROSOVs);
- provision of automatic tank contents gauging systems;
- tank high-level alarms and trips to prevent overfilling;
- whether alarm and trip systems are independent of tank contents gauging systems;
- the integrity of tank bunds;
- means of detecting significant leaks;
- the provision of clear operating procedures;
- shift handover arrangements; and
- maintenance of emergency isolation valves.

[1] Control of Major Accident Hazards Regulations 1999 (COMAH).
[2] HSE, The Environment Agency and the Scottish Environment Protection Agency acting jointly to enforce The Control of Major Accident Hazards Regulations 1999 (COMAH).

Main conclusions

5 A detailed breakdown of the findings against the 10 key issues covered by this report is given in Annex 1. Major incidents on the scale of Buncefield at fuel/oil storage sites are extremely rare and overall there was good compliance with current guidance, codes and standards at the majority of installations.

- 86% of issues reviewed were found to be satisfactory;
- 12% of issues reviewed were found to give rise to minor concern; and
- 2% of issues reviewed were found to be below good practice.

6 Significant issues were found at five sites. These related to inadequate:

- bunding (2);
- risk assessment (2); and
- maintenance of fire fighting systems.

7 The Competent Authority (CA) has taken action to ensure that good practice is met at all such sites, as a minimum standard. As a result three improvement notices have been served. Enforcement action has not been necessary at all five sites identified with serious issues, because the operators had already taken immediate action to secure the necessary improvements.

8 An important finding of the review was the inconsistent interpretation of the current, broadly-based HSE and industry guidance for sites that store and manage very large quantities of highly flammable liquids. This resulted in considerable variation in the standards adopted at different sites in some key areas. A thorough review of relevant guidance, codes and standards will therefore be undertaken by the Safety Standards Task Group (see paragraph 22).

Limitations of the review

9 It should be noted that the type and extent of the issues reviewed was decided in late February 2006 ahead of the publication of the Buncefield Major Incident Investigation Manager's second and third progress reports to the Buncefield Major Incident Investigation Board (available at www.buncefieldinvestigation.gov.uk). The review team anticipated the likely causal factors of the Buncefield incident on the basis of the information available at the time, ensuring that any necessary improvements in safety were considered at the earliest opportunity. Inevitably a number of contributory factors that have subsequently emerged in the third progress report were not covered in this review, but these are unlikely to significantly alter the overall findings of the review and will be followed up and reported in the autumn.

10 A targeted series of site inspections by the CA were undertaken as part of the review. Due to the tight timetable, the inspections focused on the key areas set out in paragraph 4 and this report is concerned only with the findings against those important areas. However, these initial findings, combined with the information from the Buncefield Major Incident Investigation Manager's third report and that still to be made available through the Major Incident Investigation Board's report expected in July, will direct the work of the Task Group[3] that the CA and industry have established to act on the lessons learned from the incident.

[3] Buncefield Safety Standards Task Group

11 After the second progress report from the Buncefield Investigation Manager to the Major Incident Investigation Board, the Environment Agency commenced a more detailed review of bunding issues and operator's environmental awareness. This work is due for completion in mid July 2006. Significant issues are already emerging from that work in relation to bund integrity and bund capacity, which are being followed up by the Environment Agency. In addition, issues are emerging about poor environmental awareness of some operators in relation to matters such as drainage and emergency response. The results attached to this report at Annex 1 are a snap-shot of the present position, but on only 10 of the 11 areas of the review (bunding is presently excluded from the analysis). The Environment Agency's more detailed results on bunding will be incorporated in the later update planned for the autumn.

12 Because of the very tight deadline set within the safety alert, in a few cases, further information or clarification is being sought before a final assessment against the areas reported in Annex 1 can be made. It is thought unlikely that any will give rise to serious concern. Matters that cannot currently be fully resolved will be finalised as part of the publication of the detailed findings of the review in the autumn.

What the law requires - using good practice in assessing compliance

13 The COMAH Regulations require an operator of a major hazard establishment to take all measures necessary to prevent major accidents and limit their consequences to persons and to the environment.

14 Operators have to undertake a suitable and sufficient risk assessment to determine the measures necessary to ensure that risks to health and safety are adequately controlled. As a minimum, the control measures adopted must achieve the standard of recognised good practice for the industry. Relevant codes, standards and guidance are used as a reference to illustrate good practice. These comprise of a range of options available for the control and mitigation of risk. Current standards and guidance do not generally contain prescriptive requirements. The CA's regulatory approach is to ensure that the operator of a COMAH site can justify the selection of the control measure provided and will take enforcement action where the standard of compliance falls significantly below accepted good practice.

Guidance on and benchmarking against good practice

15 The main HSE guidance on the storage of flammable liquids is HSG176 *The Storage of Flammable Liquids in Tanks*, and HSG186 *The bulk transfer of dangerous liquids and gases between ship and shore*. Other underpinning standards and codes are listed in Annex 2.

Benchmarking against good practice

16 The review was essentially a benchmarking exercise comparing the controls in place against good practice. For a number of issues it is difficult to generalise about which control systems constitute good practice at every site. These are decisions the operator has to make following an adequate risk assessment. For example, where the rate of filling compared to the capacity of the tank beyond the maximum working level allows sufficient time to detect and stop the filling before the tank overflows, it may not be a requirement to fit an automatic gauging system

or a high-level alarm. In certain situations, under current guidance, it is acceptable to have manual gauging systems using dipsticks or dipping tapes without any automatic gauging or alarms. However, where high-level alarms are fitted, they have to be independently 'hard wired' of any automatic tank gauging systems in order to ensure that any failure to the gauging system does not also cause the safety alarm to malfunction. The assessment protocol outlined in Annex 1 shows how decisions on good practice were reached for each of the key issues contained in this report.

17 The safety alert review offered the CA the opportunity to take a closer look at the adequacy of existing guidance, codes and standards applicable to bulk oil/fuel storage sites. The CA believes that there is considerable scope for variation in the standards adopted from the range of options available within current guidance and that there is a need for greater clarification on the interpretation of the guidance. This view is shared by the industry. One such example is on the fitting of ROSOVs, on pipelines to and from tanks. HSG176 and HSG244 both state that a ROSOV should be capable of being operated remotely and that it should remain operational in the event of a power failure or should fail safe/fail closed. Many sites are provided with motorised valves that can be operated remotely and which are used to control the normal operational flows and product routings. Many of these valves would fail 'in position' in the event of power loss in an emergency and so may not be available to isolate the contents of a tank. Such valves are therefore not considered to fully meet the requirements of a ROSOV, whereas in the review, many operators reported that installations with this sort of valve were provided with ROSOVs.

18 The adequacy of existing guidance, codes and standards applicable to bulk oil/fuel storage sites will be a key consideration by the Buncefield Safety Standards Task Group.

Action against findings

19 The CA has taken action to tackle the significant issues outlined in paragraph 6. Action is also being taken at sites where any aspect of compliance was found to be below good practice. These are items assessed as 'red' in Annex 1. Once again these sites will be rechecked to ensure that appropriate improvements are made.

20 In addition, sites where minor concerns are recorded about the standard of compliance for any key issue (scored as amber in Annex 1) will be contacted to agree any improvements required. Final action on some of these minor issues relate to clarification and interpretation of existing guidance and therefore may need to await the outcome of Task Group's work. For example, Annex 1 highlights a discrepancy on whether tank isolation valves comply with BS 6755. There is a need for an agreement with industry whether this actually is the most up to date and relevant standard needed to achieve fire safety. Once this issue has been agreed the CA will expect operators to put in place improvements to meet the recognised standard.

21 As well as the issues identified from the CA visits, many operators used the Safety Alert and the emerging findings from the Buncefield Investigation to take a close look at their safety system. Consequently, many have identified additional steps to take to increase the level of risk control. Information on the type of improvements planned is given in Annex 1, examples range from; reviewing and updating instructions for operators; extending automatic gauging, alarms and shut-down trip systems to additional tanks; to remedial improvements to bunding.

Safety Standards Task Group

22 The COMAH CA, working with the key industry trade associations, including UK Petroleum Industry Association (UKPIA), Tank Storage Association (TSA), Chemical Industries Association (CIA), has set up a 'Task Group' to act upon findings within this report and the information now available from the Buncefield Major Incident Manager's third progress report.

23 The task group will be chaired by Ken Rivers who is Shell UK Oil Manufacturing Director, and will include the regulators HSE, Environment Agency (EA) and Scottish Environment Protection Agency (SEPA) as members of the Task Group in order to ensure that appropriate regulatory oversight, and if necessary, direction, of the process is maintained. HSE will support and manage this important programme to ensure that revised best practice guidance for health, safety, and environment is produced for such installations as soon as practicable. Where any early lessons can be promulgated that will also be done.

24 HSE will work with the EA/SEPA, industry, trade unions, and others to bring the best available experience to bear on the standards which should be achieved at bulk oil or fuel storage sites. Regular contact will be maintained with the Buncefield Major Incident Investigation Board to ensure that the latest findings from the investigation can be incorporated as soon as possible.

25 HSE, working with the COMAH CA and others, will put in place enhanced safety standards to improve major accident prevention at oil/fuel storage depots by mid 2007. It will also ensure that appropriate improvement plans are developed to implement safety improvements.

Annex 1: Findings against key issues

How the findings were rated

The findings in this report are represented by a simple scoring system:

GREEN	Nothing to indicate that the standard of compliance within this item was inadequate.
AMBER	Some minor concerns relating to compliance within this item.
RED	The standard of compliance with this item was below good practice.
F/I	Further information or clarification is being sought before a final assessment can be assigned.
N/A	Issue not applicable to the installation
Improvements	This identifies where an improvement in this item is being implemented or planned. This can be where the current standard of compliance is not thought to be adequate, or more commonly, where an improvement to a standard above that considered as current good practice is being made.

Summary of the main findings against each item

	Item	Findings							
Qn No.		GREEN	% of Total	AMBER	% of Total	RED	% of Total	% F/I	% N/A
2.4.1	Shut off valves	55	51	47	43	4	4	2	0
2.4.2	ROSOVs	98	91	10	9	0	0	0	0
2.6.1	Tank capacity	104	96	4	4	0	0	0	0
2.6.2	Auto gauging	100	93	7	6	1	1	0	0
2.7.1	Overfill protection	101	94	5	5	1	1	0	0
2.7.2	Independent alarms/trips	91	84	8	7	4	4	2	3
3.2	Leak detection	97	90	10	9	1	1	0	0
4.2.1	Instructions	94	87	10	9	2	2	2	0
4.4	Shift handover	78	72	13	12	1	1	1	14
5.2	Exercise Emergency isolation valves	96	89	10	9	1	1	1	0

Findings against each item

Qn.2.4.1	**Is each pipeline connected to a tank provided with a suitable fire-safe shut-off valve located inside the bund wall and close to the tank?**
Discussion	Tanks should be fitted with means to safety isolate their contents in the event of an emergency situation. This is an important measure to prevent an incident from escalating. Isolation valves should be capable of remaining liquid-tight closed in a fire. HSE's current guidance on this issue refers to meeting the requirements of BS 6755 *Testing of valves: Part 2: Specification for fire type-testing requirements*. The assessment against this issue was based on the provision of isolation valves to each pipeline **and** that these valves met the requirements of BS 6755. The provision of fire-safe tank isolation valves was considered to be the minimum requirement.
51 % GREEN	Nothing to indicate that the standard of compliance within this item was inadequate.
43% AMBER	Some minor concerns relating to compliance within this item. Mostly this related to compliance with BS6755. Many valves were described as metal-to-metal faced gate valves that were considered to be fire resistant. This was assessed as 'amber' unless it could be clearly stated that they complied with BS6755.
4% RED	The standard of compliance with this item is below good practice. This was either where isolation valves have not been provided or if they were not considered to be fire safe.
2% F/I	Further information is being sought to finalise the assessment.
Nil	Issue not relevant at the installation.
5% Improvements	For most sites this related to ensuring that the valves were checked against BS6755.

Qn.2.4.2	Are ROSOVs provided?
Discussion	As outlined in the discussion under question 2.4.1 fire-safe isolation valves are considered to be a minimum legal requirement. These valves may be arranged so that they are capable of being automatically operated remotely from the valve position as in an emergency, rapid isolation of tanks may be one of the most effective means of preventing loss of containment, or limiting its size. The fitting of remotely operated shut off valves, ROSOVs, is not an absolute legal requirement. There is a legal requirement to assess risks and identify suitable controls to reduce these to as low as is reasonably practicable. As a minimum, it is considered good practice to explicitly assess the need for measures to control the release of hazardous substances following a loss of containment downstream. ROSOVs are one measure to deal with such events but other means may be used providing they are equally effective. HSE's current guidance (HSG176 and HSG244) both state that ROSOVs, where provided, should be capable of being operated remotely **and** that they should remain operational in the event of a power failure or should fail safe/fail closed. Many sites were provided with motorised valves that can be operated remotely but many of these would fail in position in the event of power loss. Such valves were not considered to meet the requirement of a ROSOV.
91% GREEN	Nothing to indicate that the standard of compliance within this item was inadequate. Unless information was provided to indicate that ROSOVs were required and not provided **or** that a risk assessment had not been completed to justify the current provision then the site was assessed as green. This meant that a site without ROSOVs could still be judged as compliant.
9% AMBER	Some minor concerns relating to compliance within this item. Mostly this related to the absence of an adequate risk assessment to justify not fitting ROSOVs.
Nil RED	The standard of compliance with this item is below good practice. Sites where based on a risk assessment, ROSOVs would be required but had not been provided.
Nil F/I	Further information is being sought to finalise the assessment.
Nil N/A	Issue not relevant at the installation.
14% Improvements	For many sites this meant that the operator was reviewing/improving the provision of ROSOVs or the configuration of the emergency shut down arrangements.
Additional findings	At 21% of installations ROSOVs were fitted to all tanks and at 31% of installations ROSOVs were fitted to at least some tanks. Tanks could be automatically isolated, by using either motorised control valves or ROSOVs, at 66% of installations.

Qn.2.6.1	**Are tank capacities clearly defined and is there an adequate safety margin provided?**
Discussion	Knowing that there is sufficient capacity in the tank to hold any planned load is an essential requirement for the safe planning of tank filling and emptying operations. A clearly defined and recorded capacity for all tanks was considered to be the minimum legal requirement.
96% GREEN	Nothing to indicate that the standard of compliance within this item was inadequate.
4% AMBER	Some minor concerns relating to compliance within this item. Mainly this related to the lack of adequate justification for the designated safety margin or where capacities were determined but not recorded.
Nil RED	The standard of compliance with this item was below good practice. This mainly related to sites where the tank capacities were not clearly defined and/or documented.
Nil F/I	Further information is being sought to finalise the assessment.
Nil N/A	Issue not relevant at the installation.
4% Improvements	For many sites this meant that the marking and documentation of tank capacities was being reviewed and updated.

Qn.2.6.2	**Do tanks containing highly flammable or flammable materials have automatic gauging?**
Discussion	The provision of automatic gauging is preferred to manual dipping of tanks as it allows for determination of the tank contents without opening the tank or without a person having to climb on top of the tank. Automatic gauging systems can be connected to level alarms and tank content management systems to provide an integrated control and measurement system. However, the provision of automatic gauging is not a legal requirement in all circumstances providing that adequate management of tank filling and emptying can be accomplished, eg large capacity tanks with a relatively slow rate of filling. Therefore, sites without automatic gauging systems could still be scored as compliant. Suitable arrangements for ensuring the level in tanks can be adequately monitored during filling and emptying operations was considered to be the minimum requirement.
93% GREEN	Nothing to indicate that the standard of compliance within this item was inadequate.
6% AMBER	Some minor concerns relating to compliance within this item. Mainly this related to sites where it was considered appropriate to make some minor improvements to the tank gauging systems.
1% RED	The standard of compliance with this item was below good practice. This mainly related to sites where the provision of automatic gauging is considered necessary but where none was provided.
Nil F/I	Further information is being sought to finalise the assessment.
Nil N/A	Issue not relevant at the installation.
8% Improvements	For many sites this related to reviewing or upgrading current gauging systems eg automatic gauging was being extended to all tanks on site.
Additional findings	82% of installations had automatic gauging fitted to all tanks, 9% of installations had automatic gauging on some tanks and 7% relied on manual dipping.

Qn.2.7.1	Do overfilling protection systems include alarms and/or trips?
Discussion	Suitable arrangements should be made to prevent the overfilling of tanks. Normally this involves the provision of high high-level alarms that alert operators to a tank filled beyond its intended safe maximum. A high high-level alarm may also be arranged to trigger an emergency shut down, eg stop the filling pump, close valves or divert the flow, if no action is taken following the high-level alarm. The provision of high-level alarms and high high-level alarms and trips is not compulsory providing that the operator has made adequate provision to prevent tank overfilling. This was considered to be the minimum requirement.
94% GREEN	Nothing to indicate that the standard of compliance within this item was inadequate. Some tanks, or sites with manual gauging and no alarms may still be considered adequate.
5% AMBER	Some minor concerns relating to compliance within this item. Mainly, these related to sites where it was considered appropriate to review or make improvements to the current arrangements in tank alarms or pump or valve trips. Often this involved reviewing the configuration of the alarms and safety trip systems.
1% RED	The standard of compliance with this item was below good practice. This related to sites where, given the nature and extent of the operations undertaken, the arrangements for detecting and preventing tank overfilling were considered to be inadequate.
Nil F/I	Further information is being sought to finalise the assessment.
Nil N/A	Issue not relevant at the installation.
8% Improvements	For many sites this meant the current alarm and trip systems were being reviewed, upgraded or extended.
Additional findings	63% of sites had high-level alarms fitted to all tanks, with 7% sites with high high-level alarms fitted to at least some tanks. 26% sites had high-level trip/shutdown systems fitted to all tanks while 22% had high-level trip/shutdown systems fitted to at least some tanks.

Qn.2.7.2	**Are these independent of the means of contents measurement?**
Discussion	Safety related alarms and trips should be independent of other process or operational alarms. Hard-wired high high-level alarms with, where appropriate, executive action, was the most common measure provided in this category. To be rated as adequate all high-high-level alarms and associated trip and shut down systems had to be independent of the normal tank gauging and alarm systems.
84% GREEN	Nothing to indicate that the standard of compliance within this item was inadequate.
7% AMBER	Some minor concerns relating to compliance within this item. Mostly related to where it could not be clearly stated that the alarms/trips were independently configured. Frequently, further information or reviews were being undertaken to clarify the position.
4% RED	The standard of compliance with this item was below good practice. Sites where the final high-level alarm/trip was not independently configured.
2% F/I	Further information is being sought to finalise the assessment.
3% N/A	Issue not relevant at the installation.
6% Improvements	Most improvements identified were in relation to reviewing the provision of independent alarms and trips or extending alarms and trips systems to other tanks on the site.

Qn.3.2	What provisions has the operator made for detecting and dealing with loss of containment of flammable materials?
Discussion	Gas detection is not normal for liquid storage, but some means for detecting unscheduled movement/variation in tank contents would be expected. Normally this was by unscheduled movement alarms fitted to automatic gauging systems, or liquid/oil detection in bunds or drainage systems.
90% GREEN	Nothing to indicate that the standard of compliance within this item was inadequate.
9% AMBER	Some minor concerns relating to compliance within this item. This was at sites where no means of detecting leaks was present other than by routine visual inspection.
1% RED	The standard of compliance with this item is below good practice. This was mainly at sites where the nature of the operations was such that overfilling had either occurred or where there was considered to be a high risk of overfilling and which relied on manual inspection to detect loss of containment.
Nil F/I	Further information is being sought to finalise the assessment.
Nil N/A	Issue not relevant at the installation.
7% Improvements	Most improvements identified were in relation to extension of automatic systems to all tanks or the provision of flammable gas detection systems.
Additional findings	46% of sites had some form of automatic leak detection system whilst 5% had flammable vapour detection systems in place.

Qn.4.2.1	Are suitable written instructions and/or job aids in place for operation of the facility?
Discussion	Clearly documented procedures covering, where relevant; selection and filling of tanks, selection of routes, valve/pump sequencing, stock and packet control, flow measurement and tank contents monitoring, communications for transfer control and operational tours of site were considered essential.
87% GREEN	Nothing to indicate that the standard of compliance within this item was inadequate.
9% AMBER	Some minor concerns relating to compliance within this item. This was mainly in relation to the scope of the procedures provided or clarification of some of the details.
2% RED	The standard of compliance with this item was below good practice. This was where suitable written procedures were not available.
2% F/I	Further information is being sought to finalise the assessment.
Nil N/A	Issue not relevant at the installation.
10% Improvements	Most improvements identified were in relation to reviewing procedures in the light of the lessons from the Buncefield incident.

Qn.4.4	**Is there a structured shift handover format in place?**
Discussion	Where a shift system was in operation a minimum provision was considered to be a handover procedure that specified simple and unambiguous steps to ensure effective communications at shift/crew change. These included; carefully specifying what information needs to be communicated, using structured easy-to-read logs or computer displays, ensuring key information is transmitted verbally and in writing and encouraging two-way communication.
72% GREEN	Nothing to indicate that the standard of compliance within this item was inadequate.
12% AMBER	Some minor concerns relating to compliance within this item. Mainly this was where the shift handover relied on verbal communication or very brief logs of key issues.
1% RED	The standard of compliance with this item was below good practice. This was where an adequate shift handover system was not in place.
1% F/I	Further information is being sought to finalise the assessment.
14% N/A	Issue not relevant at the installation.
8% Improvements	Most improvements identified related to handover procedures were being reviewed against HSG48 or some other good practice guidance.

Qn.5.2	**Is there a schedule to ensure that valves required for emergency isolation are exercised periodically to ensure that they are operable?**
Discussion	As a minimum standard, isolation valves that perform a safety function should be routinely tested and exercised to ensure they operated to the desired standard when called upon in an emergency situation.
89% GREEN	Nothing to indicate that the standard of compliance within this item was inadequate.
9% AMBER	Some minor concerns relating to compliance within this item. This was mainly where the testing regime could not fully test the functioning of the valves as they were used in normal operations.
1% RED	The standard of compliance with this item was below good practice. This was where there was no routine testing regime for isolation valves.
1% F/I	Further information is being sought to finalise the assessment.
Nil N/A	Issue not relevant at the installation.
1% Improvements	Most improvements identified were in relation to reviewing the testing regimes, eg by having a separate test regime beyond the normal operational use of the valves.

Annex 2: Relevant codes, standards and guidance relating to storage of flammable liquids at oil/fuel depots

The storage of flammable liquids in tanks HSG176 HSE Books 1998 ISBN 0 7176 1470 0

The bulk transfer of dangerous liquids and gases between ship and shore HSG186 HSE Books 1999 ISBN 0 7176 1644 4

BS2654: 1989: *Specification for manufacture of vertical steel welded non-refrigerated storage tanks with butt-welded shells for the petroleum industry* British Standards Institution (withdrawn and replaced by BS EN 14015: 2004 on 2005/02/11)

BS EN 14015: 2004: *Specification for the design and manufacture of site built, vertical, cylindrical, flat-bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperature and above* British Standards Institution

API standard 650: *Welded steel tanks for oil storage* (Tenth Edition) American Petroleum Institute 1998

BS 6755 Part 2 1987: *Testing of valves: Specification for fire type-testing requirements* British Standards Institution

Remotely operated shut off valves (ROSOVs) for the emergency isolation of dangerous substances HSG244 HSE Books 2004 ISBN 0 7176 2803 5

IP Model Code of Safe Practice Part 2: *Design, construction and operation of petroleum distribution installations* American Petroleum Institute 2005 ISBN 0 85293 383 5