Model code of safe practice

Part 16

Guidance on tank cleaning

4th edition

energy institute

MODEL CODE OF SAFE PRACTICE PART 16: GUIDANCE ON TANK CLEANING

Fourth edition

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FOREWORD

An Energy Institute (EI) Model Code of Safe Practice is not intended necessarily to represent the most stringent requirements for managing a particular issue, nor does it represent a minimum standard. Instead, it sets out principles and guidance on good practice rather than a set of rigid rules which, in the opinion of a cross-section of technical representatives and based on practical experience, if implemented should ensure adequate protection of people, assets and the environment.

Storage tanks containing petroleum products need to be cleaned to facilitate a change of product, maintenance, repair, inspection, modification or demolition. The cleaning of storage tanks can involve many hazards that could result in harm to people, assets and the environment if the work is not properly planned, controlled and executed. The main hazards include:

– fire and explosion arising from the flammable products stored and potential sources of ignition;
– health hazards from exposure to hazardous substances;
– hazards due to working within confined spaces, and
– hazards which may have an environmental impact.

This Model Code gives guidance on safety, health and environmental protection risk assessment and management for tank cleaning operations. It has been prepared on the basis that most tank cleaning operations are outsourced by clients to specialist contractors. The Model Code provides information that should help clients understand the contractor's operations and sets out client organisational and work control arrangements that should protect people, assets and the environment. For the contractors, the Model Code stresses the need for proper planning, control and execution of tank cleaning operations. It also identifies typical hazards and good practice control measures, including organisational arrangements and equipment specifications. Therefore, the Model Code is intended for use by both clients and tank cleaning contractors, and should be read by client installation managers, project engineers, maintenance managers, maintenance contractors, and safety advisors.

Every project is different and the specific circumstances should be considered and each project planned accordingly. The plan should be based on safety, health and environmental risk assessments that take full account of current legislative and regulatory requirements, and related guidance. Such risk assessments should identify the control measures necessary to ensure that tank cleaning operations are safely controlled and carried out.

The fourth edition of this Model Code was commissioned by the EI Distribution and Marketing Safety Committee: it replaces the third edition published 2008.

This Model Code may be further reviewed and revised from time to time. It would be of considerable assistance if users would send comments or suggestions for improvement to the Technical Department:

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OVERVIEW

Section 1 defines the scope and exclusions of the Model Code in terms of storage tanks, products and safety, health and environmental protection in tank cleaning operations. It describes how the Model Code should be applied given that most tank cleaning operations are outsourced by clients to specialist contractors.

Section 2 sets out preparatory work that should be carried out before commencing a tank cleaning project. It includes guidance on client planning, contractor selection, control of work (including risk assessment and Permit To Work (PTW) systems), provision of pre-start information (including from pre-cleaning inspections), record keeping, permissions, communications and emergency preparedness.

Section 3 provides guidance on contractor organisation and personnel, including competence, supervision and health and fitness.

Section 4 provides guidance on the selection, specification and control measures for equipment and services used during a tank cleaning project; in particular, powered, test and protective equipment, and breathing air, water and electrical services.

Section 5 provides guidance on taking storage tanks out of service, including emptying and line clearing of products and isolation of various equipment and services.

Section 6 provides guidance on the methods, hazards and control measures for gas-freeing of various types of storage tanks, and provides guidance on gas detection.

Section 7 provides guidance on hazards and control measures for tank cleaning operations. It emphasises the need to carry out as much cleaning as is practicable from outside the storage tank, and also provides guidance on tank entry requirements for various work types. In addition, it provides guidance on control of such work, including hazards and control measures.

Section 8 sets out cleaning issues, hazards and control measures relevant to the cleaning of tanks used for storing specific product groups, ranging from crude oils through to refined products and residues.

Section 9 sets out necessary checks to ensure that the storage tank is ready to be recommissioned safely by the reversal of isolations of various equipment and services. Some guidance is provided on retaining storage tanks out of service.

Annex A provides glossaries of terms and abbreviations.

Annex B provides the EI classification of petroleum products, which should be used when assessing their fire-related hazards.

Annex C sets out various hazards and relevant control measures typically encountered in tank cleaning operations, such as fire and explosion, hazardous substances, confined space hazards, radiation hazards, and physical hazards.

Annex D provides detailed guidance on Permit To Work (PTW) systems, which are key to control of work. It sets out the responsibilities of various parties and processes for managing PTWs.

Annex E provides guidance on the typical contents of a work programme, such as the requirements of method statements.

Annex F provides guidance on gas detection using portable gas detectors; in particular, principles, limitations and applications.

Annex G provides guidance on gas detection using chemical detector tubes; in particular, principles, equipment types and applications.

Annex H provides guidance on the methodology for maintaining relevant equipment at earth potential.

Annex I provides guidance on the specification and control measures for using vacuum tankers.

Annex J provides details of publications referenced – including UK legislation, regulations and standards – and a bibliography for additional pertinent publications not referenced.

KEY TECHNICAL CHANGES

This section sets out in a generalised form, the key technical changes between the third and fourth editions of this Model Code. Note that this edition also contains numerous smaller technical changes and editorial amendments. Specifically, the key technical changes are to sub-heading or clause:

1.1 This sub-section provides additional guidance on the hazards associated with tank cleaning.
1.2.1 This clause clarifies that the Model Code has not been written to cover rectangular design tanks or self-bunded tanks.
1.2.2 This clause clarifies that the Model Code covers tanks which have been used to store biofuels and the type of additives stored at distribution terminals.
1.2.3 This clause includes the need to carry out risk assessments to determine the frequency and methods of tank cleaning.
2.1.1 This clause clarifies the need for client planning at initial stages of the project.
2.2 This is a new section which covers the need to provide pre-start information to those carrying out the tank cleaning works.
2.4 This sub-section now covers Safe Systems of Work (SSOW) rather than just PTWs.
2.5 This sub-section has been extended to cover both site visits and inspections.
2.6 This sub-section has been extended to cover explosive atmospheres, not just hazardous area classification.
2.7 This sub-section has been extended to cover local environmental conditions, not just weather conditions.
2.8 This sub-section has been changed to cover the contents of the project file rather than a health and safety file.
2.10 This sub-section now covers managing changes rather than just changes in condition.
2.11 This sub-section has been rewritten so that it follows the HSE guidance on risk assessment. It also removes the example risk assessment.
2.12.3 This clause has been extended to include waste management rather than just sludge management.
2.12.6 This is a new clause which covers emissions to air.
2.15 This is a new sub-section that has been added to cover monitoring and audit.
3.2 This is a new sub-section that covers supervision.
3.3 This sub-section has been extended to cover competence rather than just training.
3.4 This sub-section has been amended to cover health and fitness rather than just medicals.
4.2.4 This is a new clause that has been added to cover modified vehicles.
4.4.1 This clause now recommends that the use of breathing air is determined by risk assessment.
4.4.2 This clause recommends that service water rather than firewater is used for tank cleaning, and that recycling wash water may be desirable for economic and environmental reasons.
4.5.6 This clause has been reduced with a recommendation to obtain specialist advice if testing for specific contaminations such as mercury or radioactive contamination.
4.5.7 This is a new clause which covers the testing for Volatile Organic Compounds (VOCs).
4.6.1 This clause has been reduced by removing some of the detail for specific pieces of (PPE).
4.7.17 This clause now includes a new section on pollution control equipment.
4.7.18 This is a new clause covering the remote monitoring of confined spaces.
5.1.1 This clause recommends the need to assess the emptying and cleaning of lines.
5.1.2 This clause recommends that the roofs of floating roof tanks are confirmed to have been safely landed before continuing with further works.
5.2.2 This clause recommends that isolations are marked on a drawing.
5.2.3 This clause recommends that lines containing product should have suitable arrangement throughout the tank cleaning works to prevent overpressuring.

5.2.5 This clause highlights the need to consider fail-safe equipment such as Remotely Operated Shut Off Valves (ROSOVs) when carrying out electrical isolation as these may remain operational due to independent powered systems.
5.2.6 This clause highlights the need to consider SIL-rated equipment to ensure works are carried out in line with BS EN 61511.
5.2.7 This clause highlights the need to determine if the fixed fire protection equipment should be left operational during the cleaning works.
5.2.8 This is a new clause which covers tank heating systems.
6.4.2 This clause recommends that consideration be given to the need to use natural ventilation until the tank atmosphere has been reduced below the LEL.
6.4.6 This is a new clause which deals with the use of foam.
6.9.1 This clause highlights that an accurate assessment when testing for flammable gases is not always possible from tank access points.
6.9.3 This clause highlights that an accurate assessment when testing for oxygen is not always possible from tank access points.
7.1.6 This is a new clause which covers tank heating systems.
7.2.1 This is a new clause that covers risk assessment in preparation for personnel tank entry.
7.2.2 This clause now includes an extended table for tank conditions for personnel tank entry and work in petroleum product storage tanks.
7.3.1 This clause has been updated to cover a broader range of hazards.
7.3.2 This clause has been extended to cover rescue procedures, as well as escape procedures.
7.3.5 This is a new clause covering remote monitoring and entry control.
7.4.3 This clause highlights that the use of biocides can introduce hazards and therefore there is a need to consider whether testing is required.
7.5.1 This clause highlights the need to ensure compatibility when changing products.
8.5.7 This is a new clause covering medical surveillance for lead.
8.13 This is a new clause covering additives and blend components.
C.5.1 This sub-section has been expanded to cover specified confined space risks.
E.1 This is a new sub-section which highlights that the works will probably be undertaken in the UK under the Construction, Design and Management regulations (CDM).

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Tony Brown	Federation of Petroleum Suppliers
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1 INTRODUCTION, SCOPE AND APPLICATION

1.1 INTRODUCTION

Storage tanks containing petroleum products need to be cleaned to facilitate a change of product, maintenance, repair, inspection, modification or demolition. The cleaning of the storage tanks can involve many hazards that could result in harm to people, assets (e.g. plant, buildings and equipment) and the environment if the work is not properly planned, controlled and executed. These hazards include:

– fire and explosion arising from the flammable products stored and potential sources of ignition;
– health hazards from exposure to hazardous substances;
– hazards due to working within confined spaces, and
– hazards which may have an environmental impact.

As such the risks associated with the work need to be assessed and controlled, by for example not entering a confined space if it is reasonably practicable for the works to be undertaken without entering.

1.2 SCOPE

1.2.1 Storage tanks

This Model Code aims to cover tank cleaning of fixed bulk storage tanks used for storing petroleum products, operating at near-atmospheric pressure, of the types commonly encountered at bulk storage installations such as petroleum refineries, import/export installations, distribution terminals, and depots. These storage tanks are principally vertical, cylindrical, above-ground steel tanks, with floating roofs, or fixed roofs (with or without internal floating covers). Therefore, its purpose is to provide guidance for these above-ground and partially buried large storage tanks, and it has not been written for rectangular design tanks and self-bund tanks where additional consideration, methods and control measures may be needed.

Large buried, semi-buried or mounded storage tanks are usually of the vertical cylindrical type, and as such many of the principles given in this Model Code can be applied to these tanks as well. However, certain aspects of their construction, such as roof columns and entrance tunnel, require special consideration and additional precautions. Advice should be sought from organisations with experience in cleaning such storage tanks.

Cavern storage (rock- and salt- mined and solution mined storage tanks) have additional hazards and cleaning issues and this type of storage is not covered by this Model Code. Organisations with experience in cleaning cavern storage should be consulted.

The Model Code does not cover road and rail tankers, container tanks, barge or ship tanks, pressurised storage vessels such as spheres and bullets for liquefied petroleum gases (LPG), or refrigerated storage. Filling station and customer storage tanks are also not expressly addressed; for the former, see APEA/EI *Design, construction, modification and maintenance of filling stations and EI Code of safe practice for entry into underground storage tanks at*

service stations. Whilst the cleaning of similar types of storage tanks is described, their siting and access may require additional control measures to be observed.

1.2.2 Products

This Model Code covers tanks which have been used for storage of:

- Crude oil.
- Finished, refined or intermediate products.
- Biofuels such as ethanol, methanol, and FAME (Fatty Acid Methyl Ester).
- The types of additives stored at distribution terminals such as cetane enhancers and 2-Ethylhexyl nitrate (2EHN). Further guidance on 2EHN can be obtained from ATC Document 79 2-Ethylhexyl nitrate (2EHN) Best Practices Manual Prepared by the 2EHN Industry Work Group.
- process water and ballast water; these contain varying amounts of petroleum and therefore should have similar control measures to those applied to petroleum storage tanks.

Hereafter, all these products are referred to as petroleum products.

Storage tanks which have been used to store other petroleum products such as aviation fuel (e.g. Avgas and Avtur) or bitumen are generally covered by this Model Code; however, care should be taken to consider any additional hazards and evaluate the risks, for example from additives including lead alkyl compounds. Further guidance should be sought when cleaning these tanks, for example from relevant bodies such as the Refined Bitumen Association if cleaning a bitumen tank. Storage tanks which have been used to store benzene, or products with high benzene content (i.e. greater than 3 % by volume), are outside the scope of this Model Code. (See Annex C.3.5.).

The cleaning of tanks which have been used for storing chemicals (with the exception of additives described earlier in this section) is out of scope. Although the guidance provided in this Model Code may be relevant in many cases, the appropriate information should be sought from suppliers to enable hazards to be understood and control measures selected following risk assessment.

1.2.3 Cleaning

This Model Code focuses on the safety and health hazards for personnel and the need for environmental protection associated with the preparation for, and performance of, tank cleaning operations. It provides guidance on devising a method of work that should protect people, assets and the environment. General guidance on tank cleaning procedures is provided; however, the Model Code does not constitute a detailed manual on the subject nor attempt to advise on the relative effectiveness of the various methods or the choice of method for any particular case.

The decision to clean a tank, the frequency of cleaning, (or the frequency of inspections which drive the need for cleaning) and the methods of cleaning (particularly where that cleaning requires tank entry), should be based on a strategic risk assessment which considers the benefits to be gained in doing the cleaning (or inspection) versus the risks to be managed. In addition, it should be noted that cleaning should always be carried out without entering a confined space if it is reasonably practicable to do so.

The purpose of the tank cleaning covered by this Model Code may be to:

– prepare a storage tank for a change of product;
– remove accumulations which are interfering with operation or quality control;
– decontaminate a storage tank that has contained products subjected to microbial spoilage;
– enable inspection, maintenance or modifications to be carried out, or
– enable a tank to be decommissioned prior to its demolition and removal.

The cleaning may give rise to hazardous liquid, semi-solid or solid waste material, and brief guidance is given on its disposal.

1.2.4 Safety, health and environmental protection

This Model Code gives guidance on safety, health and environmental risk assessment and management for tank cleaning operations. This should commence with the identification of hazards, and guidance on this is provided in Annex C.

Although this Model Code details the typical control measures needed for cleaning storage tanks, it does not deal with the additional control measures necessary before and during subsequent maintenance (e.g. painting), repair, modifications or demolition, which may involve hot work (e.g. flame cutting, welding, etc.). For general guidance on maintenance requirements see EI *Design, construction and operation of petroleum distribution installations* and for further guidance on fire control measures during maintenance see EI *Fire precautions at petroleum refineries and bulk storage installations*. Brief guidance is given, however, on the control measures that should be observed before recommissioning after tank cleaning.

1.3 APPLICATION

This Model Code is based on the premise that the appropriate level of technical expertise is available, and that where there are shortfalls, specialists should be contracted from outside the organisation.

This Model Code has been prepared on the basis that most tank cleaning operations are outsourced by clients to specialist contractors. The Model Code provides information that should help clients understand the contractor's operations and sets out necessary client organisational and work control arrangements that should protect people, assets and the environment. For contractors, the Model Code stresses the need for proper planning, control and execution of tank cleaning operations: it identifies typical hazards and relevant control measures to reduce risks, and sets out good practice to help contractors when developing their own cleaning procedures. Therefore, the Model Code is intended for use by both clients and tank cleaning contractors, such as client installation managers, project engineers, maintenance managers, maintenance contractors and safety advisors.

This Model Code sets out principles and guidance on good practice rather than a set of rigid rules which, in the opinion of a cross-section of technical representatives and based on practical experience, if implemented should ensure adequate protection of people, assets and the environment.

Users of this Model Code should develop their own procedures, which may differ in detail but should conform to the principles set out in this document. The procedures should also take into account any unusual or local circumstances; on which it is impossible to generalise. It is for users to select conditions appropriate to their specific circumstances based on risk assessment. Whilst written in the context of the United Kingdom (UK) legislative and regulatory framework, the principles set out in this Model Code can similarly be applied in other countries, provided national and local statutory requirements are complied with. Where legislation differs from this guidance the users of this Model Code should comply with whichever legislation is the most stringent. A list of relevant UK legislation and guidance is provided in Annex J.

For the purpose of this Model Code certain interpretations of terms and abbreviations apply, irrespective of any meaning the words may have in other connections; these are provided in the glossaries (see Annex A).