Guidelines for the design, installation and management of thermal insulation systems

energy institute

GUIDELINES FOR THE DESIGN, INSTALLATION AND MANAGEMENT OF THERMAL INSULATION SYSTEMS

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FOREWORD

These guidelines provide information to help develop a strategy for the management of insulation systems applied to process plant and equipment and to assist operators with maintaining integrity from construction through to decommissioning. The guidelines also include newly developed performance standards for insulation systems that are considered helpful in achieving effective life cycle management.

It is expected that these guidelines will be of use to operations and integrity engineers and managers, corrosion engineers, technicians, contractors and inspectors, and all parties concerned with the application, inspection and maintenance of insulation systems for process plant located both offshore and onshore. In addition, they should be of value in conveying details of these key activities to personnel dealing with insulation for the first time, as their structure should also serve to inform the 'novice' in the wide ranging issues, including developing strategies and liaising with specialists and contractors.

The project to compile industry guidance for management of insulation systems was instigated by representatives of the UK offshore oil and gas industry and directed by a cross-industry steering group (SG).

Although produced for the UK offshore oil and gas production industry, guidance provided herein is regarded as also being applicable to onshore oil and gas production and/or treatment facilities and similar industries such as petrochemical plant and refineries throughout the UK and the rest of the world.

Note:

In several places throughout, use has been made of examples that have been provided by members of the SG. Where these have been cited, it is implicit there may be alternative good practice ways and methods that others may use to meet the same objectives. Therefore, these examples are provided for guidance only and should not be regarded as a recommendation or an industry standard.

The Energy Institute (EI) and those involved with compiling this document cannot accept any responsibility of whatsoever kind for loss or damage or alleged loss or damage arising or otherwise occurring in or about premises, areas or facilities to which these guidelines have been applied.

It is intended that these guidelines will be reviewed and revised when there are changes in related standards, industry practices or in the light of practical experience. Comments on the document are welcome with a view to incorporating improvement at the next issue. Comments should be addressed to:

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1 INTRODUCTION

1.1 PURPOSE

Guidance provided in this publication aims to identify the major elements required to build an effective strategy for the management of insulation systems on a facility during its entire life cycle. This involves addressing the design, installation and operation stages, all of which should focus on the maintenance of integrity at all times, with the main aim being to prevent water ingress, which risks the onset of plant damage by corrosion under insulation (CUI)[1], and the loss of insulation performance.

To assist with this aim, the concept of performance standards and intervention levels has been adopted in collaboration with manufacturers to enable industry to establish an inspection and repair regime appropriate for insulation systems.

1.2 SCOPE

The scope of these guidelines covers five principal areas of activity for new or replacement insulation assemblies:

a) Management systems.
b) Design.
c) Installation.
d) Inspection and maintenance of insulation systems.
e) Review of performance.

Effective design and application of insulation and associated components is necessary to achieve the life cycle integrity required to maintain operating efficiency and safe operation of plant. This requires deployment of competent personnel in the areas of design, application, inspection and maintenance. Therefore, the scope also includes guidance on competency and provides examples of competency schemes that are in place and are commonly used. The scope covers the use of insulation systems for the following applications:

– Energy conservation (reducing heat loss) from process systems and plant.
– Maintaining process temperatures including:
  - Reducing transfer of external heat to low temperature systems.
  - Maintaining optimum process (separation, reaction) conditions.
  - Prevention of formation of undesirable conditions so as to prevent deposition of solids material such as wax and gas hydrate.
  - Prevention of freezing or winterisation. (Note, that where insulation alone would be inadequate, electric or steam tracing may be used.)
– Provision of personnel protection from extreme surface temperature conditions.
– Improving ambient working conditions for personnel (e.g. for enclosed equipment).
– Prevention of condensation onto surfaces operating at lower than ambient temperatures.

1 CUI has been an issue for industry for many years and its root cause is the lack of good management of insulation throughout its entire life cycle. The need to recognise CUI as being of potentially high risk is also evident from the HSE's Hazardous Installations Directorate internal guidance on *Corrosion under insulation of plant and pipework* issued to HSE specialist inspectors to provide an overview of the causes of CUI and the preventative measures that can be taken. Although reference is made to CUI and its mitigation in several places, this guideline does not deal with this phenomenon extensively. Information on prevention of CUI can be found in greater detail in *Corrosion under insulation (CUI) guideline* produced by the European Federation of Corrosion (EFC) and NACE SP0198.

– Protection of equipment and structures from excessive heat radiation.
– Fire protection.
– Noise (acoustic insulation) often where noise exceeds the allowable levels in normal operation. Typical causes are:
  - High pipeline velocities; especially where cavitation exists.
  - Control valves; especially those creating a large pressure drop.
  - Rotating machinery pipework; especially for gas compressors.

The guidelines are applicable for new projects, during plant operation, plant modifications and asset life extension. The scope of these guidelines excludes insulation systems for the following:
– Subsea systems.
– Buried pipeline systems.
– Refractory linings and ceramic insulating blankets.
– Passive fire protection (PFP) (spray-applied).
– Refrigerated storage tanks.

1.3 VULNERABILITY OF INSULATION

Insulation systems are relatively fragile and vulnerable to mechanical damage and deterioration which, in turn, may lead to water ingress. Any accumulation of water within the insulation system will reduce the intended performance of the insulation system and may result in the onset of CUI, which if not managed effectively can lead to serious integrity risks to plant and safety risks to personnel.

Poor management of insulation systems can be due to one or more of the following:
– Poor design practice (sometimes due to 'off the shelf' engineering).
– Poor application practice (essentially a personnel competency issue).
– Lack of in-service maintenance effort.
– Disregard for the need to replace the insulation system to the required standard following maintenance operations on insulated equipment.
– Lack of prompt reporting and remediation of damage to cladding.
– Inadequate inspection and follow-up maintenance.

Typical failure mechanisms of insulation systems commonly encountered are provided in Annex G.

1.4 FRAMEWORK FOR MANAGEMENT OF INSULATION

Operators should have in place effective policies and strategies for the integrity management of plant and equipment which should set a clear direction for the organisation to follow to eliminate safety-related risks and improve a facility's reliability. Therefore, specific strategies for fabric maintenance (FM) and corrosion management (CM) should be derived from the policy to enable compliance. Such strategies should typically set out:
– expectations, e.g. performance criteria;
– the organisation required;
– responsibilities assigned to achieve the objectives and expectations, and
– a framework for implementing the strategy.

Such strategies should cover the design, installation, inspection and maintenance of each insulation system, with special emphasis placed on risk management, inspection and maintenance and personnel competency throughout its life cycle. An example of a management framework for insulation is shown in Figure 1.

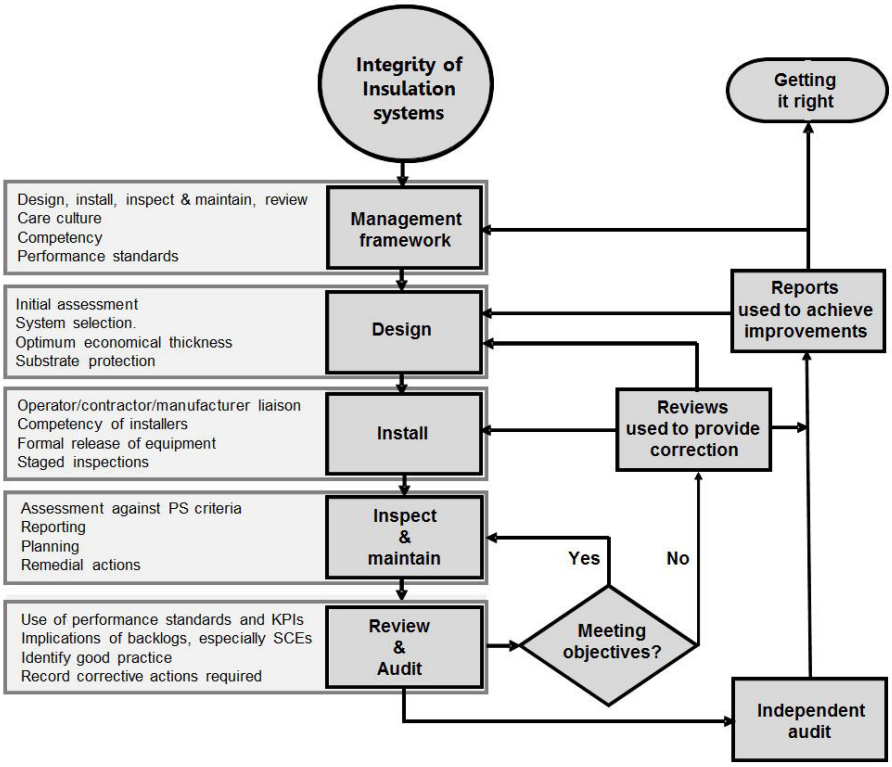

Figure 1 Insulation systems management framework

Further information on management systems can be found in section 2.