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Design for the Prevention of Corrosion under Insulation and Fireproofing (CUI and CUF)

Group Practice

**BP GROUP
ENGINEERING TECHNICAL PRACTICES**

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1. Scope

- a. This GP applies to all items to which insulation has been applied. Insulation may be applied for any one or combination of the following reasons.
 1. Process control (thermal insulation).
 2. Noise control (acoustic insulation).
 3. Protection of personnel from accidental contact with hot or cold surfaces (personnel protection insulation).
- b. It also applies to passive fireproofing achieved by the application of concrete, vermiculite cement, intumescent coatings, or subliming compounds.
- c. It describes best design practices for the prevention of Corrosion under Insulation (CUI) and Corrosion under Fireproofing (CUF) on piping, pressure vessels, and tanks. It can also be applied to civil/structural assets and rotating equipment.
- d. The following are key subjects in CUI and CUF which are addressed in this document:
 1. Design improvements, to reduce the possibility of CUI/CUF.
 2. Preventative measures, including coating to protect against CUI/CUF of carbon and low alloy steels and stress corrosion cracking, pitting, and crevice corrosion of stainless steel.
- e. Additionally information is provided on the following:
 1. Corrosion mechanisms.
 2. Factors affecting vulnerability of carbon and low-alloy steels to CUI/CUF.
 3. Factors affecting vulnerability of stainless steels to stress corrosion cracking, pitting, and crevice corrosion.
- f. Inspection for CUI/CUF is not specifically covered in this document. It is covered by GN 32-004, Inspection for Corrosion under Insulation and Fireproofing (CUI and CUF).
- g. Corrosion under insulation which is in service subsea is outside the scope of this document.

2. Normative references

The following referenced documents may, to the extent specified in subsequent clauses and normative annexes, be required for full compliance with this GP:

- For dated references, only the edition cited applies.
- For undated references, the latest edition (including any amendments) applies.

American Society for Testing and Materials (ASTM)

ASTM C871	Standard Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate and Sodium Ions.
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British Standards Institute (BSI)

BS 2972	Methods of test for Inorganic thermal insulating materials.
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BP

GP 06-60	Painting of Metal Surfaces.
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GIS 06-601	Painting of Metal Surfaces.
GP 52-10	Insulation.
GIS 52-101	Insulation.
GP 52-20	Passive Fire Protection (PFP).
GIS 52-201	Passive Fire Protection (PFP).

3. Terms and definitions

For the purposes of this GP, the following terms and definitions apply:

Corrosion under insulation (CUI)

Aqueous corrosion of the steel surface caused by water in the insulation, the water coming either from the environment or forming as condensation within the insulation.

Corrosion under fireproofing (CUF)

Aqueous corrosion caused by the penetration of water, or formation of condensation, behind the fireproofing. In essentials it is the same as CUI, and is identical to it if the fireproofing is provided by insulation materials such as mineral wool.

Jacketing

The terms jacketing, cladding, and weatherproofing, are used throughout the petrochemical industry to describe the protective covering that is applied over insulation. The term 'jacketing' is the one used in this document.

4. Symbols and abbreviations

For the purpose of this GP, the following symbols and abbreviations apply:

CUF Corrosion under fireproofing.

CUI Corrosion under insulation.

SCC Stress corrosion cracking.

TSA Thermal spray aluminium.

UV Ultraviolet.

5. Good design practice for minimising CUI

5.1. General

- a. There are a number of principles which if followed during the design stage help to minimise the risk of CUI occurring.
 1. Insulation shall only be applied where necessary for the process, for noise control, or for fireproofing.
 2. Cages shall be used where necessary to protect personnel from accidental contact with hot surfaces. Insulating protective coatings may be used as an alternative to cages subject to BP approval.
 3. Risk posed by CUI to the item being insulated shall be assessed in accordance with Table 1.



Table 1 - CUI risk versus operating temperature

Operating temperature	CUI risk
Cycles from below ambient into or through the +50°C to +175°C (120°F to 350°F) range	Severe
+50°C to +120°C (120°F to 250°F)	High
+120°C to +175°C (250°F to 350°F)	Moderate
-4°C to +50°C (25°F to 120°F)	Moderate
Above +175°C (350°F)	Low
Below -4°C (25°F)	Low

4. Good quality protective coating systems shall be applied to metal surfaces.
 5. Insulation type selection shall be based on the assessed CUI risk.
 6. Water penetration into the insulation shall be minimised by improved plant design and the design and maintenance of insulation systems.
 7. From the outset, minimisation of CUI shall be included as one of the objectives of plant design.
- b. The various aspects of these design principles are considered in more detail in the following sections.

5.2. General design aspects

The general design of items that are to be insulated shall have minimisation of CUI as one of its primary objectives.

5.2.1. Design simplification

As a general rule of thumb, complicated designs are difficult to insulate and shall be avoided.

Figure 1 - Designs/layout which are difficult to insulate

5.2.2. Shelters from prevailing weather

If there is a high concentration of insulated pipework and equipment in a small area in a location where precipitation is likely to be frequent, a permanent shelter shall be erected around the plant to protect the insulated equipment and piping from the weather.

5.2.3. Small bore pipe and fittings

Small bore pipe and fittings can be particularly vulnerable to CUI because the wall thicknesses required for pressure containment are small.

5.2.4. Walkways

Steps and/or bridges as appropriate shall be provided to allow personnel to cross low level pipe tracks without stepping on insulation.

5.3. Vessels

For the purposes of this clause the term ‘vessels’ shall be understood to also include all major types of static equipment, e.g., columns, heat exchangers, etc.

- a. The design and orientation of any protrusions shall be configured to aid effective water shedding.
- b. If possible seal welded sealing discs shall be installed on vessel nozzles and other protrusions through the insulation.

