Guidelines for in-service management of passive fire protection coating systems

energy institute

GUIDELINES FOR IN-SERVICE MANAGEMENT OF PASSIVE FIRE PROTECTION COATING SYSTEMS

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FOREWORD

Guidance provided within this publication aims to assist the operator to identify the major elements required to build an effective strategy for the management of passive fire protection (PFP) systems for a typical oil and gas production facility, in order to maintain the required performance standard (PS) for each application during its entire life cycle.

The guidance includes information on the principal activities associated with developing management strategies and implementation of good practice in the areas of condition survey, damage criteria, damage assessment, and the planning of remedial campaigns.

It is expected that this guideline will be of use to operations and integrity managers, corrosion engineers, technicians, contractors, inspectors, and all parties concerned with the maintenance and remediation of PFP coating systems, for both offshore and onshore oil and gas facilities.

The project to compile industry guidance for management of PFP was instigated by the Energy Institute's (EI's) Corrosion Management Working Group which includes participants from operating, service, and assurance companies and the UK Health and Safety Executive (HSE).

Although instigated by, and 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 which have been provided by members of the Steering Group (SG) listed in the Acknowledgements. Where these have been cited, it is implicit there are alternative ways and methods that other users may use to meet the same objective that may also constitute good practice. Therefore, these examples are provided for guidance only and should not be regarded as a recommendation or a standard.

This publication has been compiled for guidance only and whilst every reasonable care has been taken to ensure accuracy and relevance of its contents, the Energy Institute, its sponsoring companies, the document writers and the Steering Group members listed in the Acknowledgements who have contributed to its preparation, cannot accept any responsibility for any action taken, or not taken, on the basis of this information. The Energy Institute shall not be liable to any person for any loss or damage which may arise from the use of any of the information contained in any of its publications.

This guideline may be reviewed from time to time, and it would be of considerable assistance for any future revision if users would send comments or suggestions for improvements to:

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1 INTRODUCTION

This document provides guidance on in-service management of PFP coatings that have been applied to components such as fire barriers, key structural elements and items of process equipment to provide a predetermined level of protection from a given fire and/or explosion event.

PFP coatings are applied to achieve a PS for each component being protected. The PS quantifies the level of protection required when subject to a credible fire and/or fire and explosion scenario that has been identified for the component during a major accident analysis (MAA) exercise for the installation (see 1.1). In most cases, such components have also been identified as being a Safety and Environment Critical Element (SECE).

1.1 PERFORMANCE STANDARD

The PS for each PFP application is aimed at ensuring an appropriate level of integrity of the protected item is maintained to prevent an event from escalating, or for ensuring that personnel can be evacuated safely during an emergency.

In general, for a given fire and explosion scenario the applied PFP is required to:

– Protect key structural load-bearing elements by limiting temperature rise to below a specific temperature for a given length of time: 400 °C for offshore and 550 °C for onshore being generally accepted standards.
– Prevent excessive temperature rise in process vessels.
– Limit temperature rise in habitable spaces and escape routes.

Each PS should contain relevant information (i.e. functionality, reliability, availability and survivability) against which the condition of the PFP coating can be assessed and verified.

1.2 EXAMPLE SECE COMPONENTS REQUIRING PFP

For a typical installation, SECE components normally (but not exclusively) requiring PFP coverage include:

– structural steel and pipe racks to prevent collapse leading to escalation;
– vessel and pipe supports to prevent collapse leading to escalation;
– vessels; to limit temperature and pressure rise of the inventory especially leading to a boiling liquid expanding vapour explosion (BLEVE) event;
– emergency control rooms, temporary refuges/safe havens; to prevent passage of heat and smoke and provide insulation and personnel protection;
– decks, bulk heads, firewalls; to prevent passage of heat and smoke and protect escape routes;
– pipework protection; to prevent fracture and escalation due to jet fires;
– hydrocarbon risers, their associated emergency shutdown valves (ESDVs) and their actuators to ensure containment;

– fire pumps and deluge systems (e.g. piping supports) to ensure function under emergency loading, and
– emergency generators and uninterruptible power supply (UPS) systems.

Note: in some cases, the operator will deem the PFP itself to be an SECE having its own PS, or it may be included within the PSs for other SECEs that require PFP.

1.3 INITIAL APPLICATION

In general, to ensure that each PFP coating system provides a robust service life, the following are considered essential during application:

– proper preparation of the substrate;
– selection of the correct primer coating and its proper application;
– adhering very closely to the relevant procedure for applying the PFP, including achievement of a smooth finish;
– applying a resilient topcoat suitable for weather-exposed duty, and
– proper treatment of edge features to prevent coating failure and the onset of corrosion (and also where required, provide resistance to a jet fire).

1.4 INSPECTION, MAINTENANCE AND REPAIR

Operators should ensure that all PFP applications are subjected to adequate inspection, review and repair programmes. The review should include revisiting the PS to ensure that it remains adequate for the current process conditions.

PFP inspection, assessment and repair should be an integral part of the relevant asset integrity management system or equivalent.

Competency expectations for PFP inspectors can be found in Annex C.

2 SCOPE

This document provides guidance for the management of PFP systems applied to structural and process plant components used in onshore and offshore facilities. The scope of this document covers PFP coatings as summarised in 2.1, whereas other forms of PFP listed in 2.2 are described very briefly in Annex G. These include:

– preformed jackets;
– preformed rigid panels;
– elastomers, and
– concrete encasements.

2.1 MAIN GENERIC PFP COATING TYPES

There are many PFP coating materials available, but those referred to in this document are those that are commonly used in both offshore and onshore installations.

2.1.1 Cementitious

Cementitious PFP coatings are available in various formulations, but in general they are Portland cement-based and contain fillers such as vermiculite and/or fibres at varying proportions, and are in the main low density and more porous forms of concrete, specifically formulated to resist fire and spalling when exposed to heat. During application, wire mesh reinforcement is incorporated to provide resistance to cracking and to assist with building the required thickness.

2.1.2 Epoxy intumescent

Epoxy intumescent PFP materials are generally epoxy resins with additives and fillers of specific formulations, so that the coating produces a char layer when subjected to fire conditions. The char produced is a form of carbonaceous foam, having a low thermal conductivity which limits temperature rise of the substrate over time. There are many differing formulations giving differing fire performance ratings available, some employing mesh reinforcement; development of improved versions continues to this day.

2.2 NON-COATING APPLICATIONS

Other forms of PFP briefly described comprise:

– soft jacket enclosures;
– preformed or moulded removable PFP enclosures used as an alternative to the soft jacket, and
– cable and pipe transits.

2.3 RELATED ITEMS NOT COVERED

Other items that involve some form of protection from heat influx are, for the purposes of this document, not considered as being PFP, and are therefore not included. Examples of such items are:

– thermal insulation on process equipment, and

– enclosures containing emergency response systems (such as fire pumps, UPS), and communication systems.