DEP SPECIFICATION

INTERNAL FUSION-BONDED EPOXY POWDER COATING FOR WATER INJECTION LINE PIPE

DEP 31.40.30.39-Gen.

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ECCN EAR99

DESIGN AND ENGINEERING PRACTICE

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1. INTRODUCTION

1.1 SCOPE

This new DEP specifies the requirements and gives recommendations for the test procedures for factory-applied internal Fusion-Bonded Epoxy (FBE) powder coating of steel pipes used for submerged water injection flowlines. It specifies the requirements for coating materials, coating application, inspection and testing, repair, handling and storage, and gives procedures for the qualification of coating materials and coating applicators.

This DEP supersedes DEP 31.40.30.39-DWP dated October 2006; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to offshore pipeline, flowline and riser projects. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The **Applicator** is the party that applies coating.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Term	Definition
Applicator	The Applicator is the party that applies the coating.
Ambient	Environmental conditions in the immediate area of coating application work and upon surfaces being coated.
Batch	The amount of materials produced within one uninterrupted production run under constant production conditions.

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Term	Definition
Chemical Pre-Treatment	Treatment of the blast cleaned pipe surface with a chemical solution before application of the primer or adhesive to improve adhesion of the first coating layer (phosphate, chromate).
Holiday	A defect penetrating through the coating to the steel pipe surface, of such dimensions that it is detectable by means of the specified procedures.
Mil	1/1000 inch
Primer	A thin film liquid coating applied prior to application of the FBE
Shift	A set of pipes coated in one (1) production run of which the beginning and end coincide with a change in personnel, not to exceed 10 hours.
Water Injection (or Waterflood)	The injection of deoxygenated, chemically treated seawater to aid recovery of hydrocarbon.

1.3.3 Abbreviations

Term	Definition
AFC	Approved for Construction
AUT	Automated Ultrasonic Testing
FBE	Fusion Bonded Epoxy
ID	Internal Diameter
ITP	Inspection and Test Plan
MP	Manufacturing Plan
OD	Outer Diameter
PQT	Pre-Qualification Trial
SCR	Steel Caternary Riser
QC	Quality Control
QP	Quality Plan
RH	Relative Humidity
TLPE	Three Layer Polyethylene

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets ( ). Other documents referenced by this DEP are listed in (8).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a conversion of DEP 31.40.30.39-DWP dated October 2006 into DEP 31.40.30.39-Gen. There are no significant non-editorial changes.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of "DEPs on the Web", available through the Global Technical Standards web portal http://sww.shell.com/standards and on the main page of the DEPs DVD-ROM.

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1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

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2. GENERAL INFORMATION

2.1 GENERAL

This coating is used to prevent large-scale generation of corrosion product on the internal surface of the flowline when there is an upset in the water injection deoxygenation system.

The Contractor shall furnish at his cost, all labour, supervision, equipment, materials, and testing necessary to complete coating work. Unless specifically stated as the Principal's responsibility, the requirements of this DEP shall be the responsibility of the Contractor.

All surface cleaning, coating application and pipe handling shall be performed in a safe manner and in accordance with the principles of good workmanship.

This DEP can be used for general qualification purposes or for specific projects.

General qualification is performed for the purpose of an overall qualification of the coating system by the Applicator.

NOTE Qualification and approval may not be related to a specific project.

The Principal shall approve the Applicator to this DEP prior to production of any pipe coating.

For specific projects the qualification is for the line pipe diameter and wall thickness as detailed in the contract documents, AFC drawings or pipe coating datasheet.

The coating system shall consist of a primer and FBE (AkzoNobel® EP-10 primer and Dupont® 7-0008 FBE or a Principal-approved equivalent). The coating shall be subject to approval by the Principal.

NOTE The Principal shall determine that the coating system is suitable for the temperature class, based on the maximum operating temperature or design temperature of the pipeline.

The suitability of the coating system has been demonstrated by performing qualification tests given in this DEP. If required, additional testing should be performed at temperatures specified by the Principal.

2.2 SAFETY

This DEP may involve the use of hazardous materials, operations, and equipment, and does not purport to address all of the potential safety concerns associated with its use. It is the responsibility of the Applicator to establish appropriate safety and health requirements, and determine any regulatory requirements or limitations prior to use.

Safety concerns regarding personnel and the environment shall be identified and included in the detailed coating procedure, and pre-job discussions. All surface preparation and coating application systems shall undergo a complete safety inspection and checkout prior to use.

Adequate exhaust/ventilation equipment shall be used, as required, for removal of over-spray and other spray by-products to acceptable air quality standards, and to provide for operator personal protection.

Industry standards recommended safe practices shall be followed. Waste material shall be handled and disposed of properly. Protective equipment requirements on the Manufacturer's Material Safety Data Sheet(s) shall be followed.

Coating work pieces shall be electrically grounded, as required, to eliminate static charges associated with surface preparation and coating operations.

2.3 PRINCIPAL ACCESS

The Principal's Representative, including independent inspectors or consultants as may be contracted by the Principal, shall be permitted access to the coating application site at any time for the purpose of conducting performance analyses, including quality control tests of the materials being used.

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The Principal Representative has the right to reject any and all work or equipment that in his/her opinion does not conform to these requirements. Any work that in the opinion of the Principal Representative does not comply with these requirements shall be rectified at the Contractor's expense.

The Principal Representative has the right to request quality control tests at any time in addition to those completed at a determined frequency.

2.4 PRE-JOB MEETING

The Applicator shall schedule a pre-job meeting to ensure that job requirements are fully understood.

NOTE Clarification of roles and responsibilities shall take place at the pre-job meeting, such as when the Principal deals directly with the Applicator.

The personnel present at the meeting shall include, but not be limited to, the Principal Representative, Applicator's Technical Representative, Applicator's Coating Supervisor, Principal Safety Representative, Applicator's Quality Control (QC) Representative, and Manufacturer's Technical Representative (as required).

2.5 APPLICATORS TECHNICAL REPRESENTATIVE

The Applicator shall designate a Technical Representative who is fully conversant with the coating material and application techniques. The Technical Representative shall attend the pre-job meeting and other similar meetings, serve as the primary liaison between the Principal and the Applicator, and provide the Principal Representative with copies of all documents and reports required by this specification.

2.6 INFORMATION TO BE SUBMITTED BY THE PRINCIPAL

For a project qualification, the Principal shall supply technical information to the Contractor regarding the project [data sheet in (Appendix C)], in particular the installation and operating conditions. This information shall contain as a minimum:

a) Project name;

b) The thickness of coating required;

c) Description of steel pipe;

d) The applicable line pipe specification;

e) Installation method;

f) Subsequent external coatings to be applied (e.g., FBE, TLPE);

g) Storage and handling requirements.

2.7 INFORMATION TO BE SUBMITTED BY THE CONTRACTOR

The Contractor shall submit information to the Principal on the coating system to be used. This information shall contain as a minimum:

a) Coating application procedures;

b) The name(s) of the proposed coating applicator(s);

c) The Applicator's qualification information (Appendix A) and (Appendix B);

d) Quality Plan;

e) Safety Plan.

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3. COATING SYSTEM REQUIREMENTS

3.1 GENERAL

The coating system deemed suitable for the pipeline installation and operating conditions is specified by the Principal in (2.1) and (2.2).

Prior to beginning any production run, the Contractor or the Applicator shall demonstrate that the final coating system will fulfil the finished coating system requirements (3.2) and application qualification requirements in accordance with (Appendix A), (Appendix B) if necessary, and (5.3). Any modification of the application shall require re-qualification.

The Contractor or the Applicator shall demonstrate by effective quality control procedures in accordance with (5.3) that the coating system, as applied during normal production, fulfils the requirements of this DEP.

3.2 FINISHED COATING SYSTEM REQUIREMENTS

3.2.1 Visual appearance

The coating shall be free from blisters, pinholes, scratches or any other irregularities detrimental to coating performance and shall have a uniform colour and gloss when inspected from each end.

NOTE All other irregularities shall be brought to the attention of the Principal Representative who will advise on the disposition of the pipe.

3.2.2 Degree of cure

The degree of cure shall be determined by differential scanning calorimetry in accordance with ISO 21809-2, Section A.8.4. The ΔTg value shall be between +3°C (37°F) and -1.5°C (29°F).

3.2.3 Microscopic examination

The coating interface shall have no more than 10% contamination by foreign matter. Foaming shall not be present in either through-film or across-film. Occasional voids can be present in the cross-section and at the interface but shall not exceed a number 1 rating in accordance with NACE RP0394-2002 (Appendix G; Figure G2).

3.2.4 Total coating thickness

The average thickness of the total coating system shall be 177 μm (8 mils) to 305 μm (12 mils). No individual thickness reading shall be below 6 mils (150 μm) or greater than 14 mils (350 μm). The dry film thickness of the EP10 primer component shall be between 6.4 – 4.5 μm (0.25 – 1.0 mil).

The coating thickness shall be measured in accordance with (5.3.8).

3.2.5 Holidays

Holiday detection shall be used to monitor consistency of coating applications. The method of holiday detection shall be as per this DEP. The number of holidays shall be reported per pipe joint. Excessive holidays shall require the Applicator to review the application process.

3.2.6 Adhesion

Pull-off adhesion when tested in accordance with ASTM 4541-02 shall exceed 20 MPa (3000 psi) and the failure mode shall be cohesive for more than 75% of surface area.

3.2.7 Flexibility

The flexibility of the coating shall be such that holidays, cracks and disbondment do not appear when tested in accordance with a modified ISO 21809-2, Section A.12 test at 3.0°/PD minimum, total strain (arc matching). (A1.2) shall also be considered.

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