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## TECHNICAL SPECIFICATION

### SP-J306 POLYUREA ROOF WATERPROOFING SYSTEMS Revision 0

### NON-SAFETY RELATED

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# 1 INTRODUCTION

Polyurea is a type of elastomeric coating formed through the reaction of an isocyanate component with a resin blend component. This chemical reaction results in a fast-curing material that can be spray-applied to various surfaces, including concrete or metal.

This Technical Specification outlines requirements for the use of roof waterproofing systems based on polyurea and/or polyurea hybrid.

## 2 SCOPE

The work to be performed under this Technical Specification shall include the furnishing of all labour, equipment, documentation, materials and installation of polyurea roof waterproofing systems for roofing applications on the buildings at NEK site.

### 2.1 WORK INCLUDED

The work shall include following:

- a. Labour  
The contractor shall be trained and qualified to install polyurea roof waterproof systems and shall be approved by the manufacturer of the material.
- b. Equipment;  
The contractor shall have all equipment for the installation of polyurea roof waterproofing system, that is required by the manufacturer of the material.
- c. Documentation;  
The contractor shall provide all documentation as specified in sections 2.3(b) and (e) of this Technical Specification. The contractor shall also provide all records from installation inspections and quality controls as specified in section 4.5 of this Technical Specification.
- d. Materials;  
The contractor shall provide material for the scope of work per this Technical Specification. The material shall conform to requirement set in section 4.1 of this Technical Specification.
- e. Installation;  
The contractor shall be responsible for the installation of polyurea roof waterproofing system in accordance with the requirements set in section 4.3 of this Technical Specification.
- f. Inspections and quality control;  
The contractor shall be responsible for inspections and quality controls of the installation in accordance with section 4.5 of this Technical Specification.

## **2.2 WORK NOT INCLUDED**

The following work is not included in this Technical Specification and it is covered by separate specifications:

- a. Insulation of roof slabs;
- b. Roof drains;
- c. Expansion joints;
- d. Walkway threads;
- e. Roof collars and cap flashing.

## **2.3 INFORMATION REQUIRED BY THE PROPOSAL**

Information required with the proposal shall include, but not necessary be limited to, the following:

- a. Statement of guarantee;
- b. Material certification or examination and test records;
- c. Deviations or exceptions to this Technical Specification;
- d. Reference polyurea roofing projects;
- e. Specific details for various applications of the system, such as penetrations (electrical conduits, piping and ventilation ducts), expansion joints, equipment hatches, equipment supports installed on the roof slab, etc.

### 3 APPLICABLE DOCUMENTS

#### 3.1 APPLICABLE CODES AND STANDARDS

The following standards and codes have been included in total or in part throughout this Technical Specification:

- [1] EN 1504-2:2004, Products and systems for the protection and repair of concrete structures, Definitions, requirements, quality control and evaluation of conformity, Part 2: Surface protection systems for concrete;
- [2] ASTM D5385-93(2006), Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes;
- [3] EN 12390-8:2019, Testing hardened concrete, Part 8: Depth of penetration of water under pressure;
- [4] ISO 7783:2018, Paints and varnishes, Determination of water-vapour transmission properties, Cup method;
- [5] EN 1062-3:2008, Paints and varnishes, Coating materials and coating systems for exterior masonry and concrete, Part 3: Determination of liquid water permeability;
- [6] EN 1062-6:2002, Paints and varnishes, Coating materials and coating systems for exterior masonry and concrete, Part 6: Determination of carbon dioxide permeability;
- [7] EN 1062-7:2004, Paints and varnishes, Coating materials and coating systems for exterior masonry and concrete, Part 7: Determination of crack bridging properties;
- [8] EN 1062-11:2002, Paints and varnishes, Coating materials and coating systems for exterior masonry and concrete, Part 11: Methods of conditioning before testing;
- [9] ISO 6272-1:2011, Paints and varnishes, Rapid-deformation (impact resistance) tests, Part 1: Falling-weight test, large-area indenter;
- [10] EN 13501-1:2018, Fire classification of construction products and building elements, Part 1: Classification using data from reaction to fire tests;
- [11] EN 13501-5:2016, Fire classification of construction products and building elements, Part 5: Classification using data from external fire exposure to roofs tests;
- [12] EN 13687-1:2002, Products and systems for the protection and repair of concrete structures, Test methods, Determination of thermal compatibility, Part 1: Freeze-thaw cycling with de-icing salt immersion;
- [13] CEN/TS 14416:2014, Geosynthetic barriers - Test method for determining the resistance to roots;

- [14] EN 1542:2023, Products and systems for the protection and repair of concrete structures, Test methods, Measurement of bond strength by pull-off;
- [15] ISO 5470-1:2016, Rubber- or plastics-coated fabrics, Determination of abrasion resistance, Part 1: Taber abrader;
- [16] ISO 2812-1:2017, Paints and varnishes, Determination of resistance to liquids, Part 1: Immersion in liquids other than water;
- [17] ISO 2815:2018, Paints and varnishes, Buchholz indentation test;
- [18] ISO 8501-1:2007, Preparation of steel substrates before application of paints and related products, Visual assessment of surface cleanliness, Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings;
- [19] EN 13036-4:2011, Road and airfield surface characteristics, Test methods, Part 4: Method for measurement of slip/skid resistance of a surface: The pendulum test.

The contractor is required to use the latest version of the listed standards above or perform a reconciliation between the revisions, ensuring that the most stringent requirements are applied.

### 3.2 DRAWINGS

The following Drawings set the extent and locations of the work and are hereby made part of this Technical Specification:

| <b>Drawing No.</b> | <b>Revision</b> | <b>Description</b>                                                                              |
|--------------------|-----------------|-------------------------------------------------------------------------------------------------|
| 101-080            | 0               | Architectural, Polyurea Roof Waterproofing Systems, Nuclear Island and Turbine Building, Layout |
| 101-081            | 0               | Architectural, Polyurea Roof Waterproofing Systems, Essential Service Water Building, Layout    |
| 101-082            | 0               | Architectural, Polyurea Roof Waterproofing Systems, Sections and Details                        |

Apart from specified Drawings in the table above, which provide basic information and details about roof structures, other Drawings from the series 100-181 provide additional informations and shall be used.

## **4 GENERAL REQUIREMENTS**

### **4.1 MATERIALS**

Polyurea Roof Waterproofing Systems can consist of several material, which combined, form a certified waterproofing system. Polyurea roof waterproofing system shall conform to EN 1504-2, Products and systems for the protection and repair of concrete structures [1] standard. The system shall consist of, but not limited, to the following materials.

#### **4.1.1 Primers**

Primers shall ensure the adhesion of the waterproofing polyurea membranes on concrete, aluminum, cooper, stainless steel and other materials as specified in this Technical Specification. Epoxy resin based primers or others applicable shall be used. Material shall be compatible with polyurea spray-applied membranes.

#### **4.1.2 Spray-applied membranes**

Spray-applied membranes shall be from polyurea or polyurea hybrid based material. The materials shall have high build capability, ability of application to vertical surfaces without runs, easy application on various roof slab installations (such as supports, grounding, ventilation ducts, penetration sleeves, etc.), without welds or seams, fully bonded to roof slab, high water vapor permeability with low risk of blistering, excellent crack bridging, resistant to puncture and standing water, elastic at low temperatures and resistant to root penetration.

#### **4.1.3 Top coatings**

Top cotings shall be pigmented, elastic and crack bridging with excellent UV and weather resistance and easy to clean and maintain. The top coating material shall be compatible with polyurea spray-applied membranes.

### **4.2 PROPERTIES**

Properties of individual materials of the polyurea roof waterproofing systems are provided in sections 4.2.1 to 4.2.3 of this Technical Specification, and properties of the system are listed in section 4.2.4 of this Technical Specification.

The contractor shall provide document evidence that the material conforms to the requirements defined by this Technical Specification. The documentation shall be in form of material certification or examination and test records.

#### **4.2.1 Primers**

##### **4.2.1.1 General requirements**

Primers shall ensure adhesion to various roofing materials: concrete, aluminum, cooper, stainless steel and other materials as defined in this Technical Specification.



## 4.2.2 Spray-applied membranes

### 4.2.2.1 Hydrostatic pressure resistance

Spray-applied polyurea or hybrid polyurea membrane shall have no leak at 5 bars with 3.2 mm crack width on surface in accordance with standard ASTM D5385 [2].

### 4.2.2.2 Depth of penetration of water under pressure

Spray-applied polyurea or hybrid polyurea membrane shall have no penetration of water at 5 bars of pressure in accordance with EN 12390-8 [3].

## 4.2.3 Top coatingss

### 4.2.3.1 General requirements

Colour scheme of top coatings shall be defined by NEK.

## 4.2.4 Polyurea roof waterproofing system

### 4.2.4.1 Permeability

Permeability to water (capillary absorption) of the system shall be  $< 0.1 \text{ kg/m}^2 \times \text{h}^{-0.5}$  in accordance with standard EN 1062-3 [5].

Permeability to water vapor of the system shall be Class I,  $S_d < 5 \text{ m}$  (Permeable) in accordance with standard ISO 7783 [4].

And permeability of the system to  $\text{CO}_2$  shall be  $S_d > 50 \text{ m}$  in accordance with EN 1062-6 [6].

### 4.2.4.2 Mechanical resistance

Impact resistance of the system shall be Class III in accordance with ISO 6272-1 [9].

Abrasion resistance of the system shall be qualified in accordance with ISO 5470-1 [15]. The system shall have weight loss, less than 1000 mg with abrading wheel H22 at 1000 cycles and load of 1000 g.

### 4.2.4.3 Chemical resistance

Chemical resistance shall be qualified in accordance with ISO 2812-1 [16]. The reduction in hardness of the system shall be less than 50% when measured with Buchholz method in accordance with ISO 2815 [17] 24 hours after the specimen is removed from immersion from the test liquid.

### 4.2.4.4 Crack bridging ability

Crack bridging ability of the system at  $+23 \text{ }^\circ\text{C}$  shall be Class A<sub>5</sub> for static and Class B<sub>4,2</sub> for dynamic in accordance with EN 1062-7 [7].

Crack bridging ability of the system at -20 °C shall be Class A<sub>5</sub> for static and Class B<sub>4,2</sub> for dynamic in accordance with EN 1062-7 [7].

#### 4.2.4.5 Adhesion to concrete

The system shall have adhesion to concrete after 50 cycles of freezing and thawing with de-icing salts Class 3 (1.5 MPa – 2.5 MPa) or better in accordance with standard EN 13687-1 [12].

#### 4.2.4.6 Reaction to fire

The system shall have fire performance class B<sub>Roof-t2</sub> or better in accordance with EN 13501-5 [11].

The fire reaction class of the system shall be C<sub>fl</sub> or better and smoke emission class shall be S<sub>1</sub> in accordance with EN 13501-1 [10].

#### 4.2.4.7 UV resistance

The system aged under artificial atmospheric agents (2000 hours of UV rays and condensation) shall have no swelling, cracks or flaking in accordance with EN 1062-11 [8].

#### 4.2.4.8 Resistance to root penetration

The system shall be resistant to root penetration in accordance with CEN/TS 14416 [13].

#### 4.2.4.9 Slip/skid resistance

Slip/skid resistance of the system shall be Class III in accordance with EN 13036-4 [19].

#### 4.2.4.10 Temperatures

The system shall be designed for temperatures in range between -30 °C and +90 °C.

#### 4.2.4.11 Service life

The system shall be designed for minimum 25 years of service life.

The system shall comply with the requirements defined in EN 1504-2 and other applicable standards and the relative acceptance limits set by this Technical Specification.

## 4.3 INSTALLATION

The installation work shall be performed in accordance with the recommendations of the material manufacturer and requirements set by this Technical Specification.

### 4.3.1 Site preparation

Surrounding areas and equipment during spray applications shall be protected from overspray by the contractor, using suitable barriers. Ways of equipment protection shall be approved by NEK. Special care shall be taken by the contractor to prevent spray mist being carried by wind during spray applications.

### 4.3.2 Surface Preparation

#### 4.3.2.1 Concrete and cementitious material surfaces

Concrete and other cementitious material surfaces shall have a minimum pull off strength of 1.5 N/mm<sup>2</sup> [12] unless otherwise specified by the material manufacturer.

Any laitance present on the surface shall be removed mechanically using shot blasting method or other method approved by NEK. The surface shall be abraded by either grinding, high-pressure water jetting or grit blasting ensuring removal of any friable matters, weak surface layers and defects that will affect the adhesion.

Surface defects which were exposed during surface preparation such as shrinkage cracks, blow holes, minor honey combing, and minor damage to joint arises, etc. shall be repaired in accordance with procedures. Material and concrete repair procedures shall be approved by NEK prior the start of repair.

Release oil and other contaminants which may impair adhesion shall be removed prior to the application of the primer.

Surface shall be dry (following cleaning, rain or moisture condensation), residual dust or dirt shall be blow away using compressed air or using industrial vacuum cleaners prior the start of priming.

#### 4.3.2.2 Metal surfaces

Metal surfaces shall be sand blasted to a Sa 2 ½ [18] finish with average surface profile in the range of 30-50 µm prior to application of the primer unless otherwise specified by the material manufacturer.

All surfaces shall be free of oil, grease, dust and any other friable material. All surfaces shall be wiped with cleaning solvent to remove any contaminants.

Small gaps or holes shall be closed using suitable sealants. Larger gaps shall be repaired/covered by metal sheets. Material and procedures shall be approved by NEK prior the start of repair.

#### 4.3.2.3 Other material surfaces

The installation of polyurea roof waterproofing system on other materials shall not be allowed without prior approval by NEK.

All other materials, such as gravel, bituminous or other roofing shall be, normally, completely removed and the surface prepared in accordance with requirements set by this Technical Specification.

#### 4.3.3 **Priming and top coating**

Materials, surfaces and air temperature shall be in range between +3 °C and +30 °C for best results for priming and top coating applications. The temperature of the surface shall be at least +3 °C above the dew point both during the application and for at least further 24 hours. Work shall not be permitted outside this temperature ranges except approved by NEK.

Mixing, preconditioning of the primer and top coating shall be done in accordance with manufacturer instructions.

Primer and top coating shall be applied by roller or brush.

Coverage and curing time of both, primer and top coating, shall be specified by the material manufacturer.

Coverage of the primer and top coating shall be as required to fulfill requirements set by this Technical Specification.

#### 4.3.4 **Spray-applied membranes**

If the spray application is delayed for more than 48 hours or if its surface is noticeably contaminated with moisture, dust and/or dirt, the surface shall be cleaned and primer shall be re-applied.

The membranes shall be installed using heated, high-pressure spray machines, which are capable of providing required pressure and heating temperature required by the membrane manufacturer.

Before the spray application, the contractor shall conduct a trial spray on a plastic sheet or foil (approximately 1 m<sup>2</sup> in size) to confirm that the material is properly setting and to find any discoloration.

Recommended thickness of the membrane shall be defined by the manufacturer and shall be such, that the requirements set by this Technical Specification are met. Corners and detailing shall be initially sprayed with 20 – 30 cm bandage width of membrane as a reinforcing layer prior to the main layer.

The main layer of the membrane shall be applied at a consistent rate by spraying in constant hand speed and at standard crosshatch spray pattern. Applying each layer at perpendicular direction will provide more uniformity in its thickness and coverage. Each parallel spray stroke shall overlap 50% with previous stroke to ensure proper coverage of material.

Typical construction details for membrane application are provided on the Drawings in section 3.2 of this Technical Specification.

#### **4.4 PERSONAL PROTECTION**

The protective equipment shall be used in accordance with local safety regulations and NEK applicable procedures. The contractor shall know and understand the regulations and site procedures regarding safety and environmental measures.

#### **4.5 INSPECTIONS AND QUALITY CONTROL**

Inspections shall be performed by contractor and independently verified by NEK.

The contractor shall prepare inspection check lists based on below requirements.

All check lists shall be signed by the contractor responsible person and handover to NEK for review and approval. The pre-requirement for start of next installation phase are performed inspections and inspection results approved by NEK.

Following inspections shall be performed by the contractor.

##### **4.5.1.1 Visual inspection of the surface**

Visual inspection of surface preparation, just prior the spray is applied, shall be performed by the contractor. Acceptance criteria for surface preparation are set in Section 4.3.1 of this Technical Specification.

The locations and results of visual control shall be recorded on check list.

##### **4.5.1.2 Pull-off test**

Where application will be performed on concrete surfaces, pull-off test shall be performed in accordance with standard EN 1542 [14]. Minimal required pull-off strength shall be 1.5 N/mm<sup>2</sup> unless otherwise specified by the material manufacturer. The test shall be performed on random locations. At least one test shall be performed every 100 m<sup>2</sup>.

The locations and results of pull-off tests shall be recorded on check list.

##### **4.5.1.3 Material**

The contractor shall prepare daily records of material and batch used including location of material application, weather conditions (air temperature, humidity and weather conditions) as well as surface temperatures on application locations.

The information shall be recorded on check list.

#### 4.5.1.4 Thickness

Destructive or non-destructive tests can be performed by the contractor in order to inspect the material thicknesses of the spray-applied membranes. Minimum and/or maximum thickness of the membrane shall be defined by the membrane manufacturer.

For destructive test small piece (approximately 20 x 20 cm) shall be cut and measured using a calliper. Measurement shall be performed at random locations. For every 100 m<sup>2</sup>, one measurement shall be performed. The repair of cut material shall be performed in accordance with Section 4.6 of this Technical Specification by the contractor.

Non-destructive test shall be performed using a digital thickness gauge. Measurements shall be performed at random locations. For every 50 m<sup>2</sup>, one measurement shall be performed.

Test locations and results of the thickness measurements shall be recorded on inspection check lists.

### 4.6 REPAIR WORK

Damages, defects or locations that do not meet minimum acceptance criteria from section 4.5 of this Technical Specification shall be repaired by the contractor.

The repair work shall be performed in accordance with manufacturers procedures and requirements set by this Technical Specification.

### 4.7 DELIVERY, HANDLING STORAGE AND TRANSPORT

All material shall be delivered in original and unbroken packages or in sealed containers, bearing the manufacturers original labels.

Specific safety information referring the handling, transport and storage of materials shall be provided by the manufacturer and delivered to NEK.

The materials shall be stored in dry, sheltered place on site, not exposed to direct sunlight. The temperature in the storage area shall not exceed the limits set by the manufacturer data and shall in no case be less than +5 °C. Shelf life shall be specified for all materials. After expired shelf life, materials shall be disposed by the contractor. Also, the contractor shall be responsible for disposal of all extra material and its containers, including empty containers.

Disposal of materials and its containers shall be carried out according to the local legislation.

### 4.8 GUARANTEE

The contractor shall provide a written guarantee against damages and defects in workmanship and material, which will become valid within a period of 25 years following the date of acceptance of the work.

This gurantee shall bind the contractor without further recourse and without cost to NEK to repair, replace or otherwise suitably eliminate such defects immediately.