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ERA TECHNOLOGY

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TEST SCHEDULE FOR ELECTRICAL EQUIPMENT TO BE INSTALLED IN AREAS SUBJECT TO WATER DELUGE SYSTEMS

Prepared by the Explosion and Fire Hazards Group of ERA Technology Limited in collaboration with Shell UK Exploration and Production Limited

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TEST SCHEDULE FOR ELECTRICAL EQUIPMENT. STANDARD TEST METHOD FOR THE EVALUATION OF PROTECTION FROM WATER INGRESS IN THE EVENT OF WATER DELUGE

1 INTRODUCTION

Electrical equipment on offshore installations may be located in areas which are equipped with emergency deluge facilities. Exposure of such equipment must not lead to water ingress in quantities which could cause the equipment to become a potential source of ignition when exposed to a flammable atmosphere.

2 SCOPE

This standard method specifies tests to be carried out on electrical equipment, components, devices and motors (from hereon referred to as samples) to simulate their exposure to realistic water deluge conditions and establish their potential hazard. Satisfactory completion of the tests does not imply suitability for offshore use in respect of other criteria.

3 GENERAL CONDITIONS FOR EACH TEST

3.1 Number of samples

The samples submitted shall be identical to each other and the number of samples as indicated in the table 1 below

Table 1

Type of equipment	Number of samples
Fluorescent luminaires	6
Floodlight and wellglass luminaires	3
Control, Fuse, Isolation and Junction Boxes	
$\leq$ 10 litre enclosed volume	3
> 10 litre enclosed volume	6
Motors	
below 1kW	2
above 1kW	1

3.2 Mounting

Each fitting shall be rigidly mounted in its normal orientation, in such a manner that the water spray onto the fitting is not impeded.

3.3 Electrical connections

The sample shall be connected where appropriate (see 3.4 below) to a remote electrical supply using a suitable cable gland. Any unused cable entry on the samples shall be sealed off with a suitable blanking plug.

3.4 Sample Internal Heating

The sample may be divided into two catgories:-

Sample enclosures category a)	where thermal cycling during opearation of the equipment will result in a reduction in air pressure within the enclosure below that of the surrounding atmosphere.
Sample enclosures category b)	where reductions in pressure below the surrounding atmospheric pressure are not present.

For enclosures under category a) the equipment will be energised in accordance with 4.4.

For enclosures under category b) the equipment will remain unenergised throughout the deluge exposure.

Note: Enclosure category selection is based on BS 5490.

3.5 Deluge application

Water deluge shall be applied using K80 medium velocity deluge nozzles. The water pressure at each nozzle shall be within the range 3.5 bar to 4.5 bar.

3.6 Deluge water

Water shall be supplied to the deluge nozzles at a temperature in the range 5°C to 10°C. A salt solution of 35g of sodium chloride (NaCl) per litre of water shall be used.

3.7 Deluge nozzle position

Tests shall be carried out simultaneously with the deluge nozzles in two positions relative to the sample.

Position 'A' - Base of nozzle at a height of 1 metre from the top of the sample (not including mounting brackets), directly over the centre of the sample.

Position 'B' - Base of nozzle at the same height but displaced 1 metre from position A on a line at right angles to the samples longest seal.

4 SEQUENCE OF TESTS

Each of the samples supplied shall be subjected to the tests specified below. The tests are to be carried out in the sequence given below.

4.1 Insulation Resistance Test

An insulation resistance test of 500V d.c. shall be applied between all circuits and earth. The reading is to be noted.

4.2 Preconditioning

Where required, the sample seals shall be pre-conditioned by exposure to vibration or heat ageing as defined in Section 6 below.

4.3 Insulation Resistance Test

The insulation test of 4.1 shall be repeated and the results noted.

4.4 Deluge Test

Electrical power shall where appropriate (see table 1 above) be applied to the sample for 60 minutes prior to the commencement of the deluge. The samples shall be exposed to the deluge spray for a period of 3 hours. The electrical power to the samples shall be interrupted at the start of the exposure to deluge, resumed after 60 minutes, and remain on for the remaining 120 minutes.

Note:- Where it is not practical to achieve full dissipation within the deluge facility with the samples normal full exitation (for example a loaded motor), other means of internally heating the sample by the equivalent of its full continuous load dissipation may be used ie. d.c. on an inductive component or internal heater or etc.

4.5 Insulation Resistance Test

The insulation test of 4.1 shall be repeated and the results noted.

5 RESULTS OF TESTS

An individual sample shall be deemed to have met the requirements of this standard if it continues to operate satisfactorily after the deluge test, and satisfies the criteria in Section 5.1 and 5.2

5.1 Insulation resistance

The test voltage in all cases shall be 500V d.c. The test shall be applied between all leads (all circuits) connected together and earth and where appropriate, between poles.

The insulation resistance shall be not less than 10 Megohms.

5.2 Examination

The sample shall be opened and visually examined for the presence of water.

5.2.1 Inspection

If water is present inside the sample it shall be decanted into a measuring container and its volume recorded. If the test sample has an internal volume of 0.1 litres or greater, it shall be deemed to met the requirments of the standard if less than 5 ml of water is present inside the sample. For internal volumes less than 0.1 litres the pass value shall be 5% of the internal volume.

If, subsequent to deluge exposure, the insulation fails to meet the requirements of Section 4.1, the condition of the sample shall be investigated to diagnose the probable cause of the failure including, if appropriate, the identification of the likely water ingress path.

6 PRE-CONDITIONING (AGEING) TESTS

If it is appropriate, and any seals could be expected to age, then one of the following pre-conditioning procedures may be instigated at the discretion of the test authorities.

6.1 Vibration exposure sequence

Each sample shall be tested to determine its resonant vibration frequencies in the frequency range 0.5Hz to 100Hz.

It shall then be exposed to vibration at selected frequencies, with a specified amplitude or acceleration, for 8 hours in each mutually perpendicular axis at each selected frequency.

6.1.1 Resonant frequency determination

The sample shall be rigidly mounted, in its normal orientation, to a vibration test apparatus. Testing shall be carried out in three mutually perpendicular directions, one of which shall be vertical in respect to the normal orientation of the fitting. The fitting shall be subjected to vibration with a frequency swept between 0.5Hz and 100Hz at a rate sufficiently slow to enable external resonances to be clearly observed. At frequencies between 0.5Hz and 13.2Hz, the vibration amplitude shall be ± 1mm. At frequencies between 13.2Hz and 100Hz, the vibration acceleration shall be ± 0.7g. During each determination the resonance amplification factor Q shall be measured. The frequency and Q factor shall be recorded whenever the Q factor exceeds 2 but is less than 5.

In addition, attention shall be paid to relative movement between the body and cover (end plates) of the sample. The frequencies and sample orientation at which movement occurred shall be noted.

6.1.2 Vibration exposure

The fitting shall be mounted as Section 6.1.1 above. It shall be exposed to vibration for a period of 8 hours at each of two frequencies noted for maximum body to cover movement. If only one body to cover resonance was noted, the two 8 hour exposures shall consist of that body to cover resonance and the highest (but between a Q and 2 and 5) fitting resonance noted at Section 6.1.1.

If no resonances between body and cover were noted, then the two 8 hour exposure runs shall consist of the two maximum fitting resonances noted in Section 6.1.1. with a 'Q' of between 2 and 5. If only

one fitting resonance with a Q of between 2 and 5 was noted, the exposure shall consist of that frequency and 30Hz (± 0.7g). If no resonances of the fitting of a 'Q' between 2 and 5 and no body to cover resonances were found, the exposure shall consist of one 8 hour exposure at 30Hz (± 0.7g).

This procedure shall be repeated for each mutually perpendicular direction.

Note:- The vibration exposure sequence is based on Vibration Test 1 of the Lloyd's Register Type Approval Scheme, and apparatus suitable for the Lloyd's test will normally also be suitable for this sequence.

6.2 Thermal ageing

The following temperature and humidity exposures are designed to prematurely age any non-metallic seals by exposure to a combination of high temperature with high humidity and low temperature.

6.2.1 Thermal ageing by heat

The sample shall be subjected to continuous storage for four weeks in an ambient of 90% relative humidity and at a temperature of 20K above the maximum service temperature specified by the manufacturer and at least 80°C.

In the case of a maximum service temperature above 80°C the period of four weeks provided above will be replaced by a period of two weeks at (95 ± 2) °C and 90% relative humidity followed by a period of two weeks at a temperature of 20K higher than the maximum service temperature specified by the manufacturer and at normal ambient humidity.

6.2.2 Thermal ageing by cold

The sample shall be subjected to storage for 24 hours in an ambient temperature specified by the manufacturer corresponding to between 5 and 10K below the minimum service temperature.

Note:- The Thermal ageing sequence is based on CENELEC Standard EN50 014.