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RADIATION TESTS ON OPTICAL FIBRES – GOOD AND BAD PRACTICE

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I. INTRODUCTION

Testing optical fibers for their response to ionizing radiation is unavoidable if their properties in radiation environments need to be known. So far, no model exists that would be able to predict the behavior of optical fibers in the presence of radiation, for example because too many, mostly unknown parameters influence the changes in the fiber.

To obtain reliable results from irradiation tests of optical fibers a well-defined setup and thorough experience is needed to avoid erroneous data that might lead to wrong decisions for the final application.

This presentation tries to introduce basic concepts of radiation testing of optical fibers, focusing on not so well known influences or typical errors. Focus will be laid on the measurement of radiation-induced attenuation (RIA) in optical fibers. The presentation will include the following topics:

II. OVERVIEW OF PARAMETER DEPENDENCIES

Examples of measured influences that lead to differences in the obtained RIA are discussed. Generally they are defined by the manufacturing parameters, the application parameters and environmental parameters. For all areas test results are presented that should be known to test and use optical fibers in radiation environments.

III. RELEVANT TEST STANDARDS

An overview is given of the relevant standards in the field issued by IEC, ASTM, ISO and others. Their common concepts are shown, but also their deviation. Finally a critical review of some details is given.

IV. EXAMPLES OF PROBLEMATIC TEST CONDITIONS

This part of the presentation will discuss some examples of test conditions or influences that might be overlooked but are validated to result in large variation of the measured RIA.

A. Room temperature

Even if a typical test is done at room temperature a wide range of definitions exist for this temperature range. Some examples highlight the general influence of temperature on the measured RIA and in particular those of small temperature changes of a few degree centigrade.

B. Photobleaching

A general statement is that the light power should be kept “low” to “avoid photobleaching” in the measurement. Examples are shown why this is a questionable concept and in which specific cases the effect could be larger than expected.

C. Spool geometry

Preparation of the sample spool is done in many variations in different labs or test sites. Cases are presented where the spool geometry had impact on the test results. Especially at lower temperatures this plays an important role.

D. Influence of coating material

Many manufacturing parameters are known to lead to different RIA. But besides the dopants and the fiber type, also other influences are known. Exemplary results are presented where the coating material led to a strong variation of the RIA in fibers that were thought to be identical.

V. UNCERTAINTIES AND QUALITY ASSURANCE

This part will cover a discussion of sources of uncertainty in RIA measurements and how a difference between two samples can be judged to be significant and not caused by the experimental setup. The reproducibility of test results is discussed and compared to uncertainty estimations.