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HIGH VOLTAGE A.C. SWITCHGEAR AND CONTROLGEAR— VACUUM INTERRUPTERS— HIGH VOLTAGE TESTING— PROTECTION OF PERSONNEL FROM X-RAY EMISSION

This Australian Standard was prepared by Committee EL/7, Power Switchgear. It was approved on behalf of the Council of the Standards Association of Australia on 23 June 1987 and published on 3 August 1987.

The following interests are represented on Committee EL/7;

Australian-British Chamber of Commerce

Australian Electrical and Electronic Manufacturers Association

Confederation of Australian Industry

Electricity Supply Association of Australia

Institution of Engineers, Australia

Railways of Australia Committee

Testing authorities

Representatives of the following interests also participated in the drafting of this Standard:

Department of Health. N.S.W., Radiation Health Services

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PREFACE

This Standard was prepared by the Association's Committee on Power Switchgear to satisfy the expressed need of testing interests for standard precautions to protect personnel from X-ray radiation that may be produced during the high voltage testing of vacuum interrupters.

It is based on a draft code of practice prepared by an independent specialist committee with members representing the interests of the Electricity Supply Association of Australia, the Australian Electrical and Electronic Manufacturers Association, Railways and testing authorities, and acknowledgement is made of the assistance received from that draft.

This Standard lays down the testing conditions and procedures to keep the emission of X-rays as affecting personnel to acceptable limits in the carrying out of high voltage testing on vacuum interrupters and switchgear incorporating vacuum interrupters. The Standard covers factory testing, on-site commissioning, in-service testing and specifies that a chain of responsibility be established for the implementation of these procedures.

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FOREWORD

When a high voltage is applied across electrodes in a vacuum, X-ray emission may occur. Such a situation exists across the open contacts of a high voltage vacuum interrupter and the introduction of these interrupters has generated a need to consider the possible production of X-rays across the open contacts.

For vacuum interrupters with rated voltages up to 36 kV (the highest rating presently in general use) the X-ray output is virtually undetectable when they are operating at their rated voltage. Although a small but finite X-ray output occurs under test conditions when a higher voltage is applied, the radiation levels are generally well below those accepted as limits for exposure of members of the general public under AS 2243.4, Safety in Laboratories, Part 4: Ionizing Radiations. This Standard lays down simple procedures and precautions which should be observed in certain instances and in particular at higher test voltages, to ensure that safe conditions are maintained for testing personnel.

The emission of X-rays from electrodes in vacuum occurs when electrons in the electrical field are accelerated to a sufficiently high level of kinetic energy and then impinge on electrode material. This emission mechanism is exhibited by X-ray tubes, where free electrons are produced by thermal electron emission. In vacuum interrupters the free electrons can be produced by field emission.

The X-ray flux is a function of the emission current and the applied voltage, and the penetrating power of the X-rays increases rapidly with voltage. On the other hand, the radiation intensity at a location under any given operating condition decreases approximately as the square of the distance from the source. For vacuum interrupters and switchgear incorporating vacuum interrupters, much of the emission produced at the higher test voltages is absorbed by the shielding provided by the interrupter envelope and the metal enclosure of the switchgear. Because of this, in most cases all that is necessary is that the test voltage should be applied with the operator at the normal electrically safe distance.

X-rays can be generated only when a high voltage is applied across the open contacts. There is no residual emission after the test voltage is removed, nor is there any generation of X-rays from a closed interrupter when high voltage is applied to earth or between phases.