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STUDY ON ARC-QUENCHERS FOR MHD GENERATOR ANODE WALL

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The interelectrode breakdown on the anode wall accompanied by propagation of the electric arc inside the wall is a major limitation in achieving a higher Hall field intensity in segmented Faraday-type channels.

Considering the fact that a breakdown may occur due to such hard-to-control phenomena as local non-uniformity of the load factor, inter-electrode voltage fluctuations, on-load over-voltage of inverters, etc., the preference of some average channel parameters cannot be regarded as a guarantee for the reliable performance of the anode wall.

The report presents the results of the anode wall protection by means of arc-quenchers which effectively employ the arcing phenomena inside the anode wall. Various designs of arc-quenchers are discussed. The operational principle of the quenchers consists in stretching of the arc while it is in progress under the force of the acting magnetic field to a length exceeding the critical value.

The report presents the results of theoretical research and experimental investigation performed on a laboratory rig.

The criteria for the option of the design are the maximum voltage at which the arc is reliably quenched and the maximum number of quenching cycles retaining its quenching ability.

The geometrical dimensions of the quenchers are predetermined by the requirements of their suitability for medium-scale channels.

The dynamic volt-ampere characteristics, rate of arcing process, quenching time as a function of the arc current and the magnetic field intensity have been analysed for the arc-quencher that proved to have the best qualities.

Using high-speed filming technique the mechanisms responsible for the arcing process and quenching in relation to specific volt-ampere characteristics has been studied and the critical arc length determined. The experimental data are in good agreement with the results of the simple-model calculations. This allows to predict parameters of the arc-quenchers to be used in MHD channels.

The results thus obtained formed a basis for the development of an interelectrode gap model with an arc-quenching cavity. The model was tested on a combustion chamber facility.

The combustor, burning liquid fuel containing potassium seed, generated a flow of combustion products at Mach number of about 2 and a flow rate of 0.5 kg/s.

A pair of cold or semi-hot electrodes was placed downstream in the magnetic field to simulate in the applied electrical field to the best possible degree the breakdown and arc-quenching conditions in the channel.

The experimental results of the arc-quenchers' performance under different operating conditions were obtained. High-speed filming technique was used to study the arc-quenchers process.

The critical arc length as a function of various parameters at average current values of 20-30 amperes was determined.

The results confirmed the data of calculations and model tests performed in the laboratory. The arc-quencher operated reliably with continuous over-voltage on the interelectrode gap at a frequence of 2.5 kHz.

The experimental data obtained with the herein-discussed arc-quencher used in the anode wall of a segmented Faraday-type channel are presented. Performance of the arc-quencher was evaluated by the curve shape of the inter-electrode voltage variable component. Comparison was drawn for the case of concrete-filled interelectrode gaps.

It is proved that the suggested principle of the anode wall protection and its practical implementation produce satisfactory results as far as the arc-quencher performance at both random over-voltage and continuous operation is concerned.

The study indicates that the arc critical length is slightly dependent on the current value is about 4mm. This makes it possible to arrive at a simple design of the anode wall.

Consideration is given to a qualitative analysis of a number of problems regarding the use of arc-quenchers in the channels of full-scale plants, including such items as:

- -build-up of seed in the arc-quenching cavity
- -mode of discharge at breakdown under various over-voltage conditions;
- -possible design alternatives promoting a a higher performance reliability of arc-quenchers.

The results obtained are encouraging but require further experimental verification in the conditions of a continuously.

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