Related Problems in Ultrasonic Detection of Porcelain Insulator

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Abstracts:

Ultrasonic detection is a new method to detect the porcelain insulator in recent years. We can find the deficiencies of porcelain insulator which used in grid in the early stage to avoid the heavy accidents caused by the abruption of porcelain insulator. Discriminate methods of deficiencies and several common problems in detection of ultrasonic detection of porcelain insulator were analyzed and discussed. The paths and suggestion of increasing the reliability of detection results are extracted establishing in work experience.

Keywords: Porcelain insulator, Ultrasonic detection

1. Introduction

Porcelain insulators and porcelain shells are important equipments in the operation of power plants and transformer substations which insulation and supporting wire. Internal deficiencies were easily generated during manufacturing process. Also, local stress of porcelain insulators and porcelain shells increased in formidable natural conditions. Even a tiny deficiency can also result in the destruction of porcelain insulators and porcelain shells and induce heavy accidents.

Destruction of in service porcelain insulator mainly depends on three factors: material performance, stress level and hazard degree of deficiencies. Nondestructive examination of in service porcelain insulator is established in the analysis of material performance and stress, then identifies whether deficiency existed, and the deficiency equivalent, deficiency property and the hazard degree to the porcelain insulator. So the authenticity of nondestructive examination of porcelain insulator is a critical constituent of the safe reliability.

2. Properties and limitation of ultrasonic detection

The conventional examination is mainly checking the internal and surface deficiencies of porcelain insulators and porcelain shells. The common internal nondestructive examination is ultrasonic and radio examination, penetrant detection is only used in detecting surface deficiencies. But radialgraphic inspection is not applicable in internal examination of porcelain insulator. The other detection methods such as magnetic powder detection and eddy current detection is not suitable. So the

nondestructive examination of porcelain insulator is only ultrasonic detection.

Ultrasonic examination can detect the cracks buried inside 2~3mm of flange mouth of porcelain insulators and porcelain shells and the other methods can not do this. Through field investigation we can find that 95% fracture position located in flanges' face(as shown in Fig.1.).So this place is the major in our ultrasonic examination work.

Ultrasonic examination is sensitive for plane deficiencies in material. When detect sound beam normal to deficiencies during detection progress then can get higher deficiencies' reflect echo (as shown in Fig.2 and Fig.3.). Such as the detectable rate of porcelain insulator's crack deficiency is very high. But due to the limitation of diffusion and sound of ultrasonic beam, we can get enough deficiencies' reflect echo wave if the deficiencies big enough or reflect angle suitable for strip and sphericity deficiencies of porcelain insulators and porcelain shells.

3. Uncertain factors of ultrasonic detection

There are so many influence factors of examination results in ultrasonic detection work. The main effects contain equipment used in work, work methods and process, shape and property of deficiencies etc. Misevaluation and misdetection will be discussed in the following paper.

3.1 Evaluated error of deficiencies

The evaluation results of examination often have some unreliability, and the misevaluation always leads to rework and a large member of waste. Different angle detectors, different equipments and people maybe get different detection results to the same deficiencies.

3.2 Misdetection of deficiencies

Misdetection of deficiencies always exists in ultrasonic detection and this will depend on two facets, first, whether the detection program and method is right, second, technique level and responsibility of detection worker.

The sonic velocity in majority material of porcelain insulators and porcelain shells is 6000 ~ 6200m/s from large quantity experiments to the ultrasonic detection. So 2.5~5MHz is the suitable frequency of ultrasonic detector. Now, we can get well effect when we use once reception and emission twin crystal creep inspector and auxiliary with longitudinal oblique incidence unit crystal detector. Otherwise, the material of porcelain insulators and porcelain shells is different from the steel, so the adjustment of the equipment is different the other methods too. To prevent the misdetection during detection, we need high sampling frequency, greater than 120MHz will be better. So, electing suitable detection equipment and methods is the critical segment for getting well detection result.

4. Discussion and analysis of the problems

From the problems mentioned above, the detection of porcelain insulators and porcelain shells is not only depending on the choice of detection methods and the

understanding of the properties and limitation, but also control and understand of some uncertain factors. Now, some apparent achievement has been obtained by large quantity of domestic research..

4.1 Disposition of professional technologists

Disposition of the professional technologists is the primary problem during examination process. We have done a statistic that we asked 300 professional nondestructive examination technologists to detect several groups of standard samples. The results show that the disposition and experience is very important, at the same time, the shape of samples and the type of deficiencies effect the detector to get correct judgment directly too. Some foreign research institutes divide the disposition of detectors into qualification, reaction sensitivity, ability of identification and judgment, attention and excitation of brain, and the curve of these factors change with time. They want to find the way of increasing the disposition of detectors by comprehensive analysis of sound, light and heat factor of external environment and summary all of these into a digital model to compare. Researchers in domestic also do a lot of wok. Now, our country has no unified standards of detecting porcelain insulators and porcelain shells, but some provinces promulgate guide rules to norm the works. At the same time, every province begins to prepare training and qualifying the detectors.

4.2 Detection equipments

Detection equipment is the critical factor of detection results, also it is the important facility to increase the authenticity of the nondestructive examination of porcelain insulators and porcelain shells. Now the models of ultrasonic detection equipments are various, from the angle of removable and utility, economic, and easy to study, it is better to choose the home equipments. We can build well foundation of ultrasonic detection if we can choose good equipments, detectors, test blocks and correct detection parameters.

4.3 Detection occasion

We should use every detection chance of inservice units to detect the porcelain insulators and porcelain shells. The surface of the porcelain insulators and porcelain shell should be cleaned before detection. Before the ultrasonic examination, we should do penetrant test on the doubtful place to determine whether micro-cracks existed in the exteriority. To indeterminate place, we should do detection registration and the reflect echo of deficiencies from the internal surface should be especially pay attention to analyze, judge and make correct evaluation.

The new porcelain insulators and porcelain shells should be overall detected before bringing into service and the detection results should be recorded. Then we can do comparison between the next detection and the original deficiencies to determine whether the deficiencies extended after operated several days. The porcelain insulators and porcelain shells which have rather large deficiency should be replaced immediately.

5. End statements

The State Grid Co. defines the ultrasonic detection of porcelain insulators and

porcelain shells definitely in the ***Technical Supervision Specification of Pillar Insulators Used in 72.5KV and upward Voltage Class***:

1. External appearance and ultrasonic detection of high voltage pillar insulators should be proceeded after conveyed to the loading bay.(item 14 of chapter 5)
2. Ultrasonic detection of high voltage pillar insulators should be proceeded again after installment and debugging. (item 19 of chapter 5)
3. Ultrasonic detection periodicity of pillar insulators operating in the transformer substations is one year for new equipments and 3 years for 72.5KV and upward from the commission day and the detection periodicity changing into one year after 3 periodicities, the detection rate should be 100%. (item 28 of chapter 7)

Now it is impossible to detect the deficiencies in the material completely with single nondestructive examination method. We should increase the safe operation reliability of equipments with various facilities to find the deficiencies and erase them. We should choose correct detection methods and dimension to increase the reliability of nondestructive examination results. First of all, we should know the material and ordinance of porcelain insulators and porcelain shells, potential position and properties of deficiencies. The best detection method and equipments should be selected after evaluating the shape of deficiencies, determination of orientation harmfulness and calculating the maximal permitted size of deficiencies under related standards. We should use several detection methods to get more information if possible. Of course we can increase the reliability of detection results of porcelain insulators and porcelain shells by the other facilities except from nondestructive examination and make comprehensive judgments found in multi-disciplinary knowledge. Finally, it is important to know the purpose of nondestructive examination and the material properties of porcelain insulators and porcelain shells. We can warrant the safe operation of porcelain insulators and porcelain shells by nondestructive examination.

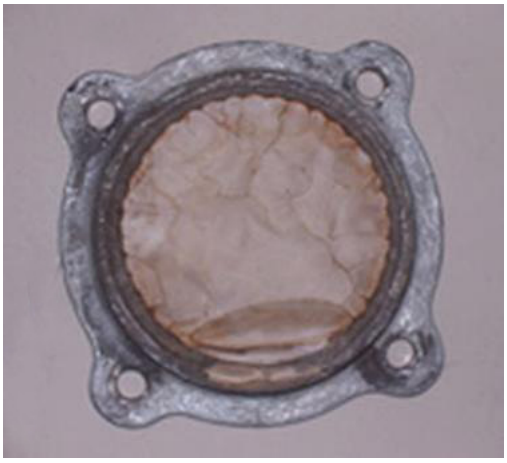


Fig.1 Fracture of porcelain insulator

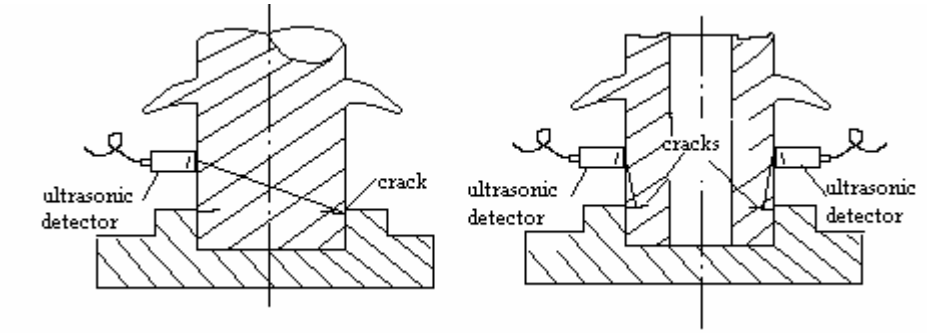


Fig.2 Sketch chart of ultrasonic longitudinal wave probe detecting porcelain insulators

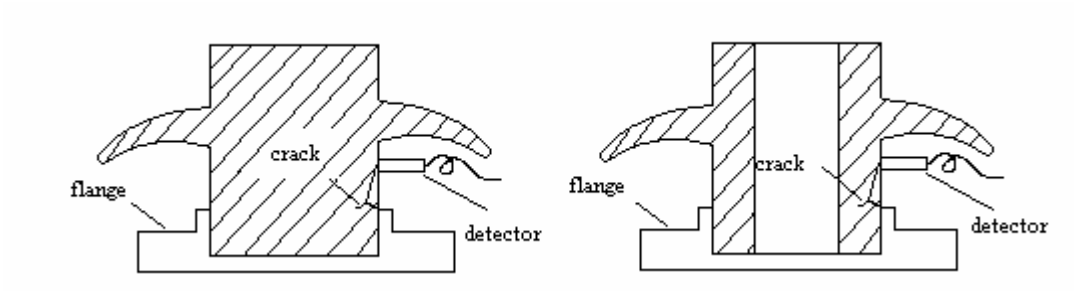
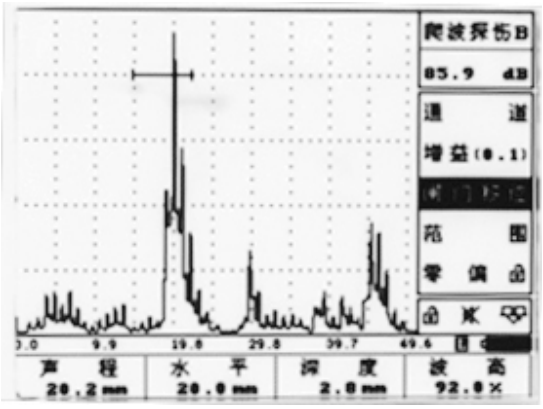
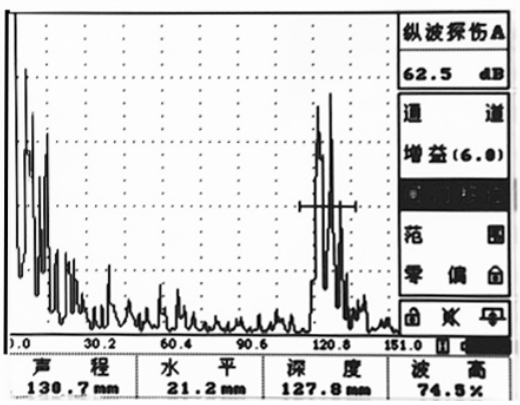


Fig.3 Sketch chart of ultrasonic creeping wave probe detecting porcelain insulators



a) echo of creeping wave probe



b) echo of longitudinal wave probe

Fig.4 echo of pillar porcelain insulator detecting