UV Testing Personnel Training and Certification

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Abstract. The thermal testing technique for electrical equipment is good known in NDT word. Most of power generating and transporting companies use it (1). Thermal testing sensitive to all imperfections which generate heat (bad joints, damaged cable e.t.c, but there is some imperfection which not generate sufficient amount of heat to be detected. This id the corona discharges, which can happen on damaged insulator or busbar. This type of imperfection has leakage current 10−8 of amperes, and produce 0.01 – 0.1 watt of heat depend on voltage of line. Mean while these imperfections quite dangerous. The UV radiation destroys polymeric insulators and produce ozone which join wiz nitrogen and produce nitric acid. Nitric acid quickly destroys metallic parts of insulators and busbars (Pic. 1.). The special UV equipment for corona detection has been developed (Pic.2.), but as an regular NDT flow detector is useless without detailed inspection procedure and qualified personnel.

SEC “Kachestvo” join its efforts with “Panatset” (Russian NDT equipment distributor) and “UVIRCO” (South African UV camera manufacturer) to solve absence of qualified problem. First target for our team was collecting and analyzing all existing procedures of UV testing. The most detailed were the inspection technology of “Energo Atom” (RF) (2) and ASTM D1868 – 13 (3). Analyzing of this standards give us an ability to understand the knowledge base required for UV NDT inspector. The training program has been developed and discussed with leading energetic companies in RF. Now SEC “Kachestvo” perform training of personnel for UV testing of electrical equipment based on this program. But training is not sufficient to perform inspection. Personnel performing such inspections have to be certified.

SEC “Kachestvo” with assistance of “Panatset” and “UVIRKO” work out the certification procedure in accordance to ISO 9712-2012. Candidates have to perform measurement of a real sample and analyze results of infield inspection data files during practical exam as in thermal testing. The procedure and examination materials have been sanded to DAkkS (German national accreditation agency) to extent accreditation filed of SEC “Kachestvo” for UV testing method.
Introduction

It is known that power supply lines and high voltage electrical equipment - hazardous industrial object. A lot of incidents occurs with electrical equipment across the world. The number of accidents caused by high contact resistance reduced many times because of wild spreading of infrared diagnostics. All imperfection which produce enough heat (bad contact joint e.t.c) can be easily detected by infrared diagnostics. But not all imperfections of electrical equipment produce enough heat to be detected. Insulation failure on early stages, mistakes in equipment design, damages of single wires in busbars become the sources of partial discharge. Discharge activity is not less dangerous to equipment condition than other defects. Long influence of discharge activity lead to damage of support structures metal and degradation of polymer insulators, but it not produce enough heat to be detected. Several years ago UV inspection technique of corona discharge detection was introduced. But equipment is no enough to perform inspection. Inspection have to be performed by trained and certified personnel in accordance to inspection technology.

Does it make sense to certify UV inspection personnel?

Prerequisites for personnel training and certification.

To make a decision that certification for personnel performing some technological operation is necessary and required by customer you have to be sure in next statements.

- This technological operation is used in field and give reliable result
- There is serially produced equipment.
- There is a typical technological instruction how to perform operation.
- The operation is complex and responsible.

The current status of the issue

It is obvious that it is impossible to speak about certification procedures before the requirements for basic practical skills and theoretical knowledge of NDT inspectors are described.

So we have to wait while UV flow detectors become serial commercial equipment (today there is two main equipment manufacturers UVIRCO - South Africa, UVOLE - Israel). In 2010 both companies presented UV and multispectral cameras (Visual, IR an UV). This equipment was reliable and suited for infield inspection.

At the same time first inspection technologies appears. The most detailed were the inspection technology of “ENERGOATOM” (RF) (2) and ASTM D1868 – 13 (3). Inspection technology of “Energo Atom” was implemented and it is begin to possible to collect data about inspection efficiently.

SEC "KACHESTO" and its exam centre "PANATEST" start their work from assisting in implementation of UV inspection technology on ENERGOATOM, BASHNEFT and regional power distribution companies (during this time our TT inspectors, with experience of electrical components inspection, performs in filed UV inspection and compare infrared and UV inspection results.

After 4 years of performing of UV inspection we next conclusions have been made
- UV inspections give a reliable and valuable result.
- Inspection technology is complex (like an infrared testing) and responsible.
If we summarize all collected data we can see that all necessary criteria fulfilled and UV inspection personnel certification is necessary and required by customer. Also we collect all data to work out certification procedure.

Training and certification procedure

Main steps list.

Because UV inspection have relation to NDT method it is necessary to work out procedure in accordance to ISO - 17024-2012 Conformity assessment — General requirements for bodies operating certification of persons [1] and ISO 9712-2012 Non-destructive testing — Qualification and certification of NDT personnel [2]. Before we start we need to make a plan of our actions
  - Define practical skill and knowledge base required for UV inspector.
  - Define requirements for candidates.
  - Work out training program.
  - Work out certification procedure
  - Work out certification exam materials (question books and practical exam samples)

Practical skills and knowledge base.

Necessary for UV inspector skills and knowledge's were defined based on experience received by our inspectors during implementation of UV technique.

The basic requirement for candidate we make quite similar with requirements for TT NDT inspector. Of course UV inspector have to know a lot of particle discharges, factors which have an influence on discharges intensively, construction of insulation, e.t.c.

Requirements for candidates.

It is only one extra to regular requirements for candidates. A lot of UV inspection performed in areas with high level of electrical field intensively so candidate can not work if he has cardio stimulator or other problems which not allow him to work in such areas.

Training.

In case of UV inspection only passive technique applicable, only high voltage equipment can be checked. So it is obvious situation with limited industrial sector And it is possible to decrease training time for level 1 and level 2.

One of the problem was that UV inspection objects is not suited for common product sectors (forging casting welding e.t.c). In Russian standards there is a industrial sector "electrical equipment" so we to describe this sector (such procedure described in ISO 9712). Equipment of this sector include metal busbars, contacts and , and contact connections, insulation of all types (glass, ceramic an polymer), supplying electrical equipment (overcharge protectors, capacitors e.t.c), electrical machines ( engines, transformers and generators). This sector was called electrical equipment. This sector was accepted by DAKkS Auditors and now is applicable for TT inspection and UV corona disaccharide detection technique.

As a result only level 2 training hours have been reduced relative to TT method. The main reason is TT inspection can be applicable to large scale of objects and consist of 2
basic techniques (active and passive). training ours for UV corona discharge detection is represented in table 1.

<table>
<thead>
<tr>
<th>Method</th>
<th>1st level</th>
<th>2nd level</th>
<th>3rd level</th>
</tr>
</thead>
<tbody>
<tr>
<td>TT</td>
<td>40</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>UV Corona discharge detection</td>
<td>40</td>
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<td>40</td>
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</tbody>
</table>

The Training syllabuses has been worked out in cooperation with PANATEST and UVIRCO (basics of requirements to UV inspector and training time table). TT and UV corona discharge detection has a lot of similar in physical base so in candidate citified on TT the training ours for UV can be reduced twice.

Certification procedure.

Certification procedure was not changed relative to TT method also candidate for level 1 have to perform inspection of 1 sample and make and analyze 2 UV data files. For level 2 the technological instruction for sample inspection also required.

Exam materials.

It was not a new problem to write a exam question books and it was solved easily. Also it was no any problems UV data files. During four years of work we make thousands of UV data files. Make an exam data file passports not take a lot of time.

But the exam samples was a real problem. To emit UV radiation sample have to be loaded with high voltage, not less than 20 kV or has an artificial source of radiation. The test show that artificial is not looks like the real discharge activity on UV camera screen. So the only way was to produce samples loaded with high voltage and as safe for candidates.

So we have to find a high voltage souse with very low current and without capacitors on high voltage part. The problem was solved. And first two samples were produced (pic. 1.)

![Picture 1](Image)

**Picture 1.** Exam samples for UV corona discharge detection.

One more problem it was an exam passport for this samples, because of discharge activity depend on many parameters. So we have to keep humidity and temperature under
control and give large confidence interval (about 10%) to compensate fluctuations of other parameters.

**Accreditation.**

To pass accreditation it is necessary to fill application forms, attached all materials and it to an accreditation agency. We try to pass accreditation on DAkkS (German national accreditation body) and in NTC "Industrial Safety" (Accreditation body of Russian voluntary certification system). In both cases it was impossible to pass accreditation without accreditation procedure.

Russian and German accreditation bodies were very interested in presented documents and make a decision that it is necessary to establish personnel certification in field of UV corona detection technique. As a result DAkkS issue two documents - certification procedure (Ergänzende Anforderungen an akkreditierte Stellen, die Fachpersonal für den Umgang mit UV-Bestrahlungsgeräten gemäß § 4 UV-Schutz-Verordnung (UVSV) zertifizieren.) [3] and accreditation procedure (Ergänzende Anforderungen an die Akkreditierungsstelle und an das Akkreditierungsverfahren von Personenzertifizierungsstellen nach DIN EN ISO/IEC 17024 für den Bereich “Fachpersonal für den Umgang mit UV-Bestrahlungsgeräten gemäß § 4 UV-Schutz-Verordnung (UVSV)”[4]. In Russia SDOS 10-2015 "Rules of personnel certification performing UV inspection of electrical equipment"[5] was issued.

**Conclusion.**

SEC "Kachestvo" pass audit by DAkkS in accordance to ISO 17024 for accreditation area extension for NDT personnel certification performing UV corona discharge detection. In accreditation area it is described as special technique for TT. Also SEC "Kachestvo" was accredited as an certification body for UV NDT personnel certification in national certification body NTC "Industrial Safety"

**References**

1. ISO/IEC 17024: Conformity assessment - General requirements for bodies operating certification of persons.
2. ISO 9712:2012 Non-destructive testing -- Qualification and certification of NDT personnel.
3. Ergänzende Anforderungen an nach DIN EN ISO/IEC 17024 akkreditierte Stellen, die Fachpersonal für den Umgang mit UV- Bestrahlungsgeräten gemäß § 4 UV-Schutz-Verordnung (UVSV) zertifizieren. (Zertifizierungsschema), DAkkS, 06.11.2015
5. CДОС 10-2015 "Regulations in field of UV NDT personnel certification" NTC "Industrial Safety" 26.06.2015