Analysis of metrological supply problems in electricity generation

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Abstract. In this article, the data on metrological supply issues of electric energy and production enterprises and laboratories in modern economic conditions are analyzed. Methods of choosing a measuring instrument and reducing errors are analyzed and recommendations are given.

Introduction

As everyone is aware, the entire world has been enduring economic changes for years. These periods have seen a considerable change in both the state of production and its objectives. In such circumstances, no one questions the significance of measuring devices in various production branches, i.e., the goal, duties, and function of metrological supply. The primary goal of metrological maintenance is to use the proper application of the measuring method, measurement tool, measurement process, and analysis of the measurement data through proper management to achieve the requisite accuracy and ensure good results [1-8].

Any technology is evolving to meet the society's expanding requirements and capacities. This increases the need for metrology and its upkeep. The quantity of measuring tools and sensors in manufactured equipment has expanded by several percent yearly since the turn of the 20th century. But because of the competition, they are forced to alter equipment speed. It is getting more and more difficult to move measuring instruments from their installation to the metrology laboratory when the calibration interval is needed and then back to their original place once calibrated. The development and invention of new modern technologies, or the design and production of high-quality, high-tech products that are competitive in both domestic and international markets of each country, is one of the manufacturing sector's most significant aims today. Developed nations have recently allotted significant financial resources for all manufacturing sectors in order to accomplish this. Metrological assurance is intimately tied to the issue of electricity production and quality in all nations since it forms the cornerstone of any industrial enterprise's quality management system. The development of tools, including intelligent instruments, that should function for a very long time without human interaction is related to the necessity for long-term mechanisms. Maintaining the functionality of measuring devices is a task that is still necessary today. Long-term use of measuring devices, however, increases the influence of influencing factors, their effects (including considerable material wear, increasing external influences, changes in magnetic characteristics, etc.), and the likelihood of metrological failure. The automation of equipment control increases the relevance of metrological supply and, consequently, the requirements for the reliability of measurement data, particularly in the transportation sector as well as in the generation of power and its delivery to the consumer. Up to 60% of industrial failures and accidents, in the opinion of Chinese specialists, are brought on by sensor flaws. The metrological serviceability of the measuring instruments should be tested more frequently in order to increase the effectiveness of the equipment and to reduce wear and tear on the equipment as well as the danger of defects and accidents. Controlling the supply of laboratories for organizations dealing with issues of metrological supply as well as for scientific, production, and industrial companies is vital for this, as is providing them with the requisite measuring equipment [6-11].

But again, issues arise since each metrolog is purchasing for the laboratory. If the product promoted by the supplier is unable to successfully complete the tasks for which it was purchased, problems will arise with the acquisition of the measuring equipment. In other words, the measuring device you obtained could not be completely enough for the jobs you need it for. This puts a lot of duty on experts in this area. Businesses today spend a lot of money on unnecessary features when purchasing equipment that will never be in demand [12].

There are frequently issues with how newly purchased equipment are organized to provide the essential environment [1-2]. Our analyses reveal that the majority of these issues can be attributed to the lack of a detailed technical task preparation, incomplete information collection, and unclear task formulation during the decision-making process to purchase a new measuring instrument. This issue is mostly caused by the specialists in power generating firms' inability to make decisions due to a lack of knowledge. Today, the majority of measuring instruments used in the
laboratories of many electricity-generating companies have a lifespan of more than 25 years, and the majority of metrologists lack sufficient knowledge of cutting-edge measurement techniques and the true capabilities of contemporary equipment [13-16].

The principal users of this clause are the producers and suppliers of measuring instruments who, in their promotional materials regarding the equipment they sell, frequently refer to the equipment's limitations. In a sizable advertisement window, it is challenging to notice the device's true features. The provider frequently provides old equipment "as a last resort" in an attractive package. It is nearly impossible to evaluate all of the measuring tool's potential uses, its operating features, and even its level of efficiency if you don't know anything about the new tools and equipment you have just encountered. The adage "it is better to see one month than to hear it a hundred times" must therefore be followed. Metrologists try to find out about these devices from their peers or try to see samples of the devices at supplier conferences and trade exhibitions. This is the correct course of action, but you should be aware that your measurement tasks and your colleagues' opinions don't always line up, that the operator using this device might not have the necessary skills, that the operating conditions might be off, and that the new device might not have an equivalent in Uzbekistan [17-20]. Metrologists have a difficult challenge in choosing measurement tools and equipment for metrological supplies and laboratories based on the examination of the provided data. As science and technology have advanced, it is now crucial to understand the components of intelligent measuring devices and adhere to usage regulations in order to produce and utilize them. It's important to concentrate on a certain feature while picking measurement equipment for laboratories [21-25].

In other words, some measurement devices and laboratory equipment require software updates. At times, manufacturer-provided codes and passwords may be necessary. This calls for experts to exercise caution. As a result, traditional components will gradually be largely replaced by metrological self-monitoring inside the metrological supply. Regular metrological processes will take less time, but there will be more demand for highly skilled metrologists to work on developing new measuring instruments [26-31].

2. Methods
As we all know, when picking a measuring device and method, the findings are evaluated in the laboratories of the power generating firm using a number of parameters. Accuracy and speed are typically the major factors to consider when purchasing measuring equipment. Devices with high accuracy, i.e., low relative error and high sensitivity appropriate for challenging working conditions, can easily lose stability and fail before their time. As a result, measuring equipment should be chosen in line with the standards for measurement accuracy and the type of tests being run. In the selection of the measurement tool and method, in the production laboratories, and in the industry for the analysis and creation of this article, statistical analysis methods were widely employed to elucidate the issues of metrological supply [32-38].

3. Research results
1. It is important to carefully study and analyze a variety of criteria when selecting a measuring tool for different measurement purposes, optimizing them based on the sum of all technical data and attributes.
2. The primary elements affecting the selection of the measurement device are:
3. The capability of measuring the signal under study.
4. The kind of measurement parameter.
5. Measuring technique (direct, indirect, group, joint, etc.).
6. The length of the measures.
7. The measuring tool's practicality (general dimensions and weight).
8. Necessary measurement precision.
9. The equipment's cost.
10. A measurement inaccuracy was fixed.
11. The weather when using a device.
12. Requirements for the format (analog, digital, analog-digital, etc.) of recording measurement results.

The device's intended usage (e.g., individually, as a component of an automated system, etc.).

It is unavoidable that, in every measurement, the measurement result would differ from the actual value of the quantity being measured for a variety of reasons. Measurement mistakes are the name given to these variations.

Measurement errors are divided into categories based on their types (absolute, relative, random, etc.), reasons of occurrence, modes of manifestation, and other factors. Of course, it is essential to account for all possible measurement errors and work to minimize them by determining their root causes. [39-45] We concentrate on approaches for minimizing (removing) systematic measurement mistakes. The measurements are accurate if the systematic errors in their findings are near to zero. Methods include theoretical analysis, replacement, compensation of mistakes using symbols, statistics, various measurements, sample signals, and the way of introducing correction and correction factors to discover and exclude systematic errors. If systematic mistakes cannot be completely eliminated, they can be minimized by removing the sources, changing the measuring tools both during the inspection and before the measurement, employing unique measurement techniques, and other procedures. Microprocessors found in contemporary measurement devices enable the automatic detection and exclusion of systematic erroneous readings. According to the theoretical analysis method, the systematic error can be computed using specific features of the tools being used or characteristics of the measuring technique, or in other words, using formulae. So, if the input resistance is known, it is easy to calculate the device's power consumption-related systematic error. The substitution approach entails substituting a known
quantity or repeatable measurement for the measured quantity. If the source of the error has a directional effect (for instance, errors caused by permanent magnetic fields, the thermoeffect, etc.), the systematic error is included in the measurement results twice, but with opposite signs. This is known as the method of compensating the error by sign [46-50].

In order to process the measurement results, the statistical approach divides them into numerous independent observation groups. The existence of systematic error is shown by the difference between group variances and group means (group averages), which makes it possible to compute it. The technique used for different measurements enables the detection of systematic mistakes, the origin of which is unclear. For this, the value is measured in various ways, using various measurement tools, under various circumstances. In this instance, the internal errors of the measuring devices utilized for the measurements should be roughly comparable. The reference signal method compares the measured and measured reference signals of the same type that are delivered to the measuring device's input. The systematic error is determined by the difference between them. Introduce correction and corrective factors in this way. The value that is added to the value obtained during the measurement in order to account for systematic mistakes is referred to as the correction and bears the same name as the measured value. The adjustment has the opposite sign from the absolute systematic error but is equal to it. Corrections are presented via graphs, tables, or mathematical formulas. Due to the small size of systematic errors, systematic measurement error can also be reduced by multiplying the measurement findings by a correction factor that is close to the average value. It is expected that during the inspection of measuring instruments, correction and correction factors are predetermined [25-29, 33].

The use of screens to shield against the effects of electromagnetic fields, the use of stabilized power sources, the moistening of the device, and removing it from potential sources of exposure can all help to reduce systematic error. Other methods include measurements in thermostated rooms (to exclude temperature errors), the use of screens to shield against the effects of electromagnetic fields, and the use of stabilized power sources [34-38].

The systematic error of the device can be reduced by adjusting the measuring instruments both during the inspection and before to the measurement. This entails ensuring that the device's position is accurate, that the pointer is set to zero, that it is positioned in relation to the nearby objects, etc.

Making it random significantly lessens the impact of systematic error. As a result, the error value will be greatly decreased if you test a certain parameter using various instruments and then compute the arithmetic average of all the data.

The values of systematic errors of independently measured, directly measured quantities are used to calculate systematic errors in indirect measurements. Their accuracy rises as the measurement error falls. The quality of the measurements refers to their precision, which reflects how closely the quantity's obtained value corresponds to its actual value. It should be emphasized that due to the complexity of the measurement process and the rising expense of measuring devices, there is typically a certain fair degree of accuracy that cannot be exceeded under specific situations and measurement objectives [41-46].

Daily and hourly physical quantity measurements, particularly electrical measurements, are carried out in practice for a variety of reasons. The results of these measurements-i.e., the same number of measurements-obtained using measuring devices at various times and locations should be equal or differ by a predetermined amount in the interests of the nation's economy. In other words, the dimensions must be consistent.

In a unit of measurement, errors are expressed and legally recognized as such, and the outcomes of measurements are known. The science and practice of guaranteeing the uniformity and essential precision of measurements are covered by metrology. On the basis of the data examined above, we may suggest the following guidelines for picking a measuring tool and minimizing its errors [44-50]:

1. We must correctly select the measurement tool and objective.
2. Based on demand, we must report the location and circumstances of the measuring device.
3. After executing the measurement process using several techniques, it is vital to select the one that is the most practical, quick, accurate, and efficient.
4. The results must be accurately analyzed and recorded.

The following are some factors influencing the measurement results:

Depending on the nature of the object, the object of measurement denies the need to change the measurement. Measurement subject (expert or experimenter; the operator-subject relationship should be kept to a minimum) a collection of methods for evaluating the measured quantity in relation to its unit, measuring device, and measurement method.

It is important to consider the following elements that affect the aforementioned measurement findings while selecting measuring instruments and minimizing their errors [50].

**Conclusions**

In conclusion, it should be highlighted that local industrial companies' current state of development is typically critical to catching up to more established rivals, particularly in terms of quality assurance. Using current technological tools, it won't be able to complete this task quickly. Measurements also play a crucial part in verifying the quality of the final product. The effectiveness of the choice of measurement instruments and techniques of decreasing mistakes is increased in electricity production companies and laboratories by the use of quick, high-accuracy measurement systems that account for small defects.
References

2. B.B.Kholikhmatov, M.T.Erejepov, and others. E3S Web of Conferences, 384, 01032, (2023), https://doi.org/10.1051/e3sconf/202338401032
11. R.Karimov, D.Xushvaktov. E3S Web of Conferences, 384, 01053, (2023), https://doi.org/10.1051/e3sconf/202338401053
12. R.Karimov. E3S Web of Conferences, 384, 01056, (2023), https://doi.org/10.1051/e3sconf/202338401056
13. R.Karimov, and others. E3S Web of Conferences, 289, 07021, (2021), https://doi.org/10.1051/e3sconf/202128907021
15. E.Abduuraimov. E3S Web of Conferences, 384, 01051, (2023), https://doi.org/10.1051/e3sconf/202338401051
16. E.Abduraimov, B.Nurmatov. E3S Web of Conferences, 384, 01052, (2023), https://doi.org/10.1051/e3sconf/202338401052
17. A.Burkhankhodzhaev, B.Nurmatov. E3S Web of Conferences, 216, 01112, (2020), https://doi.org/10.1051/e3sconf/202021601112
29. A.Alimov, F.Akbarov, G.B.Eshniyazova, A.Turenyiaziyava. E3S Web of Conferences, 289, 07035, (2021), https://doi.org/10.1051/e3sconf/202128907035
32. A.Nuraliyev, Y.Adilov, A.Esenbekov. E3S Web of Conferences, 384, 01054, (2023), https://doi.org/10.1051/e3sconf/202338401054
34. K.Jurayeva, Kh.Sattarov. E3S Web of Conferences, 389, 01060, (2023), https://doi.org/10.1051/e3sconf/202338901060
35. Kh.Sattarov, and others. E3S Web of Conferences, 383, 01028, (2023), https://doi.org/10.1051/e3sconf/202338301028
38. A.Safarov, Kh.Sattarov, and others. E3S Web of Conferences, 264, 05038, (2021), https://doi.org/10.1051/e3sconf/202126405038
40. M.V.Melikuziev. E3S Web of Conferences, 384, 01033, (2022), https://doi.org/10.1051/e3sconf/202338401033
42. O.G.Hayitov, M.O.Gafurova, and others. AIP Conference Proceedings, 2432, 030101, (2022), https://doi.org/10.1063/5.0091265
43. I.Kh. Siddikov, M.T. Maksudov, and others. AIP Conference Proceedings, 2432, **020003**, (2022); https://doi.org/10.1063/5.0089681
44. N.N. Norkhojaeva, N.B. Pirmatov, N.K. Kamalov. E3S Web of Conferences, 402, **10041**, (2023); https://doi.org/10.1051/e3sconf/202340210041
45. S. Yaxayeva, N. Pirmatov, and others. E3S Web of Conferences, 402, **05016**, (2023); https://doi.org/10.1051/e3sconf/202340205016
46. O. Toirov, N. Pirmatov, and others. E3S Web of Conferences, 401, **04033**, (2023); https://doi.org/10.1051/e3sconf/202340104033
47. N.B. Pirmatov, U.T. Berdiyev, and others. E3S Web of Conferences, 401, **03021**, (2023); https://doi.org/10.1051/e3sconf/202340103021
48. N.B. Pirmatov, A.M. Egamov, and others. E3S Web of Conferences, 401, **03056**, (2023); https://doi.org/10.1051/e3sconf/202340103056
49. N. Pirmatov, A. Panoev, and others. E3S Web of Conferences, 383, **04046**, (2023); https://doi.org/10.1051/e3sconf/202338304046
50. N. Pirmatov, A. Bekishev, and others. AIP Conference Proceedings, 2612, **050005**, (2023); https://doi.org/10.1063/5.0135546