DERri

Common protocol for research laboratory work

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DERri

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DELIVERABLE SUMMARY:

Common protocol for research laboratory work

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EXECUTIVE SUMMARY

A programme of Networking Activities (NA) is a part of the project “DERri, Distributed Energy Resources Research Infrastructures” which has a primary objective of the further integration of the European Distributed Energy Resources research community. Work Package NA2 addresses an important issue for users of large facilities that is the compatibility of test procedures at the different sites, respecting a common set of criteria based on international standards.

The “DERRI Common protocol for research laboratory work” aims at creating the conditions to guarantee the reliability of the activities performed in each facility and their traceability. Within this work, common requirements for quality management are defined in order to provide similar technical (and management) requirements when accessing and using the infrastructure of DERri partners.

Commonly agreed criteria and guidelines for research laboratory work have been developed. where the focus is put on:

- Acceptable quality requirements for different types of participating laboratories (commercial versus non-commercial use of laboratories, accredited versus non-accredited labs)
- Methods of coordinated equipment management in order to optimally use the infrastructure
- Criteria for ensuring the quality of the equipment and laboratory work.
- Criteria for the skill of the operators taking into account the approach to experimentation adopted by each Laboratory.
- Quality management criteria: differentiation between the QM range of the RI and the QM area required by the type of trial (ICT-related tests, electrical testing, electrochemical testing).

The requirements are mainly in accordance with the standard *ISO/IEC 17025 ‘General requirements for competence of testing and calibration laboratories’* taking into account the requirements of the technical standards followed in the laboratories. It is expected that the main elements of the above standard can be agreed upon in order to create and maintain equal testing conditions in all DER testing and research laboratories, be they commercial, non-commercial (i.e. customer-oriented), university-owned (i.e. research-oriented) or both.

Quality management is considered as an essential factor for comparability and interoperability of laboratories, enabling precision and accuracy.

1 QUALITY MANAGEMENT

1.1 Management requirements

The requirements of the management will not be treated in detail in this document, as almost each laboratory has a management system following either ISO/IEC 17020-series [4] or ISO 9001 [3]. However, the management part can be considered as an essential prerequisite for the successful implementation of all testing activities.

1.2 Technical requirements: Short review

The quality standard ISO/IEC 17025 has been found most comprehensive for laboratory testing activities. The most important technical requirements are here shortly reviewed.

- **Skill of the operators**

  Personnel performing special tasks shall be qualified on the basis of appropriate education, training and experience. The laboratory shall have a policy for maintaining the competence of technical personnel.

- **Test environment, conditions**

  The accommodation and environmental conditions may have an influence on the test result. The conditions shall be documented and kept as stable as possible. Access to the test site shall be controlled.

- **Test methods**

  The laboratory shall use appropriate methods and procedures for all tests within its scope. The methods can be standardized. Laboratory-developed methods and non-standard methods may also be used but these shall have been validated before taken into use.

  Testing laboratories shall apply procedures for estimating uncertainty of measurement [5]. All uncertainty components shall be taken into account. Control of data is important when computers are used for the acquisition, processing, recording, reporting, storage or retrieval of test data. The software shall be safeguarded from adjustments.

- **Criteria for ensuring the quality of the equipment**

  Equipment and its software used for testing shall have the required accuracy and shall comply with specifications relevant to the tests in question.

  The records of equipment shall include identification number, manufacturing information, main specifications, location, instructions, certificates of calibration, calibration programme, adjustments, maintenance plan and any damage, malfunction, modification or repair to the equipment.

  The quality standard [2] presumes that the equipment shall be calibrated in a laboratory that can demonstrate competence, measurement capacity and traceability which in most cases means an accredited calibration laboratory.

- **Sampling and handling test items**

  The laboratory shall have a sampling plan if appropriate. The test items shall be clearly registered when received in the laboratory: identification number, reception

date, etc. Confidentiality issues may apply also at this point, in terms of hiding the brand or manufacturer marks, etc.

If test items will be returned into service after testing, special care is required to ensure that the items are not damaged during the testing or transportation.

- **Assuring the quality of test results**

  The laboratory shall have quality control procedures. It may include regular use of certified reference material, participation in the inter-laboratory comparison programmes, the possibility of repeating the tests using same or different methods. Quality control data shall be analyzed. The selected methods should be appropriate for the type and volume of the work undertaken.

- **Reporting the results**

  The quality standard [1] requires altogether 22 items for the test report. The requirements include for instance a unique identification of the report with page numbers, identification of the test method, description of the item tested, ambient conditions and the test results. The report shall be signed by the authorized person(s).

2 GUIDELINES TO FULFIL THE CRITERIA FOR A COMMON PROTOCOL

“Can testing results be accepted, if no commonly fixed procedures and criteria exist?”

The first approach is that some common rules are needed to overcome this critical question. Recommendations and best practice for the way to the common protocol have been discussed in the DERri consortium. The final collection of the rules is commonly accepted by the DERri participants.

2.1 Common protocol and minimum requirements/criteria of DERRI laboratories

The following list is a proposal for the criteria to be fulfilled by the laboratories offering access to their infrastructure.

- Well documented methods, to be accepted by the customer/user
- Competent personnel
- Traceable calibrations and maintenance of measuring equipment
- Test conditions, handling of measuring data
- Internal and inter-laboratory comparisons, reproducibility of the tests (if applicable).

The so-called minimum level is accepted by those laboratories that already have an accreditation in the DER field and those with no accreditation in the field of DER testing. The accredited testing laboratories are fulfilling the previously mentioned items.

The requirements of the management are intentionally left out of the list, as almost each laboratory has a management system following either ISO/IEC 17020-series or ISO 9001. However, the management part can be considered to be as important as the technical part.

The minimum requirements of the common protocol for laboratory work include those requirements which are feasible and acceptable for all laboratories. They refer to the areas of testing methods, personnel, equipment and its calibration, conditions and test data, comparability, and safety. The issue of unique and unambiguous safety rules is of crucial importance when it comes to the access of stakeholders from very different backgrounds.

2.2 Recommendations, best practice in view of a the common protocol

As most of the laboratories have a management system following either ISO/IEC 17020-series or ISO 9001 the requirements of the management will not be treated in detail in this section. However, the management part can be considered as an essential prerequisite for the successful implementation of all testing activities. Based on the technical requirements of the Quality Management standard ISO/IEC 17025 as well as on the analysis in section 4.1 acceptable quality requirements for different types of participating laboratories were developed. The following minimum technical requirements valid for all laboratories (also for those not having an accreditation in DER-field) are proposed:

2.2.1 *Skill of the operators and users*

Personnel performing special tasks shall be qualified on the basis of appropriate education, training and experience. Students and guest users shall be supervised by trained and experienced staff. The laboratory shall have a policy for maintaining the competence of technical personnel. The laboratory shall maintain job descriptions (requirements and responsibilities) for managerial, technical, key support personnel and users involved in tests.

2.2.2 *Test environment, conditions*

Depending on the technical standard followed in the test the accommodation and environmental conditions cause possible disturbances and may have an influence on the test results. In that case the conditions shall be documented (Temperature and moisture if relevant). Conditions shall be monitored and recorded as given in relevant specifications.

The user shall ensure that environmental conditions do not invalidate the results. Tests shall be stopped if there is any doubt of the environmental conditions affecting the test result.

2.2.3 *Test methods*

The laboratory shall use appropriate methods and procedures for all tests within its scope. These include among others sampling, handling and preparation of items to be tested. Instructions on use of all relevant equipment are required as well as on handling of the items to be tested. If it is needed to deviate from standardized test methods or these are not applicable, sufficient documentation, technical description and acceptance by the user/customer will be provided.

The laboratory shall select methods which are appropriate and meet the needs of the user/customer and the research questions. Methods published in international or national standards shall be preferably used. Other methods may also be used if they are documented and agreed by the user/customer or requested by the research work.

Laboratory-developed methods and non-standard methods

The methods not covered by standard methods shall be documented. All potential risk shall be prevented before using a new method. The laboratory-developed test method should contain at least the following information:

- identification
- scope
- description of the type of item to be tested
- parameters or quantities and ranges to be determined
- equipment used/needed
- environmental conditions required
- description of the procedure: handling and preparation of items; adjustment (and calibration) of equipment; method of recording the observations and results; any safety measures to be observed
- criteria for approval or rejection
- data to be recorded and method of analysis

Within the DERri project a common format to document the procedures is defined. The TA reports mentioned in section 4.1 and described in more detail in (“Technical Reporting of the TA activity XYZ”) are the basis of this agreements and should be continued not only for the

transnational access during the project life time, but also for the research work in DER Laboratories without accreditation.

Validation of methods

Validation means the confirmation that the particular requirements for a specific use are fulfilled. Non-standard methods and laboratory-developed methods shall be validated. The process should be one of the following or be a combination of them:

- calibration using reference standards or reference materials
- comparison of results achieved with other methods (e.g. simulation – experiment)
- inter-laboratory comparisons (In the range of the DERri project non-standard test methods shall preferably be mutually accepted by other DER laboratories, e.g. by the means of common tests or similar)
- systematic assessment of the factors influencing the result

Validation is always a balance between costs, risks and technical possibilities. The laboratory shall record the validation procedure and the results obtained from the validation. A statement shall be given whether the method is suitable for the intended use.

Estimation of uncertainty of measurement and control of data

All laboratories shall perform a assessment for uncertainty of measurement. Reasonable estimation shall be based on the method and on the measurements scope. The required uncertainty limits depend on the test method given for instance by the test procedure (also laboratory developed) and on the requirements of the user.

Control of data is important when computers are used for the acquisition, processing, recording, reporting, storage or retrieval of test data. Commercial programs in general use may be considered to be sufficiently validated.

2.2.4 Criteria for ensuring the quality of the equipment

Equipment and its software used for testing shall have the required accuracy and shall comply with specifications relevant to the tests in question. The records of equipment shall include:

- the type and identity of the item of equipment and its software (could be a record in a list of equipment, checked if it is used)
- the manufacturer: name, type and serial number (could be a record in a list of equipment)
- check against specification, suitable test facilities and test equipment specified for the tests in question, standardized measuring methods already implemented (e.g. Flicker measurement)
- certificates of all calibration, adjustments, acceptance criteria and the due date for next calibration
- the maintenance plan, if appropriate

Equipment that has been overloaded or mishandled shall be taken out of service. The failed device shall be clearly marked to prevent its use.

For customer testing services all equipment used for tests shall be calibrated before putting into service. A calibration program and procedures for the equipment includes the schedule of the calibration in an accredited calibration laboratory.

2.2.5 *Assuring the quality of test results*

Monitoring the validity of tests shall be planned and may include the following where appropriate:

- Recording enough information in order allow to repeat the test
- control of test data
- retesting of retained items
- correlation of results for different characteristics of an item.
- use of certified reference material (even at irregular intervals, if it is needed)
- participation in a suitable interlaboratory comparison or proficiency-testing programs

The selected methods should be appropriate for the type and volume of the work undertaken. Quality control data shall be analyzed. If the results are outside pre-defined criteria, planned action shall be taken to correct the problem and to prevent incorrect results from being reported.

2.2.6 *Reporting the results*

As a minimum requirement the following items have to be stated in a test report:

- identification of the equipment used for the test (may with checkboxes of a list of available equipment, once prepared)
- include the list in the report
- unique identification of the report, page numbers
- name and address of the laboratory and test location
- identification of the method used
- description of the item tested and its condition
- test results with the units of measurement
- deviations from, additions to, or exclusions from the test method and the information on specific test conditions, such as environmental conditions
- Name(s), function(s) and signature(s) of person(s) compiling the test report.

2.2.7 *Safety*

The safety at electrical work must be ensured, e.g. considering the 5 safety rules

1. Disconnect from the power supply
2. Take the necessary means to prevent closing of the isolating switches
3. Test absence of voltage
4. Earthing and short circuiting
5. Protect adjacent live parts by covers and barriers and fit a suitable warning notice

Due to the paramount importance of this issue, it has been already well developed in other DERri reports and the resulting indications can be considered as common requirements and criteria:

a) “Safety provisions” extracted from D_NA1-2 “Template of the contract between the proposing team and the research infrastructure” [11]:

b) D_NA-1.3-a “Protocols for regulating the stay of users at the facilities” [6] can be used as a reference for common safety requirements for DERri partners:
   b.1) Electrical safety guidelines
   b.2) General safety guidelines

2.2.8 *Summary*

The minimum requirements of the common protocol for laboratory work include those requirements which are feasible and acceptable for all laboratories. They refer to the areas of testing methods, personnel, equipment and its calibration, conditions and test data, comparability, and safety.

It is worth to be aware of the technical requirements stated in this report and respect them in order to obtain correct and reliable results. Beside potential costs for calibration, no other costs can be expected when following the commonly agreed protocol and minimum requirements.

Common protocol and minimum requirements
• Creating awareness of the importance of QM also at educational institutions, taking into consideration elements of the IEC 17025
• Education and training of personnel, skilled personnel working in laboratories
• Having available relevant standards and related documents, being aware of state-of-the-art testing methods
• Use either standardized or well documented methods for performing the tests
• Documented test setup, ideally fixed configuration with reproducible variability (core setup, with extensions) e.g. describing all of the devices once, unchecking the components not used.
• Use of adequate measuring equipment with standardized measuring methods implemented (e.g. Power Analyzer with Flicker measurement according to IEC61000-3-2 and IEC61000-3-3 standards)
• check precision of measurement devices (Calibration or comparison) and performing an uncertainty assessment at least once
• Use automated testing approaches as far as possible
• Computer assisted test evaluation
• Harmonized test reports, use the same template for all activities in the same laboratory

Within the Networking Activities (NA) of the FP7 Infrastructure project “DERri, Distributed Energy Resources Research Infrastructures” the integration of the European Distributed Energy Resources Research Community is targeted. An important issue for users of large laboratory facilities is the compatibility of test procedures at the different sites, respecting a common set of criteria based on international standards. The most commonly used international quality standard is ISO/IEC 17025 – General requirements for competence of testing and calibration laboratories.

Among these criteria, quality management is considered as an essential factor for comparability and interoperability of laboratories, enabling precision and accuracy. In order to

reach a common agreement of the applied criteria, different considerations have to be taken into account:

The nature of tests influences as well on the quality management (QM) criteria to be employed. Here, a differentiation has to be made between the initial QM range of the RI and the QM area required by the type of trial, be it ICT-related tests, electrical testing, or electrochemical testing.

The minimum requirements of the common protocol for laboratory work refer to the areas of testing methods, personnel, equipment and its calibration, conditions and test data, comparability, and safety.

3 REFERENCES

[1] DERRI, "General criteria for laboratory work and equipment management D_NA-2.2, Rev R-8," October 2011.

[2] *ISO/IEC 17025:2005/Cor.1:2006 General requirements for competence of testing and calibration laboratories, 28 p..*

[3] *ISO 9001:2008 Quality management systems. Requirements, 37 p..*

[4] *DIN EN ISO/IEC 17020:2012-07: Conformity assessment - Requirements for the operation of various types of bodies performing inspection (ISO/IEC 17020:2012); German and English version EN ISO/IEC 17020:2012.*

[5] "JCGM 100:2008 Evaluation of measurement data – Guide to the expression of uncertainty in measurement (“GUM 2008”), Joint Committee for Guides in Metrology, Working Group 1, 134 p.".

[6] DERRI, "Protocols for regulating the stay of users at the facilities, D_NA-1.3-a Rev. R-1," November 2010.

[7] "Mrakotsky E, Mayr C, Questionnaire DERri NA 2.3 organised by AIT Austrian Institute of Technology, PPT-presentation 27.10.2010, 17 p.".

[8] "IEC 61400-12 standard: Wind turbines – Part 12-1: Power performance measurements of electricity producing wind turbines.".

[9] DERRI, "Technical Reporting of the TA activities D_NA 1.3b," November 2010.

[10] "FIPA (Foundation for Intelligent Physical Agents) specifications, see www.fipa.org.".

[11] DERRI, "Transnational User access procedure template of the contract between the Proposing Team and the Research Infrastructure, D_NA-1.2 Rev. R1-1," May 2010.

DERri project

Distributed Energy Resources Research Infrastructure (DERri), 2009-2013, is a collaborative research project of sixteen partners co-funded by the 7th Framework Programme (FP7) of the European Commission. Networking and research activities of DERri foster common procedures and complementary capabilities among the partner laboratories.

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