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ENIQ RECOMMENDED PRACTICE

ENIQ Recommended Practice 4

Recommended Contents for the Qualification Dossier

Issue 2

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FOREWORD – BRIEF REVISION HISTORY OF RP4

The first issue of ENIQ Recommended Practice 4 (RP4) was produced by the former ENIQ Task Group 2.2 and was approved by the ENIQ Steering Committee for publication in 1999. As part of the revision of all ENIQ RPs in 2017 / 2018 RP4 was revised. Because the content of the first issue of RP4 is still valid only a number of smaller changes were made for Issue 2 of RP4.

EXECUTIVE SUMMARY

This Recommended Practice (RP) has been developed as a consensus document amongst the members of NUGENIA Technical Area 8 (TA8) - ENIQ. The main objective of this RP is to support licensees, inspection qualification bodies and inspection vendors to produce and assess a qualification dossier (QD). The document includes all the information relevant for the definition and the execution of the qualification. The appendices give examples of the content of the different sections of a QD.

TABLE OF CONTENT

1. Introduction

The European Methodology Document [1] is intended to provide a general framework for the development of qualifications for the inspection of specific components to ensure they are developed in a coherent and consistent way while still allowing qualification to be tailored in detail to meet different national requirements.

This ENIQ Recommended Practice (RP) will assist those involved in inspection qualifications to identify the material, which might be included in the qualification dossier. The latter is defined as an assembly of all the relevant information for the definition and execution of the qualification. This RP also assists in producing qualification dossiers in a uniform format throughout Europe. Note that the concept of a dossier is not that of a single document or report but rather that of a file in which key documents of the qualification are inserted. It may take the form of a paper file or a computerized database containing multiple files and supporting disposition and comment reports.

It is emphasised that the list of contents recommended here is only a starting point. The precise content must be determined on a case by case basis depending on the particular qualification and the component and inspection involved together with the level of detail required. In some cases certain sections of the recommended list of contents may be omitted or truncated.

This RP is relevant to any non-destructive testing (NDT) method. Because the area in which qualifications have been most frequently applied until now is ultrasonic testing (UT), where examples are given for the purpose of clarification. It is emphasised that the principles given in this RP were developed specifically for in-service inspection (ISI) of nuclear power plant components, but can also be used for inspections performed in the non-nuclear field or for qualification of manufacturing inspections.

Section 2 of this document contains a table, which summarises the recommended contents for a qualification dossier and identifies the different sections it might contain.

Appendix 1 of the document gives more detail about the contents of the different sections of the qualification dossier.

The definitions as given in the second issue of the ENIQ Glossary [2] are applicable.

2. Recommended contents for the qualification dossier

Important Note: Not all the sections listed below may be necessary for any particular qualification dossier. Depending on the purpose and requirements of the particular qualification, some of the sections may be omitted or truncated.

Section	Contents
Summary	Purpose of the qualification and summarising statement indicating how well the inspection objectives as set out in Section 2 are shown by the qualified inspection to be met. Any limitations of the qualification performed should be mentioned also.
1. Introduction	(see appendix)
2. Input Information	Relevant details of: ▪ Component; ▪ Defects; ▪ Inspection method / technique; ▪ Required inspection performance. Also give information about influential / essential parameters of

	the qualification as mentioned in RP2 [3].
3. Quality assurance scheme applicable to the qualification body (QB)	An overview of the quality assurance and organisation used for the qualification to be performed. This may be common to all qualifications performed by the QB.
4. Requirements to be met by the vendor prior to start of inspection qualification exercise	In this section the requirements to be met by the vendor prior to the start of the qualification exercise are specified: Quality assurance, documentation to be provided prior to the start of the qualification, etc.
5. Qualification plan	The way the inspection qualification will be implemented in practice covering at least the following issues: ▪ Qualification level; ▪ Balance between TJ and test piece trials; ▪ Information to be provided by the vendor; ▪ Way the TJ and inspection procedure / equipment are assessed; ▪ Way the personnel is qualified beyond what is required in national certifications schemes (This should include reference to the training and qualification plan applicable to personnel who will operate the equipment to perform the acquisition and analysis of data.); ▪ Rules for the practical implementation of the test piece trials; ▪ Criteria used for the overall assessment of the proposed inspection system.
6. Details of the inspection system	All document relating to the inspection system submitted for qualification: Inspection equipment, inspection procedure and inspection personnel roles.
7. Technical justification	All TJs produced for the qualification. To draw up a TJ see RP2 [3].
8. Qualification test pieces	As a result of the analyses performed in the TJ, the exact requirements for the test pieces are described in this section. The exact characteristics of the manufactured qualification test pieces are also given in this section. Note that the exact details of blind test pieces need to be kept confidential according to the rules agreed. General descriptions of the bounding characteristics of the blind test pieces could be included to support the technical justification.
9. Results of open and/or blind test piece trials	The results of open and/or blind test piece trials should be reported in the technical justification or referenced and a summary presented in the technical justification.
10. Assessment of the results obtained during qualification	This section contains the overall assessment of the inspection system taking into account all evidence obtained from TJ and test piece trials during qualification.
11. Conclusion of the qualification	Conclusions on the positive or negative outcome of the qualification performed, the limits of validity of the qualification performed, etc.

12. Recommendation in view of attribution of certificates	Recommendations in view of attribution of the qualification certificates.
13. Update of the qualification dossier	Description of the way the qualification dossier will be updated taking into account for example field experience and how this could impact upon the qualification certificates delivered.
14. Summary of technical evidence (references)	A document summarising all the evidence from the qualification on the capability of the proposed inspection. The document therefore contains, or gives references to, both the TJ and the results of any open and blind trials.

REFERENCES

[1] *European Methodology for Qualification of Non-Destructive Testing – Issue 4*, ENIQ Report No. 61, The NUGENIA Association, 2019.

[2] *ENIQ Glossary – Issue 3*, ENIQ Report no. 62, The NUGENIA Association, 2019.

[3] *ENIQ Recommended Practice 2: Strategy and Recommended Contents for Technical Justifications – Issue 3*, ENIQ Report no. 54, The NUGENIA Association, 2018.

[4] *ENIQ Recommended Practice 8: Qualification Levels and Approaches – Issue 2*, ENIQ Report no. 59, The NUGENIA Association, 2018.

[5] *ENIQ Recommended Practice 7: Recommended General Requirements for a Body Operating Qualification of Non-Destructive Tests – Issue 2*, ENIQ Report no. 58, The NUGENIA Association, 2018.

[6] *ENIQ Recommended Practice 5: Guidelines for the Design of Test Pieces and Conduct of Test Piece Trials – Issue 3*, ENIQ Report no. 56, The NUGENIA Association, 2018.

[7] *ENIQ TGQ Technical Document: Practical Examples for Manufacturing of Test Pieces for Inspection Qualification*, ENIQ Report no. 44, EUR 24878 EN, 2011.

APPENDIX: GENERAL EXPLANATIONS OF THE CONTENTS OF THE SECTIONS OF THE QUALIFICATION DOSSIER

This appendix provides further details of the possible contents of the various sections of the qualification dossier, using the recommended list of contents given in Section 2. Where appropriate, reference will be made to other RPs rather than repeating their content.

This appendix is intended primarily as a kind of checklist of the sorts of information that might be included in each section of the qualification dossier. It is not intended to be a prescriptive list. The amount of information to be included in any specific qualification dossier will vary from case to case, depending on such factors as the qualification level, need for test piece trials or not, safety consequences of the inspection, etc.

1. Introduction

The introduction normally contains the following information:

- Purpose and scope of qualification dossier;
- Components and inspection method covered by the qualification dossier;
- Description of the layout of the qualification dossier.

2. Input information

It is essential, before starting the qualification that the full details of all relevant input information as discussed below are available. This is a requirement of the European Methodology for Qualification of Non-Destructive Testing [1]. This includes information on all aspects of the components and defects, which can influence the outcome of the particular inspection method used. Information about the required performance levels for detection, size measurement and false calls is also needed for this. More information on this issue can also be found in ENIQ RP2 [3].

2.1 Components

The information, which may be needed regarding the components, is listed below although it is emphasised that all the items on the list below may not be needed or may not be available. The required and available information about all components are directly included in each qualification dossier.

- Component drawings showing details of the geometry and all dimensions;
- Specifications for all the materials used in the component;
- Welding and buttering procedures used to fabricate the components;
- Details of any weld repairs carried out through the history of the component;
- Details of any known mismatch between components;
- Component surface finish including both small scale roughness and longer scale undulations;
- Details of weld caps and roots where relevant to the inspection i.e. where caps may need to be scanned or defects located near the root (for ultrasonic inspections);
- Details of U-bends, tube sheet expansion geometry, presence of deposits and/or denting (for inspections of steam generator tubes);
- Any access restrictions;
- Any time constraints for inspection set by radiation levels or other environmental factors.

2.2 Defects

For the defects, the following information may be needed depending on the used inspection method:

- Defect types which must be detected and sized;
- Defect sizes to be detected;
- Defect positions in thickness and in plan (inside/outside), in particular for ultrasonic inspection of welds, the relationship of defect position to features of welds such as roots, heat affected zones, caps or surfaces or for eddy current inspections of steam generator tubes;
- Defect orientation ranges in tilt and skew;
- Defect gape (for radiographic inspection);
- Any information such as a crack macrograph which is available for previous defects which have occurred in this or similar plant.

2.3 Components In-service inspection objectives – Inspection performance

Depending on the purpose of the inspection, different criteria defining performance may be of importance. These could be based upon specific fracture mechanical calculations or requirements of codes and standards. The ones, which are relevant to the particular problem, could be included in the input information. The following list indicates some of the parameters, which may be specified:

- Detection requirements;
- False call rate;
- Sizing accuracy in depth or length;
- Detection of remaining ligaments;
- Measurement accuracy;
- Acceptance and rejection criteria.

The way critical defect sizes, obtained for example by fracture mechanics, are translated into ISI objectives could be a matter to be discussed between the different parties involved in inspection qualification but the ultimate responsibility is with the utility. See ENIQ RP8 on how to define qualification objectives from ISI objectives [4].

3. Quality assurance scheme applicable to the qualification body

In this section an overview is given on the quality assurance scheme applicable to the QB. In ENIQ RP7 [5] more detailed information can be found. Issues which may have to be covered more specifically (also indirectly by reference to already existing documents) in the qualification dossier are the following:

- Quality assurance scheme followed by the QB;
- Confidentiality of the qualification results;
- Confidentiality of the test pieces used for blind trials;
- Way the results are assessed and evaluated;
- Practical organisation of the test piece trials, if required;
- Way appeals of and conflicts with vendors will be treated.

4. Requirements to be met by the vendor prior to the start of the qualification exercise

In this section the requirements, which have to be met by the inspection vendor before the start of the qualification exercise, are given. These requirements could cover the following issues:

- Quality assurance scheme;
- Documentation related to experience and certification of inspection personnel;
- Previous experience;
- Documentation to be provided prior to the formal start of the inspection qualification exercise.

5. Qualification plan

The qualification plan is defined as an orderly sequence of rules, which describe how a specific non-destructive test on a specific component is to be qualified. Each specific qualification plan will depend upon a number of factors such as the specific purpose of the qualification, the type of inspection to be qualified, and the component to be inspected, the type of qualification (equipment, procedure, personnel or a combination). In the qualification plan instructions are given on the way how the obtained inspection results will be assessed. This involves defining the following:

- Balance between TJ and test piece trials;
- Need for test piece trials: Which parts of the inspection system proposed for qualification can be assessed by TJ and for which parts of the inspection system additional test piece trials are required;
- Times and conditions available for qualification test piece trials ;
- Commensurate with times and conditions available for the site tests. Realistic simulation of site conditions and time constraints will not always be necessary or indeed possible ;
- Way the TJ will be assessed;
- Way the inspection equipment will be assessed;
- Way the inspection procedure will be assessed;
- Way the inspection personnel will be assessed;
- Applicable rules for modifying / updating the inspection procedure as a result of the feedback from the qualification;
- Criteria used to determine whether a qualification is successful or not.

In the European methodology, it is recommended that the qualification of the NDT procedure / equipment is separated from the complementary personnel qualification. This aids exact identification of where any weaknesses lie. Furthermore, qualification of the NDT procedures / equipment may be done through TJ and, if required, open trials, for both detection and sizing. Note that the qualification procedure may be different for detection and sizing. An important aspect of qualification of the NDT procedure / equipment through open trials is the fact that the obtained inspection results are explained and justified in full detail to the QB. It is not recommended to use blind trials for either procedure or equipment qualification.

If it is decided to perform personnel qualification beyond the requirements of the national certification schemes (along ISO-EN-9712 for example) it is recommended to use TJ complemented with either open or blind trials. This should be defined in a training and qualification plan. More information on how to conduct test piece trials can be found in ENIQ RP5 [6]. Test reports and examination papers produced during the qualification process could be archived as part of the qualification dossier.

6. Details of the inspection system

In this section all relevant information concerning the inspection system are provided. Depending upon the specific purpose of the qualification this section may contain any combination of the following items:

- Document describing the inspection equipment ;
- Inspection procedure document;

  The inspection procedure covers at least the following aspects:

  1. Examination method and techniques ;
  2. List of essential parameters related to input (component / defects), procedure and equipment group ;
  3. Inspection equipment list including the following items taking into account the equipment essential parameters:
     - Make and model of data acquisition and data analysis equipment,
     - Probes used ;
  4. Inspection equipment checks/verifications;
  5. Inspection equipment set-up;
  6. Techniques of calibration and of establishing scanning sensitivity levels, including instrument controls to be used and acceptance standards for calibrated conditions ;
  7. Design of:
     - Calibration block(s),
     - Probe characterisation block(s),
     - Reference block(s);
  8. Scanning details;
  9. Data to be recorded and method of recording;
  10. Methods of data interpretation;
  11. Presentation of results;
  12. Checklists;
  13. Personnel qualification requirements and responsibilities, defined in a training and qualification plan
  14. Reference documents.

The inspection procedure should contain clear and unequivocal instructions on how the inspection should be performed both for data acquisition and data analysis. The data analysis scheme used to judge whether the indications found are due to defects is an extremely important part of the inspection procedure. In the inspection procedure all the decision steps related to combination and interpretation of the results of the different techniques allowing one to arrive at the final result should be written down in a clear, logical and traceable manner. Therefore the data analysis scheme should be sufficiently detailed in the inspection procedure and the most important decision steps should be justified in the TJ. Examples of decision steps, which should be covered in the inspection procedure, are:

- Criteria used to distinguish indications due to the geometry of the component from those due to real defects;
- Choice of sensitivity above which indications have to be reported;
- Way the results of the different techniques are combined in order to decide that an indication is due to a defect or not;

- Criteria used to characterise defects, for example to determine whether they are surface-breaking;
- Criteria / methods used to arrive at the size of the identified indications;
- Information, which may be required for the inspection personnel, in view of the requirements imposed by the inspection procedure and qualification procedure.

The information given should by preference be related to the essential parameters as defined and analysed in the TJ [3].

7. Technical justification

As mentioned before the TJ is considered as a very important part of the qualification. A RP is devoted to TJs and those interested to know more about the purpose and possible contents of the TJ are referred to this document [3].

8. Qualification test pieces

It is recommended that all available information on the inspection procedure and TJ is used in order to define the detailed test pieces requirements. These may be fully documented in the qualification dossier. In ENIQ RP5 [6] and ENIQ TGQ Technical Report “Practical Examples for Manufacturing of Test Pieces for Inspection Qualification” [7], more information can be found regarding the design of the test pieces covering issues such as:

- Use of worst case concept;
- Number of defects to be inserted in the test pieces;
- Size distribution of the defects to be inserted in the test pieces;
- Manufacturing of defects;
- Test piece quality checks.

All this may be fully documented in the qualification dossier. The as manufactured data of the qualification test pieces may also be part of the qualification dossier. The list of essential input parameters can be used as a guideline on the information available in the data package on the manufactured qualification test pieces. Other information, which might be provided, is the following:

- Quality assurance checks done at the test piece manufacturer’s premises;
- Quality assurance scheme used by the test piece manufacturer;
- Relevant documentation on the materials and welding procedure used;
- Comparison with characteristics of the components found in the plant.

An assessment of the defect fabrication methods used may have to be conducted in order to verify that the defects manufactured simulate, to a sufficient extent from an NDT point of view, the postulated or specific defects.

It is very important to carry out test piece quality checks before practical qualification work commences. In principle this may be done by personnel of the QB. The documentation provided by the different test piece manufacturers should be reviewed. The test pieces could be examined using X-rays and ultrasonics and / or any other NDT method judged useful to ensure that the defects are as intended. It is also important to check that the volume around each defect does not contain significant indications that would make the defect unusable for qualification. A report containing the main conclusions of the quality checks could be included in the qualification dossier. If results of destructive examination are available then these could also be included.

9. Inspection results obtained during open and blind trials

If test piece trials were judged necessary for the qualification then the following information should be given in the qualification dossier:

- Detailed way the practical trials have been conducted;
- Inspection results obtained during the open and / or blind trials reported in the agreed format.

10. Assessment of the results obtained during qualification

The QB should make a report on the assessment of the results obtained during the qualification. The main objective is to verify whether the inspection system is capable of meeting its stated objectives in terms of detection, characterisation and sizing. The assessment should include the following:

- Assessment of the TJ and the extent to which the presented evidence is relevant and sufficiently convincing to show that the proposed inspection system is capable of meeting the objectives set out at the beginning;
- Assessment of the test piece trial results, if required, against the ISI objectives. This may include:
  - Logbook kept by the QB on the conduct of the test piece trials;
  - Report on the capability of the inspection team to follow the written instructions as given in the inspection procedure both for data acquisition and data analysis;
  - Assessment of the extent to which the ISI objectives were met (for blind trials for example);
- Assessment of the complementarity between TJ and test piece trials:
  - Proof that the inspection system can meet the ISI objectives for the specified range and this for all essential parameters to be covered within a range;
  - Essential parameters, which are not fully covered in the TJ, need to be covered in the test piece trials and vice versa.

11. Conclusion of the qualification

This section contains the conclusions of the qualification performed in terms of success of meeting the ISI objectives set out at the beginning. Any difficulties encountered during the qualification, which might limit the scope and validity of the qualification performed are mentioned in this section. In case of failure to meet the ISI objectives this section provides the reasons for this. The limits of validity of the qualification with respect to the original scope are also provided in this section.

12. Recommendation in view of attribution of certificates

This section contains the recommendation of the QB concerning the attribution of the certificates. The detailed contents of the qualification certificates is agreed between the different parties involved.

13. Update of the qualification dossier

Rules could be agreed between all involved parties on how field experience might be incorporated in the qualification dossier and how this might affect the issued qualification certificates. If, for example field experience shows that a qualified inspection system is not performing satisfactorily rules could be agreed on the procedure to follow in order to cancel the validity of the certificate. Other issues, which could be agreed on, are:

- Extent to which the obtained results can be made public;

- Extent to which the experience gained from the specific qualifications can be used for technology transfer;
- Extent to which statistical information gained from several qualifications can be used;
- Process for requalification of system when changes to equipment or procedures are necessary due to obsolescence or similar impacts.

14. Summary of technical evidence

In some cases, the plant owner and regulator may agree that the results of the qualification are summarised in a single document. This document, a “Summary of Technical Evidence”, contains, or gives references to, all the evidence for the capability of the proposed inspection, both the TJ and the results of any open and blind trials. It thus combines and summarises in a single document all the key information in the qualification dossier. If such a document is produced, the qualification dossier is still compiled, but is not generally issued. The dossier remains accessible, if required, by the regulatory body. This summary of technical evidence, if available, is also part of the qualification dossier.

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ABOUT NUGENIA AND ENIQ

NUGENIA is an international non-profit association under Belgian law established in 2011. Dedicated to the research and development of nuclear fission technologies, with a focus on Generation II & III nuclear plants, it provides scientific and technical basis to the community by initiating and supporting international R&D projects and programmes. The Association gathers member organisations from industry, research, safety organisations and academia.

The activities of NUGENIA cover plant safety & risk assessment, severe accidents, reactor operation, integrity assessment and ageing of systems, structures & components, development of fuel, waste & spent fuel management & reactor decommissioning, innovative light water reactor design & technologies, harmonisation and in-service inspection & their qualification.

The European Network for Inspection and Qualification (ENIQ) is a utility driven network working mainly in the areas of qualification of non-destructive testing (NDT) systems and risk-informed in-service inspection for nuclear power plants. Since its establishment in 1992 ENIQ has issued over 50 documents. Among them are the “European Methodology for Qualification of Non-Destructive Testing” and the “European Framework Document for Risk-Informed In-Service Inspection”. ENIQ is recognised as one of the main contributors to today’s global qualification guidelines for in-service inspection. ENIQ became Technical Area 8 of NUGENIA in 2012.

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