ENIQ GLOSSARY

ENIQ Glossary of Terms

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Foreword – Brief Revision History of the ENIQ Glossary

The first issue of the ENIQ Glossary was produced as a section of definitions in connection with the first issue of the European Methodology for Qualification of Non-Destructive Testing in 1995. The second issue of the Glossary of Terms was published as a supplementary document to the second issue of the European Methodology for Qualification of Non-Destructive Testing in 1999 when qualification of inspections of nuclear power plant components was still at the beginning. The significant progress made since then required a revision of ENIQ guidance documents and the terms used in these documents. Issue 3 of the ENIQ Glossary contains all terms that are used in the current versions of all ENIQ guidance documents, meaning the European Methodology for Qualification of Non-Destructive Testing, ENIQ Framework document for Risk-Informed In-Service Inspection and the ENIQ Recommended Practices.

EXECUTIVE SUMMARY

The main objective of the ENIQ Glossary is to provide users of ENIQ guidance documents with a list of all terms used in these guidance documents. Definitions of terms that appeared newly in latest revisions of ENIQ guidance documents and not used before were added to this issue of the ENIQ Glossary. Terms whose definitions were changed in latest revisions of ENIQ guidance documents were changed accordingly in this issue of the ENIQ Glossary.

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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.

The ENIQ Glossary provides an overview of all the terms used in ENIQ guidance documents, meaning the European Methodology for Qualification of Non-Destructive Testing [1], the Framework Document for Risk-Informed In-Service Inspection (RI-ISI) [2] and the ENIQ Recommended Practices [3] [4] [5] [6] [7] [8] [9] [10] [11] [12].

2. Glossary

Terms related to Qualification	
Artificial Defect	A defect deliberately introduced into a test piece which may not metallurgically resemble a real defect in appearance. Ease and reproducibility are major factors in selection of such defects. Defects such as electro discharge machined (EDM) notches or saw cuts might be used as artificial defects. The most useful types of artificial defects for qualification purposes are those whose non-destructive testing (NDT) responses resemble, or can be related to, those of the real defects of interest, for the NDT techniques being considered.
Blind Trial	A trial in which an inspection technique is applied to a test piece and those applying the NDT have no specific and detailed knowledge of the numbers, sizes, orientations and positions of defects which the test piece may contain. It is normally part of a formal qualification exercise supervised by the qualification body.
Capability Statement	A simple form of technical justification. There is currently no formal definition of a capability statement, but the document is often similar to a technical justification based on a reduced quantity of evidence (e.g. test piece trials) or based entirely on reference to existing evidence.
Code	A document describing a prescriptive system and specification for completing an activity, for example the ASME Boiler and Pressure Vessel code.
Essential Parameters	Those influential parameters, which if changed in value outside of a justified tolerance would alter the outcome of an inspection in such a way that the inspection could no longer meet its defined objectives.
Experimental Evidence	Evidence of practical experiments usually on test pieces that contain artificial defects. This data would commonly be included, or referenced, within technical justifications. Experimental evidence would commonly include the following: a. Results from relevant round robin exercises; b. Results from relevant experimental studies, whether conducted on representative or simplified test pieces; c. Results from previous relevant inspection qualification exercises and results from field experience. This can cite previous work or contain an account of work carried out specifically for the component in question.

Examination	ASME V, Article 1, Mandatory Appendix 1 defines Examination as: The process of determining the condition of an area of interest by non-destructive means against established acceptance or rejection criteria.
False Call	Erroneous reporting of an indication as a defect from a part of a test object which is, in fact, free of defects. This definition also applies to cases where the inspection procedure has been correctly applied, but no defect exists.
Human Factors	Human factors are the mental and physical make of an individual, the individual's training and experience, and the conditions under which the individual must operate, which influence the ability of the non-destructive examination (NDE) system to achieve its intended purpose.
Influential Parameters	Those parameters if changed would eventually alter the outcome of an inspection.
Indication	An instrument output of display which requires disposition in terms of (a) a signal or output not related to the condition of the component or material (e.g. counter bore, root geometry) or (b) an imperfection of the material or component.
Input Information	Information (including essential parameters describing the component, material, defects, etc.), which has to be made available prior to the start of the process of inspection qualification.
Inspection	Inspection is a process of verifying conformity with a written requirement, which can be carried using many methods, e.g. Non-Destructive Testing, dimensional assessment.
Inspection Method	Discipline applying a physical principle or phenomena in NDT, e.g. ultrasonic testing method.
Inspection Objectives	Requirements to be met by the NDT system, for example: definition of inspection volume, defect description, demands on detection performance and false call rate, demands on defect characterisation, sizing, positioning and accuracy.
Inspection Procedure	An orderly sequence of rules, which describe how an inspection is implemented for a specific test situation. A written description specifying all essential parameters and setting out the precautions to be observed when applying an inspection technique, following an established standard, code or specification.
Inspection Qualification	The systematic assessment, by all those tools that are needed to provide reliable confirmation, of an NDT system to ensure it is capable of achieving the required performance under real inspection conditions.
Inspection Performance **Inspection Capability**	The degree to which an NDT system achieves its purpose regarding detection, characterisation, sizing at an acceptable false call rate.
Inspection Technique	A specific way of utilising an inspection method (e.g. ultrasonic immersion technique).
Modelling **Simulation**	Generation of quantitative and qualitative predictions about aspects of inspection performance through the use of mathematical models of the physical phenomena on which the NDT technique under consideration is based.
Model Validation	All activities aimed to prove that a model is simulating phenomena in an adequate way, with known limitations and simplifications, so that it provides

	correct predictions with expected deviations in the range of considered input essential parameters. Validation is usually done by comparison of model output either with experimental output, or with output of another model, which was previously validated.
NDT System	All parts of the non-destructive test including equipment, inspection procedure and personnel which can influence the outcome and quality of the inspection.
Open trial	A trial of an inspection in which those applying the inspection to test pieces have specific knowledge about the defects in the test pieces. It is part of a formal qualification exercise supervised by the qualification body.
Parametric Studies	Studies to establish the separate influence of the various influential parameters such as defect characteristics, equipment characteristics, etc., which can affect the outcome of a test. Parametric studies may be performed by experiments and / or by modelling.
Pass/Fail Criteria **Qualification Objectives**	The criteria relating to the number of defects detected in test pieces, number of false calls, size and positional accuracy and so on reported in an inspection qualification, which determine success or failure of the NDT inspection.
Performance Demonstration	A demonstration of the capabilities of an examination system to accurately evaluate a specimen with known flaw characteristics in an environment simulating field conditions.
Personnel Certification	The process that demonstrates that personnel have the basic knowledge and skills to implement an inspection method. To be granted certification, personnel will normally be required to complete training, practice hours and successfully complete tests administered by an organization authorized to do so. Certification will normally be for a specific non-destructive examination method, will not reference a specific inspection procedure and will be in accordance with a standard accepted by the regulatory authority for the non-destructive examination method to be employed.
Personnel Qualification	In the context of the European Methodology, personnel qualification is defined as the process that demonstrates that a person is capable of reliably implementing a specific inspection.
Personnel Re-Qualification	Process, usually conducted at defined intervals, whereby a previously qualified inspector re-confirms his / her competency in front of an independent Qualification Body with respect to their performance applying a qualified inspection procedure. Re-qualification is a separate process from requirements related to re-certification of personnel as defined, for example, under a general NDE certification scheme such as ISO 9712/EN473
Physical Reasoning	Part of the technical justification containing a compilation of the detailed reasons for selection of a particular NDT approach. If early design of test pieces is needed, the input can be based on physical reasoning, which is usually available at the start of compiling the technical justification.
Practical Assessment **Practical Trials** **Test Piece Trials**	The assessment of a non-destructive test by applying it to test pieces containing defects.

Probability of detection (POD)	A numeric value in the range from 0-1 which reflects the statistical likelihood that a defect with certain parameters will be successfully detected, under random effect of varying essential parameters.
POD Curve	Mathematical function which shows dependency of POD on certain defect parameters (most often defect through wall extent).
Qualification Approach	The range of qualification activities and the type and nature of the qualification body needed to achieve the desired qualification level.
Qualification Body (QB)	Body that conducts inspection qualifications. Qualification bodies should be independent and impartial, and should have the necessary technical competence and resources.
Qualification Certificate	A document issued under the quality rules of an inspection qualification system. It indicates that adequate confidence is provided that inspection procedures, equipment and personnel or any combination of these are capable, for a specific test, of achieving the stated objectives of the test.
Qualification Dossier	An assembly of all the information relevant for the definition and execution of the inspection qualification. It includes input information including the qualification requirements, the qualification plan, inspection documentation, records of test pieces used, records of invigilation and assessment and final reports and certification. It also includes the qualification plan, technical justification and as its final part the result of the inspection qualification.
Qualification Level	An alphanumeric value that reflects the qualification level required against a definition of several qualification levels. Qualification levels would normally be differentiated by the assurance required that the inspection will attain its objectives as stated in the inspection specifications.
Qualification Plan	An orderly sequence of rules and criteria, which describe how an element of a NDT system (i.e. inspection procedure, personnel, etc.) needs to be qualified.
Real Defect	A defect, which has developed in a component during its manufacture or in service, without any steps having been undertaken to deliberately encourage its development.
Realistic Defect **Realistic Flaw**	A defect deliberately inserted into a test piece, which simulates the metallurgical appearance of a real defect. The most useful types of realistic defects for qualification purposes are those whose NDT responses resemble those of real defects of interest, for the NDT techniques being considered.
Recommended Practice (RP)	A consensus type of document produced by ENIQ to support countries in how to implement in practice the European Methodology for Inspection and Qualification of Non-Destructive Testing. Recommended Practices elaborate methodology principles for various topics of inspection qualification and risk-informed in-service inspection.
Technical Change	Changes to a qualified inspection procedure or NDT system of a technical nature which could conceivably result in the inspection failing to meet its objectives, e.g. changes to equipment settings or changes to steps within a procedure. Conversely non-technical changes would usual be minor editorial changes.
Technical Justification (TJ)	A document which presents a justification for why an NDT system will meet its objectives. The document also assembles all the supporting evidence for inspection capability (results of capability evaluation exercises, feedback from site experience, applicable and validated theoretical models, physical

	reasoning), and may include practical trials using deliberately defective test pieces. A technical justification may, however, be used for a number of other purposes such as for example to justify the defects or test pieces to be used during test piece trials or to justify an upgrade in equipment without the need to repeat the whole qualification.
Theoretical evidence	Evidence generated using theoretical methods and includes the results obtained by calculations, modelling, graphical analysis, etc.
Test Assembly **Test Block** **Test Piece** **Test Specimen** **Mock-up** **Qualification Test Piece**	A structure, which is used for experimental trials and which may or may not simulate geometrically or metallurgically an engineering component or part of a component.
Worst Case (Defects)	Defined as those cases of defects, component geometry, etc., which are likely to present the greatest challenges for any combination of detection, positioning and accurate sizing or characterisation within the framework of the specific situation considered for inspection qualification, as defined in the input information with considerations of the specific NDT system used.
Terms related to RI-ISI	
Allowed Outage Time	The number of hours the plant may operate under a pre-defined configuration (e.g. inoperable equipment), as controlled by the limiting condition(s) for operation in the Technical Specifications.
Approaches to RI-ISI	Three different approaches are used: quantitative, qualitative and the semi-quantitative approaches. <u>Quantitative approach</u> In a quantitative approach, numerical estimates are determined for probabilities of failures and consequences of failures. Validated and verified Structural Reliability Models are used to determine POFs, and the plant Probabilistic Safety Assessment is used to calculate COFs. <u>Qualitative approach</u> In a purely qualitative approach, both the POFs and COFs are characterised by qualitative terms, such as extremely low, low, medium, high, usually representing a logarithmic scale. In this framework, expert judgement is used to classify the POF and COF of individual components. A qualitative analysis can be used as a first step to allow systems to be prioritised for further more detailed risk analysis. A purely qualitative approach does not use the quantitative risk assessment (PSA) results in the consequence evaluation. <u>Semi-quantitative approach</u> A semi-quantitative approach is one where usually the COFs are based on PSA results. Also failure probabilities may be partly evaluated using validated and verified SRMs, but partly also using expert judgement and experience data. The resulting risk matrix is often expressed using qualitative scales, but with quantitative links aiding realistic assessments.

Conditional Core Damage Frequency (CCDF)	Conditional frequency of core damage, given a loss of a mitigating ability.
Conditional Core Damage Probability (CCDP)	Conditional probability of core damage, given an initiating event.
Conditional Large Early Release Frequency (CLERF)	Conditional frequency of a large early release, given a loss of a mitigating ability.
Conditional Large Early Release Probability (CLERP)	Conditional probability of a large early release, given an initiating event.
Consequence of Failure (COF)	Consequence is measured as the adverse outcome that is conditional on the failure as defined earlier. For RI-ISI the consequence is measured as the Conditional Core Damage Probability (CCDP) or Conditional Core Damage Frequency (CCDF). The consequence assessment for a RI-ISI program may also include metrics as conditional large early release probability (CLERP) and conditional large early release frequency (CLERF).
Core Damage	Heating-up of the reactor core (typically following loss of coolant) to the point where damage to reactor fuel elements or cladding takes place.
Core Damage Frequency (CDF)	An estimated frequency of occurrence of events leading to core damage.
Defence-in-Depth (DiD)	A design and operational philosophy that calls for multiple and independent layers of protection to prevent and mitigate accidents. It includes the use of controls, multiple physical barriers to prevent release of radiation, redundant and diverse key safety functions, and emergency response measures.
External Event	An event that initiates outside of plant systems and results in the perturbation of steady-state plant operation (e.g., seismic event, storm, etc.).
Failure	Failure of a structural component is an event involving leakage, rupture or a condition that would disable its ability to perform its intended safety function. For piping, failure usually involves a leak or a rupture, resulting in a reduction or loss of the pressure-retaining capability of the element in question. The expected plant response depends on the severity of the failure, which is generally related to the leak size and location. Hence, if the consequences of the piping failure vary significantly with leak size, it is necessary to define and analyse different degrees of failure states of a single structural component.
Failure Modes and Effects Analysis (FMEA)	A detailed technique specifically designed to identify the failure of an analysed component, the impacts of the failure on operations, the system and surrounding components, and controls for limiting the probability of such failures.
Initiating Event	An event that perturbs steady-state plant operation or normal shutdown evolution resulting in a plant transient and challenge to control and safety systems. Based on its origin, an initiating event can be an internal or external event.
In-Service Inspection (ISI)	An inspection performed after commissioning inspections and test runs are satisfactorily completed and the system or component has been certified or accepted for normal service operation. The objective of such inspections is to detect degradation that might have occurred during plant operation.
Internal Event	An event that initiates within plant systems and results in the perturbation of steady-state plant operation (e.g., loss of coolant, loss of heat sink, etc.).

Large Early Release	A radioactive release from the containment which is both large and early. Large is defined as involving the rapid, unscrubbed release of airborne aerosol fission products to the environment. Early is defined as occurring before the effective implementation of the off-site emergency response and protective actions.
Pipe Segment	Continuous length of piping with the same degradation mechanism and failure consequence.
Piping System	An assembly of piping segments with defined functions. A piping system might include one or more ASME Code classes.
Pressure Boundary Failure	Piping element failures involving ruptures or leakage that result in a reduction or loss of the element pressure-retaining capability.
Probability of Failure (POF)	Probability of failure is the likelihood that a component or weld will fail at a given time, considering the potential degradation mechanisms it could be susceptible under the prevailing loads and environment. Fundamental for risk assessment is systematic hazards identification, i.e. here identification of potential degradation mechanisms. The probability of failure over a given time period may be assessed by use of modelling, expert judgments or statistics, depending on the degradation mechanism, service experience and available information. In this document the term 'probability of failure' is used as an abridged version of the full wording 'probability of failure over a given time into the future'. Probability of failure is defined either in terms of failure frequency, or probability of failure on demand in the case of components in a stand-by system actuated only on demand. In PSA-models the failure frequency is commonly assumed to be a constant failure rate. However, when dealing with passive components subject to a time dependent degradation mechanism, the probability of failure is not constant with time. For situations where the probability of failure is low throughout the life of the plant, this may be of small significance, but if the degradation mechanism is more aggressive, improved treatment is recommended.
Probabilistic Safety Assessment (PSA)	A quantitative assessment of risk. For NPP application, the risk is associated with plant operation and maintenance. Risk is measured in terms of the frequency of occurrence of various events, leading to a consequence of interest (e.g., core damage or release of radioactive material).
Probability	A numerical measure of the state of confidence about the outcome of an event.
Risk	The risk is defined herein in the engineering sense as the product of the probability of a failure and the consequences of that failure occurring, as follows: Risk = {Probability of Failure}× {Consequence of that Failure} As probability is dimensionless, it follows that the metric of risk is the same as the metric of consequence of failure. Uncertainties have to be considered when assessing probability and consequence levels.
Risk-Informed In-Service Inspection (RI-ISI)	In-service inspection optimised with risk insights.
Risk Reduction	The risk reduction achieved by the ISI programme is the amount by which the total risk is reduced by undertaking ISI.
Risk Reduction Worth (RRW)	An importance measure indicating the maximum possible reduction factor in risk, if the item under consideration (e.g. a pipe segment) is assumed perfectly reliable.
Segments	(See pipe segment) A portion of a pipe, components, or a combination thereof, and their supports, in which a failure (i.e. loss of its pressure

	retaining function) at any location results in the same consequence (e.g., loss of a system, loss of a pump train, indirect effects).
Spatial Effects	The indirect impact of an event affecting other systems and components in the spatial vicinity, including flooding, spray, pipe whip, jet impingement, etc.
Structural Reliability Models (SRMs)	Models concerned with the calculation and prediction of the probability of safety limit state violations (failure) for engineering structures

References

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[9] *ENIQ Recommended Practice 9: Verification and Validation of Structural Reliability Models and Associated Software to Be Used in Risk-Informed In-Service Inspection Programmes - Issue 2*, ENIQ Report No. 52, The NUGENIA Association, 2017.

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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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