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METHODOLOGY FOR QUALIFICATION OF IN-SERVICE INSPECTION SYSTEMS FOR WWER NUCLEAR POWER PLANTS

A PUBLICATION OF THE
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THE SAFETY OF WWER AND RBMK
NUCLEAR POWER PLANTS

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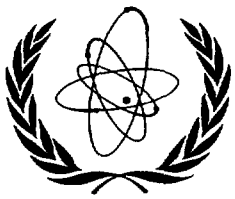

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FOREWORD

The IAEA initiated in 1990 a programme to assist the countries of central and eastern Europe and the former Soviet Union in evaluating the safety of their first generation WWER-440/230 nuclear power plants. The main objectives of the Programme were: to identify major design and operational safety issues; to establish international consensus on priorities for safety improvements; and to provide assistance in the review of the completeness and adequacy of safety improvement programmes.

The scope of the Programme was extended in 1992 to include RBMK, WWER-440/213 and WWER-1000 plants in operation and under construction. The Programme is complemented by national and regional technical co-operation projects.

The Programme is pursued by means of plant specific safety review missions to assess the adequacy of design and operational practices; Assessment of Safety Significant Events Team (ASSET) reviews of operational performance; reviews of plant design, including seismic safety studies; and topical meetings on generic safety issues. Other components are: follow-up safety missions to nuclear plants to check the status of implementation of IAEA recommendations; assessments of safety improvements implemented or proposed; peer reviews of safety studies, and training workshops. The IAEA is also maintaining a database on the technical safety issues identified for each plant and the status of implementation of safety improvements. An additional important element is the provision of assistance by the IAEA to strengthen regulatory authorities.

The Programme implementation depends on voluntary extrabudgetary contributions from IAEA Member States and on financial support from the IAEA Regular Budget and the Technical Co-operation Fund.

For the extrabudgetary part, a Steering Committee provides co-ordination and guidance to the IAEA on technical matters and serves as a forum for exchange of information with the European Commission and with other international and financial organizations. The general scope and results of the Programme are reviewed at relevant Technical Co-operation and Advisory Group meetings.

The Programme, which takes into account the results of other relevant national, bilateral and multilateral activities, provides a forum to establish international consensus on the technical basis for upgrading the safety of WWER and RBMK nuclear power plants.

The IAEA further provides technical advice in the co-ordination structure established by the Group of 24 OECD countries through the European Commission to provide technical assistance on nuclear safety matters to the countries of central and eastern Europe and the former Soviet Union.

Results, recommendations and conclusions resulting from the IAEA Programme are intended only to assist national decision makers who have the sole responsibilities for the regulation and safe operation of their nuclear power plants. Moreover, they do not replace a comprehensive safety assessment which needs to be performed in the frame of the national licensing process.

EDITORIAL NOTE

In preparing this publication for press, staff of the IAEA have made up the pages from the original manuscript(s). The views expressed do not necessarily reflect those of the IAEA, the governments of the nominating Member States or the nominatingorganizations.

Throughout the text names of Member States are retained as they were when the text was compiled.

The use of particular designations of countries or territories does not imply any judgement by the publisher, the IAEA, as to the legal status of such countries or territories, of their authorities and institutions or of the delimitation of their boundaries.

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CONTENTS

SUMMARY

Integrity of primary circuit is fundamental for the safe operation of any nuclear power plant. In-service inspection (ISI) in general terms and, in particular, non-destructive tests (NDT) play a key role in maintaining primary circuit integrity.

"Qualification" is being widely used in order to assess the capabilities and limitations of non-destructive in-service inspection systems. At its most general meaning, qualification of an in-service inspection system means the assessment of any combination of NDT procedure, equipment and personnel to demonstrate that such inspection system is fitted to its purpose.

This report provides a methodology for qualification of ISI systems which might be used by WWER operating countries as a commonly accepted basis for further development of the necessary qualification related infrastructures.

This report also provides several qualification principles defining the administrative framework needed for the practical implementation of the methodology, a description of the process of qualification of an inspection system, according to that methodology, specifying its minimum technical and documentation related requirements, as well as, several specific requirements with regard to the NDT procedures, equipment and personnel to be qualified and to the test specimens to be used in practical trials. Finally, the report suggests an appropriate distribution of responsibilities, among all the parties involved in a qualification process, based on international practice.

It should be noted that this report does not provide criteria for definition of the scope of a qualification process in terms of required inspection area(s) and NDT method(s) as well as type(s) of flaws and required inspection effectiveness. Nevertheless, that scope is a matter to be agreed upon between the licensee and the regulatory body having jurisdiction at the plant site before starting any qualification process.

The report has been prepared in the frame of the IAEA Technical Co-operation Project RER/9/035 and of the Extrabudgetary Programme on the Safety of WWER and RBMK NPPs.

1. INTRODUCTION

Radiation induced reactor pressure vessel embrittlement, application of leak-before-break concept to primary circuit piping and components and steam generator integrity problems pose stringent requirements on both the capability and effectiveness of the in-service inspections performed at WWER plants. The capability and effectiveness of in-service inspection (ISI) have been identified and ranked, in the framework of the IAEA's Extrabudgetary Programme activities, as one of the most important (Category III) safety issues for WWER plants. Although efforts to improve in-service inspection are under way at many plants, a systematic demonstration of in-service inspection capabilities and limitations is actually lacking.

Due to the high safety significance of WWER in-service inspection and also taking into consideration the requests and suggestions from several WWER operating countries, the IAEA initiated the development of methodology for qualification of in-service inspection systems for WWER NPPs. The IAEA staff prepared the first draft of the methodology which was circulated for comments among all WWER operating countries. A second draft was prepared taking into consideration all received comments and a consultants meeting was further convened in Vienna from 8 to 12 July 1996 to review and finalize this report.

The present methodology for qualification of in-service inspection systems for WWER NPPs was developed keeping in mind the approaches and experiences on this subject coming from several WWER operating countries, from the USA (ASME/PDI) and from the European Commission and other western European countries (ENIQ) [1–3]. It should be noted that those qualification approaches, methodologies and activities are different, in a number of aspects, as a result of the different industry and regulatory environments. In this respect, this qualification methodology is intended to be a pragmatic synthesis appropriate, in the short and medium terms, to the specific circumstances of the various WWER operating countries.

Implementation of this qualification methodology through all WWER operating countries would enable them to reach a common level of qualification related infrastructures, data bases, experience and expertise. It should be pointed out that qualification of in-service inspection systems is a complex and resource consuming task and hence WWER operating countries are strongly encouraged to coordinate and optimize their qualification related initiatives and resources.

The application of this qualification methodology in Member States is subject to final judgement of the concerned national authorities.

2. OBJECTIVE

The objective of this report is to provide a methodology for qualification of ISI systems which might be used as a commonly accepted basis for further development of the necessary qualification-related infrastructures in WWER operating countries.

3. SCOPE

This report refers to any non-destructive testing method and defines how non-destructive in-service inspection systems (NDT procedures, equipment and personnel) should be assessed in order to demonstrate that a given inspection system is fitted to its purpose.

It must be pointed out that it is not the intent of this report to provide criteria for definition of the extent of a qualification process in terms of required inspection area(s) and NDT method(s) nor the type(s) of flaws and required inspection effectiveness. These are matters to be agreed upon between the licensee and the regulatory body having jurisdiction at the plant site before starting any qualification process.

4. STRUCTURE

The objective and scope are given in Sections 2 and 3 respectively. Section 6 describes some general qualification principles defining the administrative framework on which qualification processes should be carried out. The qualification approach, or how non-destructive in-service inspection systems (NDT procedure, associated equipment and personnel) should be qualified, is described in Section 7. Sections 8 and 9 describe the main steps of the qualification process specifying its minimum technical and documentation-related requirements. Section 10 describes some specific requirements regarding the NDT procedures, equipment and personnel to be qualified as well as requirements applicable to the test specimens to be used in practical trials. Section 11 suggests an appropriate distribution of responsibilities, among all the parties involved in a qualification process, based on the international practice.

5. QUALIFICATION PRINCIPLES

The detailed scope of a qualification process, in terms of required inspection area(s) and NDT method(s) as well as defects being sought and required inspection effectiveness is a matter to be agreed upon, in written form, between the plant operator (licensee) and the regulatory body having jurisdiction at the plant site taking into account the safety significance of each particular case and considering the relevant national and international experience. This scope, or technical specification of the inspection required to be qualified, should be agreed before starting any qualification process and it should form part of the qualification process documentation.

Any organization managing, conducting, evaluating and certifying an in-service inspection system's qualification process (qualification body) should be independent from any commercial or operational consideration (e.g. independence criteria equivalent to those specified in EN 45004 for a type A inspection body). Qualification bodies may also be an independent part of the licensee's organization (e.g. independence criteria equivalent to those specified in EN 45004 for a type B inspection body).

Any qualification body should operate according to a written quality system which guarantees its independence, impartiality and confidentiality.

Any qualification process should be carried out according to written qualification protocols which clearly define the administrative interfaces and the types (unrestricted, restricted, confidential), paths and timing of the information to be exchanged between all involved parties (regulatory body, qualification body, licensee, inspection organization) as consequence of the qualification process.

Written qualification procedures should be developed by the licensee, reviewed by the qualification body and agreed upon between interested parties specifying:

- number, type, geometry, materials and surface conditions of test specimens to be used in practical trials;
- type(s) and ranges of the geometrical parameters of the flaws to be detected and/or sized in practical trials;
- conditions of the practical trials (open, blind);
- minimum and maximum number of flawed and unflawed grading units;
- grading criteria for detection and sizing of flaws;
- acceptance criteria for detection and sizing;

- special requirements where applicable (i.e. time limitation, access restrictions, environmental conditions, etc.).

Upon successful qualification of a NDT procedure and associated equipment, the qualification body should issue a certificate to the licensee and/or inspection organization clearly identifying the aspects of the procedure and equipment which were qualified.

Certification of a NDT procedure and associated equipment should be indefinitely valid unless changes, affecting essential variables and/or parameters, are respectively made to the equipment and/or procedure or to any mandatory document whose requirements must be met.

Personnel certificates, complementary to national certificates, should be issued by the qualification body to the inspection organization separately for each successful candidate. Validity of personnel certificates should be limited in time. Personnel certificates should be invalidated when a certified individual ceases to work for the inspecting organization which presented him/her for qualification, or when the inspection organization cannot produce documentary evidence of continuous satisfactory involvement of its certified individual in the qualified inspection.

Personnel certificates should clearly specify their scope of applicability (procedure, detection, sizing, etc.)

Responsibility for the ultimate approval of an NDT inspection system remains on the licensee on the basis of the evidence provided by the qualification body as a result of the qualification process.

6. QUALIFICATION APPROACH

Qualification of a non-destructive inspection system (NDT procedures, equipment and personnel) should be carried out through a combination of technical justification and practical trials. The relative weight of each one of these two elements is a matter to be agreed upon between the licensee and the qualification body based on a comprehensive assessment of the technical justification prepared either by the licensee or by the inspection organization on behalf of the licensee. It is recommended to separate NDT procedure and NDT equipment qualification from personnel qualification.

The qualification process is described in more detail in Section 8.

6.1. QUALIFICATION OF PROCEDURES AND ASSOCIATED EQUIPMENT

The purpose of this qualification process is to demonstrate that a proposed NDT method, technique, procedure and associated equipment is adequate for its purpose i.e. to detect and/or size specific type(s) of flaws, in a specific component or inspection area, with the required effectiveness.

If the assembled technical justification cannot provide a full demonstration of the adequacy of the proposed procedure and associated equipment then supplementary practical trials shall be required. In this case, these supplementary practical trials may be carried out under "blind" or "non-blind" conditions.

6.2. QUALIFICATION OF PERSONNEL

The purpose of this qualification process is to demonstrate that inspection personnel, certified along a national or international scheme, using a previously qualified NDT procedure and associated equipment, is able to detect, discriminate and size flaws with the required effectiveness when subject to relevant conditions resembling those to be encountered in the actual inspection. Qualification of personnel should be carried out through practical trials under "blind" conditions.

7. QUALIFICATION PROCESS

Qualification of a NDT inspection system may be required by the regulatory body having jurisdiction at the plant site, by the plant owner (licensee) or by the inspection organization. Any qualification process should be carried out according to the following main steps.

7.1. TECHNICAL SPECIFICATION

The detailed scope of qualification, in terms of required inspection area(s) and NDT method(s) as well as flaws and required inspection effectiveness, is a matter to be agreed in written form between the licensee and regulatory body, before starting any qualification process, taking into account the safety significance of each particular case and considering the relevant national and international experience. This technical specification should clearly state:

- the applicable code requirements;
- the component or area to be inspected and its essential parameters (geometry, material compositions and structure, surface finish, etc.);
- the non-destructive inspection method to be applied (UT, RT, EC, etc.);
- the inspection conditions and their essential parameters (time and/or access restrictions, relevant environmental conditions, etc.);
- the expected or postulated flaws or degradation conditions which should be detected in the actual component and their essential parameters (type, morphology, geometry, position, orientation, size and any other factor which could affect the response of the required NDT method).
- the flaw parameters which have to be measured as position, length, depth and their expected or postulated ranges;
- the required inspection effectiveness in terms of :
  - flaw detection rate;
  - acceptable false-call rate;
  - allowable differences between reported and actual flaw parameters;
- the minimum quality assurance requirements applicable to the qualification process.

7.2. INSPECTION PROCEDURE

Based on the technical specification the inspection organization will propose the particular inspection procedure and associated equipment deemed adequate to fulfil the inspection requirements. The inspection procedure must be described and the associated equipment should be identified.

This includes:

- description of the proposed NDT techniques and of their physical principles;
- description of the essential parameters;
- description of the operational conditions of the technique/equipment;
- description of the calibration process;
- indication's reporting and discrimination criteria;
- description of the equipment and software (if applicable) associated to the inspection procedure including a list of their essential parameters, necessary checks, measurement methods and acceptable values;

- statement on whether the equipment, or part of it, is under the scope of any national or international standard.

7.3. PRELIMINARY REVIEW OF THE INSPECTION PROCEDURE

The purpose of this step is to provide a detailed review and subsequently a preliminary approval/rejection, by the qualification body, of the proposed inspection procedure before proceeding with qualification.

Requirements listed in Sections 10.1, 10.2 and 10.3 are relevant for this review.

7.4. QUALIFICATION PROCEDURE

The qualification procedure describes the entire process of qualification of the inspection system (NDT procedure, equipment and personnel) and specifies all the technical details to carry out the practical trials.

It contains the description of the:

- technical justification;
- practical trials (open and/or blind);
- evaluation of the qualification results.

The qualification procedure will be produced by the licensee and/or inspection organization and submitted to the qualification body. The qualification body will review it assessing the completeness and soundness of the technical justification and specifying the administrative details to carry out the necessary practical trials including their invigilation requirements.

7.4.1. Technical justification

Practical reasons limit the number of test pieces that can be used for inspection qualification. Therefore, test piece trials can only provide a limited information on the performance of an inspection system. The purpose of the technical justification is to overcome these limitations by:

- citing all the evidence which supports an assessment of the capability of the inspection system to perform to the required level and therefore to provide a better defined confidence in the inspection;

- complementing and generalizing practical trials results by providing systematic evidence that the results obtained on the specific defects in the test pieces have a wider range of validity to other defects and conditions within the inspection scope;

- providing a sound basis for designing effective test piece trials;

- providing a technical basis for the selection of the essential parameters of the inspection system and their valid ranges.

Important elements with regard to the technical justification of the NDT procedure and associated equipment capabilities are given bellow in Sections 7.4.1.1 and 7.4.1.2.

7.4.1.1. Available evidences

All the available theoretical and/or practical evidences which supports the total or partial adequacy of the proposed procedure and equipment should be detailed in the technical justification.

Theoretical evidences may include:

- review of the NDT procedure to verify that it is written in a way which allows its reproducible application in the field minimizing operator's error, and that all essential variables are identified.

- results from application of mathematical models of the test (where available). In this case it has to be demonstrated that models used have been verified and validated for the particular conditions of the actual inspection. Mathematical models are very useful when they allow one to extrapolate or interpolate the inspection results obtained on certain test blocks to the actual component or inspection area and hence justifying the use of simplified test blocks, instead of actual components or mock-ups, for the supplementary practical trials which were deemed necessary. Mathematical models can be used in technical justifications if their predictive capability, accuracy and limitations are adequately documented.

Practical evidence may include:

- results from similar qualifications previously performed;

- applicable results of national or international research programmes;

- practical (field) experience on the application of the procedure and associated equipment in actual inspections when this information has been confirmed through destructive tests;

- applicable laboratory tests.

7.4.1.2. Assessment of the procedure and associated equipment capabilities

Based on the available theoretical and/or practical evidences the capabilities of the proposed procedure and associated equipment must be assessed, within the technical justification, in relation to:

- the inspection objectives;
- the essential parameters of the component or area to be inspected;
- the essential parameters of the flaws to be detected and/or sized;
- the essential variables of the inspection equipment;

Results of this assessment should be formulated in terms of:

- performance of the proposed inspection procedure and associated equipment (detection rate, sizing accuracy and false call rate) justified on the basis of the results obtained over the defect population included in the available practical evidence taking into account both the representativity of those defects in relation to the actual defects being sought and the appropriate statistical criteria.

- maximum range of variation of the essential parameters where the applicability, with the required effectiveness, of the proposed procedure and equipment can be justified on the basis of the theoretical and practical evidences provided.

7.4.2. Practical trials

Practical trials may be proposed by the licensee as a part of the qualification procedure or they may be deemed necessary as a result of the assessment of the technical justification by the qualification body.

Practical trials are of two major types:

- open trials, generally considered for the qualification of the inspection procedure and of the associated equipment;
- blind trials more specifically considered for the personnel complementary qualification.

Specific test pieces requirements are listed in Section 10.4.

7.4.3. Evaluation of the qualification results

Results of the qualification process will be evaluated by the qualification body and reported to the licensee.

The degree of fulfillment of each one of the specified inspection requirements (technical specification) by the proposed ISI system must be summarized in the qualification procedure. These degrees of fulfillment should be derived from the qualitative and/or quantitative comparison between each inspection requirement and the corresponding procedure, equipment and personnel capability as supported by all the theoretical and/or practical evidences generated by the technical justification and practical trials.

7.5. CERTIFICATION AND APPROVAL

After completion of a qualification process, the qualification body should issue appropriate certificates clearly identifying the particular combination of NDT procedure, equipment and personnel which has been successfully qualified.If experience demonstrates that a qualified inspection system or individual is not meeting the inspection requirements then the qualification certificate should be withdrawn by the qualification body.

Based on the evidence provided by the qualification body, the licensee should approve the utilization of the particular inspection system (NDT procedure, associated equipment and personnel) at its plant(s).

Depending on the particular circumstances in each country a review and endorsement of the qualification process by the regulatory body might be required prior to approval by the licensee.

8. DOCUMENTATION OF THE QUALIFICATION PROCESS

Any qualification process should be thoroughly documented in a qualification dossier. The qualification dossier should include:

- technical specification of the inspection to be qualified;
- the inspection procedure;
- preliminary review of the inspection procedure;
- qualification procedure(s):
  - technical justification;
  - description of practical trials;
  - results of all practical trials including ranges of considered essential parameters and limitations.
- evaluation of the qualification process;
- conclusion(s) of the qualification.

The qualification dossier should also include, in the appropriate order, all the assessments, evaluations and certificates issued by the qualification body along the qualification process as well as the licensee's approvals and/or endorsements.

The qualification process and its relation with the qualification dossier is summarized in Fig. 1.

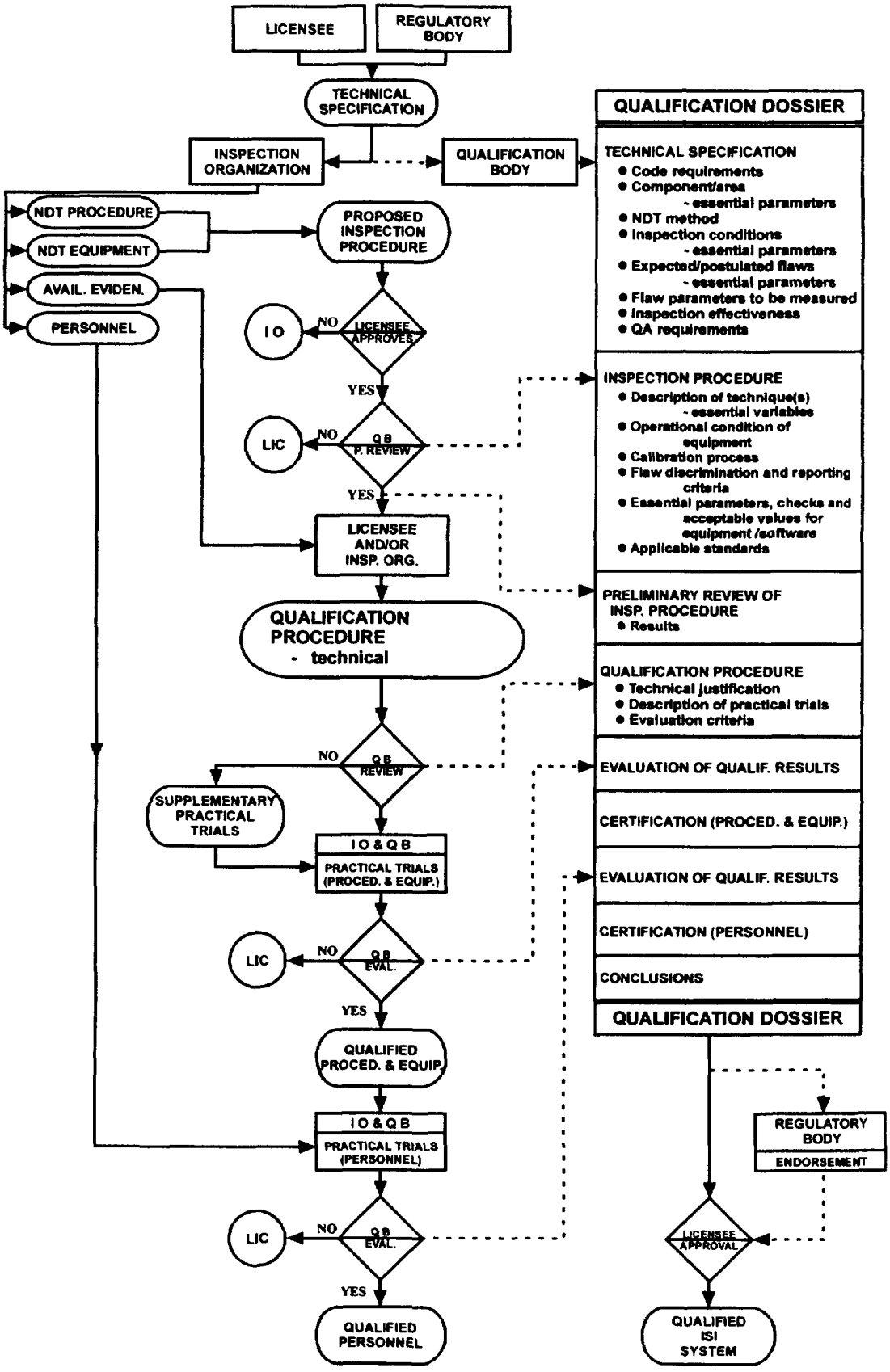

FIG. 1. The qualification process and its relation with the qualification dossier.

9. SPECIFIC QUALIFICATION RELATED REQUIREMENTS

9.1. INSPECTION PROCEDURES

Inspection procedures should be written in a step-by-step way which allows their reproducible application while minimizing the risk of operator's misinterpretation.

Inspection procedures should specifically define their scope and applicability (materials, product form, thickness, diameter, etc.) and essential parameters.

Inspection procedures should clearly specify the value or range of values of all those essential variables which can significantly affect, in a negative way, the outcome of the test for the particular NDT methodand technique used.

Inspection procedures should clearly specify the calibration and inspection data to be recorded, the recording method and recording equipment where used.

When calibration is required, inspection procedures should clearly specify the calibration methods for detection and sizing of flaws.

Inspection procedures should clearly state the flaw detection, discrimination and sizing methods/techniques used.

9.2. EQUIPMENT

Inspection procedures should include a specification of the equipment's essential variables, methods for their measurement and required performance values.

Inspection equipment should be assessed against the performance values specified in the inspection procedure.

9.3. PERSONNEL

Inspection procedures should require personnel with appropriate certifications according to a recognized national or international certification scheme.

Only inspection personnel who detect, record, evaluate and size flaws, during inspections are required to be additionally qualified through practical trials according to this methodology.

9.4. TEST SPECIMENS

Tests specimens used in non-blind practical demonstration should not be used in blind practical demonstrations.

All test specimens used in blind practical demonstration shall be perfectly identified but identifications should be obscured during qualification.

Flaws connected to the examination surface of test specimens shall be obscured during performance of blind practical trials.

All information regarding test specimens used in blind practical demonstrations (manufacturing drawings; type, number, location and sizes of flaws) should be considered restricted except for authorized staff of the qualification body.

Real defects will be used in test specimens whenever possible. Artificial defects may be used in test specimens when they have been previously validated with respect to both the characteristics of the simulated defects and their response to the actual NDT method.

For each known or postulated component degradation mechanism the minimum defect dimensions considered must be a fraction of the maximum allowable defect size, determined by structural integrity assessment, taking into account different defect geometries and in-service defect growth between inspections as well as any other applicable requirement (LBB concept application, etc.). Defect growth rate must be based either on conservative generic data or on specific test data for the component, its material composition, heat treatment, operating conditions, etc. Appropriate safety margins in relation with minimum defect size and detection and sizing capabilities should be demonstrated in accordance with regulations and codes accepted by the national regulatory body. All these information are essential elements of the technical specification of any inspection required to qualification.

10. RESPONSIBILITIES

The responsibilities of each one of the involved parties is a matter to be agreed upon before starting any qualification process taking into account the international practice and the specific circumstances of each particular country. Appropriate distribution of responsibilities might be as follows:

10.1. PLANT OPERATOR (LICENSEE)

It would be within the scope of the plant operator responsibilities:

- to ensure that any internal or external organization performing non-destructive in-service inspections (inspection organization) at its plant(s) has been previously qualified, if so required, according to this methodology;
- to define the technical specifications of the in-service inspection required to be qualified and its required effectiveness for each particular case;
- to approve the technical inspection procedures proposed by the inspection organization;
- to propose the qualification procedures;
- to review and approve (if applicable) the final qualification dossier.

10.2. INSPECTION ORGANIZATION

It would be within the scope of the inspection organization responsibilities:

- to develop detailed inspection procedures;
- to assemble the technical justification for the proposed inspection procedure and associated equipment;
- to certify its inspection personnel according to relevant national or international schemes;
- to participate in the qualification process in close cooperation with the qualification body providing all the necessary information according to the applicable qualification protocol(s).

10.3. QUALIFICATION BODY

It would be within the scope of the qualification body responsibilities:

- to develop qualification protocols;
- to review and comment qualification procedures;
- to identify and/or design the required test specimens for supplementary and personnel qualification practical trials;
- to manage the procurement of test specimens according to its quality system;
- to conduct and supervise the qualification process, as described in Section 6, including:
  - initial review and preliminary approval of the proposed inspection procedure;
  - invigilation of practical trials;
  - evaluation of results;
  - assembly of the qualification dossier;
  - issuance and withdrawal of certificates.

10.4. REGULATORY BODY

It would be within the scope of the regulatory body responsibilities:

- to approve and periodically audit the quality system of the qualification body;
- to review and approve qualification protocols;
- to review and comment qualification procedures;
- to review and endorse (if applicable) the final qualification dossier.

GLOSSARY

For the purpose of this report the following definitions apply:

Blind trial: Practical demonstration in which the inspection personnel has:

- no detailed knowledge of the number, position and size of any flaw;
- no knowledge of whether a test specimen contains any flaw at all;
- no access to flaws connected to the examination surface;
- no access to the test specimens' identifications.

Discrimination: The process and rules which allow the inspection personnel to disregard indications arising from sources other than relevant flaws.

Essential parameter: Those parameters of the component, of the defects that the test is intended to detect and/or to size and of the environmental conditions in which the actual inspection has to be performed which are significant in determining the outcome of the test.

Essential variable: Those parameters of the NDT equipment which can significantly affect in a negative way, the outcome and quality of a particular test.

False call: The reporting of a non-defective area as defective.

Flaw: Defective condition in which the metallurgical structure contains discontinuities such as cracks.

Inspection system: All parts of a non-destructive testing system (NDT procedure, associated equipment, software and personnel).

ISI System qualification: The systematic assessment, by all those methods that are available, to provide a reliable confirmation, that a inspection system is capable of achieving the required effectiveness under real inspection conditions.

NDT method: Physical principle which defines a family of non-destructive tests (i.e. ultrasonics, eddy current, etc.).

NDT procedure: Step-by-step sequence of rules describing how a specific NDT technique or combination of techniques is to be applied to a specific inspection area in order to detect, evaluate and size flaws.

NDT technique: Each one of the specific ways a NDT method can be applied (i.e. pulse-echo, rotating probe, etc.).

Open (non-blind) trial: Practical demonstration in which the inspection personnel is previously informed on the type, number and characteristics of the test specimens as well as on the type, morphology, position and dimensions of the flaws to be detected and/or sized.

Qualification body: Independent organization that conducts NDT qualification processes.

Qualification certificate: Document issued by a qualification body, under the rules of its quality system, stating that a duly identified combination of NDT procedures, equipment and personnel is capable of achieving the objectives stated for the inspection.

Qualification procedure: An orderly sequence of steps describing how a specific combination of NDT procedure, equipment and personnel applied to a specific inspection area has to be qualified including: generation of the technical justification, required test specimens, flaws, conditions of the practical trials, grading and success criteria for practical trials and any other special requirement where applicable.

Qualification protocol: Document describing the administrative actions and interfaces, as well as the types (unrestricted, restricted, confidential) paths and timing of the information to be exchanged, between all involved parties, as consequence of a qualification process.

Quality system: Document describing the structure, staff and facilities of a qualification body including the rules of procedure and management for carrying out all its activities.

Supplementary practical trials: Those practical trials which might be deemed necessary for qualification of NDT procedure and NDT equipment in addition to the practical trials proposed by the licensee.

Technical justification: The documented evidence which supports the assessment of the proposed non-destructive inspection system capabilities justifying the selection of the essential parameters of the inspection system and their valid ranges, the extent of the practical trials needed, the real or artificial defects to be used and any other particular requirement.

Complementary personnel qualification: Qualification, which applies only to those inspection personnel who detect, record, evaluate and size flaws.

REFERENCES

[1] ASME Code, Section XI, Rules for In-Service Inspection of Nuclear Power Plant Components. Appendix VIII "Performance Demonstration for Ultrasonic Examination Systems" (1989).

[2] EUROPEAN COMMISSION, DG XII, European Methodology for Qualification of Non-Destructive Tests (First issue), EUR 16139 EN (1995).

[3] EUROPEAN COMMISSION, DG XI, Common Position of European Regulators on Qualification of ND Systems for Pre- and In-service Inspection of Light Water Reactor Components, EUR 16802 EN (1996).

[4] INTERNATIONAL ATOMIC ENERGY AGENCY, Guidelines for Accident Analysis of WWER Nuclear Power Plants, IAEA-EBP-WWER-01, Vienna (1995).

[5] INTERNATIONAL ATOMIC ENERGY AGENCY, Guidelines on Pressurized Thermal Shock Analysis for WWER Nuclear Power Plants, IAEA-EBP-WWER-08, Vienna (1997).

[6] Guidelines for WWER-440/213 Containment Evaluation, IAEA-WWER-SC-170, 1995 (Report to the Steering Committee).

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