World Nuclear Association

Certification of NDE Personnel

Harmonization of International Code Requirements

WNA CORDEL Codes & Standards Task Force

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Foreword

In January 2007 the World Nuclear Association established the Cooperation in Reactor Design Evaluation and Licensing Working Group (CORDEL WG) with the aim of stimulating a dialogue between the nuclear industry (including reactor vendors, operators and utilities) and nuclear regulators on the benefits and means of achieving a worldwide convergence of reactor safety standards for reactor designs.

The Codes and Standards Task Force (CSTF) of the CORDEL WG was set up in 2010 to collaborate with the Standards Developing Organizations (SDOs) and the Multinational Design Evaluation Programme (MDEP) Codes and Standards Working Group (CSWG) on the international convergence of mechanical codes and standards, related to the design and quality of nuclear power plant components that are important to safety.

The CORDEL WG also encouraged the CSTF to work with the SDOs[1] with the objective of identifying areas where a) convergence seemed most feasible; or b) a demonstration of equivalent level of safety could be made. On the basis of an internal survey the CSTF established two pilot projects. The first focused on regulatory requirements: Qualifications for Non-Destructive Examination (NDE) Personnel. The other project relates to technical requirements: Non-Linear Analysis Methodologies Code Requirements. This first report on Qualification of NDE Personnel looks at and compares requirements in the major nuclear design codes, presents current international industrial certification practices and presents a recommendation for convergence in certification requirements of the different codes. A proposal for a harmonized international alternative for the certification of NDE personnel is presented at the end of this document. The scope of this report is limited to NDE personnel certification requirements for the manufacturing of components and does not investigate the requirements for in service inspection (ISI).

[1] The SDOs were participating in the MDEP CSWG up to this point.

1

Introduction

Under the current national nuclear design codes, non-destructive examination (NDE) is required during the manufacture of nuclear grade components to provide assurance of the absence of unacceptable defects. National design codes are usually formulated to follow the national regulations in a state. Because these regulations differ from country to country, barriers are created to the transferability of NDE certification, with obvious effects for the supply chain.

As nuclear new build gathers pace, the need for qualified and experienced personnel will increase. In the UK, for example, a report by Cogent[2] [1] on nuclear skills, investigated the availability of resources for the UK nuclear new build programme. Taking into consideration the current available workforce, the time required to train a new workforce and the competition with various other local, national and international infrastructure programmes, the report calculated the risk of companies not being able to hire adequately trained and experienced staff at various stages of the construction programme. The report estimates that there is a high probability of skill deficit in the near term[3] in equipment manufacturing and in the short term[4] for engineering construction [2], for NDE personnel.

Harmonization of codes and standards lowers trade barriers, allows interoperability of products, systems and services and promotes common technical understanding [2]. It can effectively reduce costs, by allowing personnel to be trained according to one consistent set of requirements and increase the international mobility of the workforce. In addition, this consistency can contribute to providing a large pool of certified personnel with adequate experience in the nuclear industry. All of these factors lead to a reduction in the amount of non-conformities and increased safety.

> As codes often reflect national regulatory requirements, any convergence effort needs to be taken collaboratively between the regulatory body and the SDOs.

This report looks at and compares the current code requirements in the certification of NDE personnel for the major nuclear design codes. A survey conducted by the Codes and Standards Task Force (CSTF) identified that companies performing NDE procedures normally perform examinations on a wide variety of components. These could include components under different sections of the design code (other than nuclear grade) as well as under In-Service Inspection ISI codes. Hence, this document considers requirements for nuclear grade components as well as conventional equipment when appropriate. It also presents current international industrial certification practices. Finally, a recommendation for convergence in certification requirements for fabrication is presented at the end of this document.

[2] Cogent SSC is an employer-led, strategic skills body for the science industry in the United Kingdom. http://www.cogent-ssc.com
[3] Next four to five years.
[4] Next one to three years.

2

Background

All personnel performing NDE on nuclear grade components are required to be certified by law to perform these tests. There are three stages that non-destructing testing (NDT)[5] personnel have to undergo before they are qualified to perform a test on Class 1 components (not required for class 2 and 3 components) in most countries. These are Certification, Training and Qualification.

The first stage, Certification, is required by nuclear design codes and national regulators. For example, in the United States this includes an ASNT (American Society for Non-Destructive Testing) SNT-TC-1A type certification under ASME Section III while in France it includes EN ISO 9712 in the RCC-M. The certification required by each of the design codes investigated in the MDEP-CSWG code comparison report [3] is analyzed in Chapter 3. Due to the different requirements, the inability to easily transfer certification between States establishes a major obstacle to vendors and operators of existing plants and new build. The effect of this on the international markets makes it an issue CORDEL CSTF aims to resolve.

The second stage, Training, is defined as additional in-house, job or site-specific training (procedure training, definition of degradation mechanisms, specificities of inspected components). This is often required by employers, before the employee is authorized to conduct an examination. This is not a code requirement and is applied at the discretion of the employer based on its needs and its culture. These can be particularly important when a third party certification is used to ensure that personnel are fit to follow a written procedure and perform an NDE test.

The third stage, Qualification, is the highest level. An independent third party is required to validate the qualification to the certificate holder. This qualification is normally specific to the control of Class 1 components, although it can also be required by regulatory bodies for fabrication in a limited number of countries (e.g. UK). The ENIQ framework[6] and Section XI requirements[7] are the two major sets of requirements for certification of NDE personnel for ISI of nuclear-grade components internationally.

It is important to understand the differences between the personnel certification schemes described by EN ISO 9712:2012 or ASNT SNT-TC-1A, and qualification of an NDT personnel inspection system in accordance with the ENIQ Methodology for Qualification (EMQ) or EPRI's PDI[8] approach. Basically,

- The certification processes (ISO 9712 & SNT-TC-1A) explain how to qualify workforce for a basic assessment of the basic knowledge of a method or technique. These certification processes provide confidence that an operator who is successfully certified in accordance with the process, either in-house or through a third party, has broad knowledge of the principles, application and capability of a particular NDE method in a range of situations. In other words, it is a 'method'-based certification process for personnel.

[5] In this report, the distinction has been made between non-destructive examination (NDE), which refers to manufacturing requirements and non-destructive testing (NDT), which refers to qualification requirements.
[6] The ENIQ Framework is currently used in Europe and some Asian and countries for the qualification of NDE personnel and procedures http://capture.jrc.ec.europa.eu/capture/eniq-pubs
[7] ASME Section XI defines the requirements for the qualification of NDE personnel that perform examinations on class 1 components and is required when ASME BPVC is used for ISI of class 1 components. http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001020593
[8] See list of acronyms and abbreviations

- The qualification of the personnel or a procedure according to the ENIQ EMQ or EPRI PDI is control specific, and defines performance-based requirements. A qualification of an NDT system in accordance with the ENIQ or PDI methodologies is a more stringent process that demonstrates that the combination of inspection system and personnel with a good level of knowledge, obtained via a training dossier, is capable of achieving very specific defect detection and sizing criteria in a particular situation. This report concentrates on the convergence of the certification requirements internationally, and does not investigate the Qualification requirements.

Convergence of certification requirements would provide vendors with the confidence that the certified personnel have a broad knowledge of NDT methods. This will allow for transferability of personnel but will not change the responsibility of the vendor to ensure that the procedure, and the capacity of the personnel to apply the procedure, is adequate.

The major barriers towards having an internationally transferable certification scheme were as follows:

- Mechanical nuclear code requirements and regulatory requirements
- The requirement for a third party vs in house certification responsibility of companies employing the NDE personnel
- Requirement to develop and submit a Written Practice[9]
- Industrial application of the requirements
- Responsibilities of inspection qualification body (IQB) (Area Cover and Rightfulness at the different stages of the qualification….)

[9] A Written Practice is a detailed certification procedure for the control and administration of NDE personnel training, examination and certification, that must be created by the employers when following the recommended practice SNT-TC-1A. More details of what the Written Practice should include can be found in section 6.

3

Current Codes and Referenced Standards

The certification requirements for NDE personnel employed in the nuclear industry are defined by mechanical design codes, regulatory requirements or contractual requirements. In this study the six codes reviewed by the MDEP-CSWG group were analysed (ASME (BPVC) Section III, AFCEN RCC-M, JSME, NIKIET, PNEA-G-7, KEPIC and CSA)[10]. All of these codes are currently used in the nuclear industry. They started as national design codes and evolved with the internationalization of the nuclear industry into "international" codes. Although most of these codes originated from ASME Section III (with the exception of PNEA G-7), a strong bias towards national standards and national industry practices now exists in every code[11].

The following subsections describe the requirements for the codes listed above. Table I provides an overview of the requirements for each of the codes including the applicable Sections and editions.

ASME (2011 Edition): Requirements for pressure equipment manufacturing and ISI are defined in a number of code sections within the ASME Boiler and Pressure Vessel Code. Section III and Section XI define the nuclear-specific requirements for manufacturing and ISI respectively. Whilst each technology-specific Section tends to define its own requirements for qualification of NDE personnel, Section V regroups all the requirements for non-destructive inspection, including qualification of personnel. Technology-specific Sections have the option to refer to Section V regarding any requirements for NDE.

Section III defines the requirements for the certification of NDE personnel for fabrication of new components. This Section requires personnel to be certified according to SNT-TC-1A in combination with a Written Practice. Third party certification options, available in Section V and Section XI are specifically disallowed in the current Section III requirements. It is interesting to note that a clarification of the use of third party certification has been done in Section V, allowing EN ISO 9712:2012 certifications to be used for training, experience and examination requirements in combination with a Written Practice.

AFCEN (2007 Edition): Requirements for the manufacturing of components are defined in the AFCEN RCC-M requirements. RCC-M MC 8000 defines the requirements for the certification of NDE personnel for design and conception of new components. This Section requires personnel to be certified by a third party according to NF EN 473. An international alternative to certification according to the European standard is available in the main text of the code.

JSME (2007 Edition): JSME does not address accreditation of fabricators or NDE personnel qualification requirements. However, ISO 9001 is required for nuclear projects and NDE personnel are required to be certified according to JIS Z 2305 (ISO 9712:2005 MOD[12]) in Japan. Certification is according to SNT-TC-1A is used for exported ASME stamped components, and specific European certifications according to EN 473 delivered by the adequate certification body are used for exports

[10] See list of acronyms and abbreviations

[11] Principal Development Countries: ASME (United States); AFCEN (France); JSME (Japan); NIKIET (Russia); KEPIC (South Korea) and CSA (Canada)

[12] During the adoption of an ISO Standard, Guide 21[6] provides two options:
1) Adoption of the standard as is. The standard will then be referenced as "ISO ####"
2) Modification of the text to be more, or less, restrictive than the original standard. In this case, the standard will be referenced as "ISO #### Modified" (e.g. ISO 9712 mod in Japan and Canada) or a completely different reference (e.g. CP106 in the USA is an ISO 9712 mod).

to Europe. Equivalency agreements exist between Canada and Japan on certifications based on ISO 9712:2005.

NIKIET (1989 Edition): PNAE G-7-010-89 paragraph 4.2 defines the requirements for the certification of NDE personnel for the design and conception of new nuclear components. It requires the certification to be performed following an internal procedure or by external organizations licensed by the Federal, Environmental, Industrial and Nuclear Supervision Service of Russia.

KEPIC (2010 Edition): MNB 5521 defines the requirements for the certification of NDE personnel for the design and conception of new nuclear components. It requires personnel performing NDE to be qualified in accordance with KEPIC-MEN 1002, which requires specific additions defined by Korean law in addition to the requirements of ASME Section V for NDE personnel. As alternative rules, the qualification requirements of ISO 9712 or SNT-TC-1A are acceptable to KEPIC (KEPIC Code Case QA-C-021). Additionally, NDE personnel qualified by ISO 9712 or SNT-TC-1A shall be trained at least 8 hours for applicable requirements of KEPIC and the training records shall be maintained by the certificate holder of the employer.

CSA: CSA Clause 11.3 defines the requirements for the certification of NDE personnel for fabrication of new components. In Canada, personnel certification according to CAN/CGSB-48.97/ ISO 9712 (modified ISO 9712:2005) is required for radiography, ultrasonic, magnetic particle, liquid penetrant and eddy current methods. For other NDE methods, the manufacturer can use alternative standards acceptable to the licensee and the authorized inspection agency. When applied outside of Canada, personnel can be certified according to standards acceptable to the licensee and authorized inspection agency for all methods. ASME stamped components are acceptable in Canada and in this case the use of SNT-TC-1A for qualification of NDE personnel is acceptable, provided the authorized inspection agency (AIA) and the licensee accepted its use.

Three major points can be found when comparing code requirements, which are as follows:

1. Code requirements divide into two main categories; those that require a third party certification and those that require a second party certification in combination with a Written Practice.

a) Third Party Certification Codes: RCC-M, JSME, NIKIET and CSA all require third party certification. All certifications are currently based on the national certification standards based on ISO 9712:2005 or EN 473. The CSA code also allows the use of second party certification based on SNT-TC-1A in the case of ASME Stamped components. RCC-M is developing an update which will reference EN ISO 9712:2012 standard.

b) Second Party Certification Codes: ASME Section III and KEPIC require a Second Party certification in combination with a Written Practice. All certifications are currently based on national certification standards using SNT-TC-1A guidelines, combined with a Written Practice. It is important to note that KEPIC allows the use of ISO 9712 third party certification of NDE personnel as an alternative to KEPIC-MEN A1 Mandatory 1 requirements.

2. International options have been added to code requirements on an ad-hoc basis:

a) As seen in the In the RCC-M code, two options are available in the code due to national regulatory requirements. National requirements demand that personnel be certified according to EN 473 up to 2013, and in the 2013 Edition of the code, certified according to the harmonized EN ISO 9712: 2012. A Multilateral Recognition Agreement (MRA) was agreed to allow interoperability of certification provided by different NDE certification bodies which are members of EFNDT. For outside Europe, the code allows the certification of personnel using a third party organization and using an equivalent standard.

b) The KEPIC requirements are also divided into multiple options, defined in KEPIC MEN A1 Mandatory 1, with the additional possibility of using SNT-TC-1A and ISO 9712 certifications.

c) CSA has a very open approach to certification, with an ISO 9712 based certification required for components that do not have an ASME stamp, and an SNT-TC-1A based certification accepted for all components that have an ASME Stamp.

d) The only two codes which currently do not allow any additional options are the PNAE G-7-010-89 and ASME Section III. In ASME BPVC's case, multiple certification options are available in other code Sections, including Section V allowing third party certification to be used to fulfil part of the guidelines defined in SNT-TC-1A.

This highlights two needs:

- In order to achieve convergence, it is necessary to have a consistent set of international options in order to secure interoperability of company management and certification systems.
- To promote international options to be available in the codes that currently does not have them.

3. Codes and Standards requirements for NDE personnel certification have already converged to a certain extent.

Codified requirements for the certification of NDE personnel have been on the path of convergence for some time. European (EN 473) and international (ISO 9712) standards converged in 2012. Harmonization has been happening naturally on an ad-hoc basis, which is visible through the multiple options often available in codes. Unfortunately, additional requirements introduced in addition to the harmonized rule in order to fulfil local regulatory requirements usually reduce the industrial practicality of the harmonization process.

Table 1: Code requirements for certification of NDE Personnel

ASME	**Section III:** *2011/2013 Edition* • Written Practice following SNT-TC-1A + added requirements **Section V:** *2010 Edition:* • Written Practice following SNT-TC-1A • Written Practice following CP-189 • Written Practice following SNT-TC-1A or CP-189 + third party such as ACCP can be used to fulfil examination requirements *2013 Edition:* • Written Practice following SNT-TC-1A • Written Practice following CP-189 • Written Practice following SNT-TC-1A or CP-189 + third party such as ACCP & EN ISO 9712 can be used to fulfil training, experience and examination requirements
AFCEN	**RCC-M Section III:** *2007 Edition:* • Qualification and certification of personnel according to NF EN 473 • Outside Europe, certification granted by an independent organization, certification can be done using an equivalent standard (require approval from contractor and to meet regulatory requirements) *2013 Edition:* • Qualification and certification according to ISO EN 9712:2012 • Outside Europe, certification granted by an independent organization, certification can be done using an equivalent standard (requires approval from contractor and to meet regulatory requirements)
JSME	• Non-destructive examination requirements are not set by JSME but defined by the Japanese Society for Non-Destructive inspection (JSNDI) • Qualification and certification according to JIS Z 2305 (ISO 9712:2005 MOD)
KEPIC	• Personnel performing non-destructive examinations shall be qualified in accordance with KEPIC-MEN A1 Mandatory 1 • For visual examination, the requirements are based on ISO 9712. The use of equivalent type and size letters is permitted, such as Times Romans N3.5 • For non-destructive examination methods not covered by KEPIC-MEN A1 Mandatory 1, personnel shall be qualified to a comparable level of competency by subjection to comparable examinations on the particular method involved • The emphasis shall be on the individual's ability to perform the non-destructive examination in accordance with the applicable procedure for the intended application
CSA	• In Canada: CAN/CGSB-48.97/ISO 9712 (ISO 9712:2005 MOD) for radiography, ultrasonic, magnetic particle, liquid penetrant and eddy current methods • Outside Canada: certification according to standards acceptable to the licensee and authorized inspection agency for all methods • ASME-stamped components are acceptable in Canada and in this case the use of SNT-TC-1A for qualification of NDE personnel is acceptable, provided the AIA and the Licensee accept its use.
NIKIET	• Qualification and certification according to PNAEG-7-010-89 or a similar document. PNAEG-7-010-89 provides only general requirements and should be used in conjunction with the mandatory requirements set by the regulator • Certification can be achieved through an internal certification programme or through an external organization licensed by the Federal, Environmental, Industrial and Nuclear Supervision Service of Russia • A central certification body organizes the certification requirements

4

Third Party Certification vs. Second Party (Company Based) Certification

NDE procedures are an integral part of quality management procedures in the manufacturing of new components. As such, the detection of unacceptable defects is an important issue. Two major certification methodologies exist in the world, each one possessing its unique strengths and weaknesses. Second party certification processes are developed and implemented by the company employing the NDE personnel. They require the company to define the training required for its NDE personnel to perform testing on their components using a Written Practice. The scope of the Written Practice is defined by recommended practices such as SNT-TC-1A or following standards such as CP-106. Such certification processes are very popular in North America, and are adapted for industry employing people to do a very specific/specialized job, with a specific/specialized technology [4]. The training and procedures can be tailored to a specific job, potentially allowing more specific and detailed training of personnel to perform a specific task [5].

A potential conflict of interest has been highlighted in the past, with potentially unscrupulous companies using the certification process as a rubber stamp for the personnel to be able to conduct a test. Furthermore, inexperienced companies with a small NDE personnel workforce can define inadequate or incomplete Written Practices. It can be harder to follow latest best practice in training and certification. This potential issue has been recognized, and independent third party level III personnel are now required to audit the employer based certification Written Practice. More importantly, these processes are company specific, and therefore non-transferable from one company to the next; hence they are ill suited as a basis for an internationally transferable certification scheme.

Third party based certifications are issued by an independent third party who is nationally recognized. In Europe, a system of nationally Recognized Third Party Organization (RTPO) or RTPO-associated organizations has been introduced under the requirements of the European Pressure Equipment Directive. Best practice recommends for the RTPO to be accredited according to EN ISO 17024:2003. The guidelines of how to certify personnel have been developed by the EFNDT and ICNDT[13]. Third party certifications are often based on, but not limited to, EN 473- and ISO 9712- type certification.

These certifications are adapted for industry mainly based on sub-contracted NDE workforce, with a standardized certification that is transferable from one company to the next. Third party certification bodies recognize that they should provide industry-relevant skills. The certification can be considered to provide general training, providing a good basis for NDE personnel, but lacking the relevant detailed training for the effective application of specific techniques. Hence, personnel might require additional in-house training in order to be able to use company specific methods and equipment. ISO 9712 and EN 473 are the major third party standards used internationally and are recognized by most nuclear mechanical codes investigated in this work. Unfortunately, third party certifications are not automatically transferable internationally, due to national modifications to ISO 9712 and the regulatory requirements of certification issued by specific RTPO organizations [4].

Third party certification provides a transferable certification methodology which would be ideal for the reduction in divergence in certification requirements internationally. Existing barriers to transferability of NDE certification can be overcome using a series of

[13] Qualification and Certification of NDT Personnel according to ISO 9712 and Aligned Standards, October 2009

memoranda of understanding (MOU) between each recognized national body. An example of successful international transferability of third party based certification can be found in the MOU between the Ministry of Natural Resources Canada and the Japanese Society for Non-destructive Inspection (JSNDI). It allows personnel certified according to each other's respective NDT certification programme to apply for a certification from the opposite country without further examination, provided any other qualification requirements are satisfactorily met. Consistency in certification requirements, in combination with MOUs (or Mutual Recognition Agreements (MRAs) such as the one defined through the regional association EFNDT), could allow a significant reduction in international trade barriers and the simplification of the international nuclear supply chain.

5

Manufacturer's Responsibility and Contractor's Role

The manufacturer, either within its organization or through a qualified contractor retains all responsibilities for the overall quality of NDE operations, irrespective of use of in-company certification, third-party certification or a combination of both.

In second party certification, the operator is responsible for ensuring its staff (or the contractor's staff) maintain the procedure defined in the Written Practice, and should have adequate documentation to show an inspector that the Written Practice was adequately implemented.

In third party certification schemes, the contractor's role is defined in ISO 9712:2012 section 5.5.2. The contractor ensures "all that concerns the authorization to operate, i.e. providing job-specific training (if necessary); issuing the written authorization to operate, the results of NDE operations; ensuring that the annual visual acuity requirements … are met; verifying continuity in the application of the NDE method without significant interruption; ensuring that personnel hold valid certification relevant to their tasks within the organization; maintaining appropriate records".

It is clearly stated in EN ISO 9712:2012 that the certification "provides an attestation of general competence of the NDE operator. It does not represent an authorization to operate, since this remains the responsibility of the employer, and the certified employee may require additional specialized knowledge of parameters such as equipment, NDE procedures, materials and products specific for the employer.

Where required by the Regulatory Authority (and the codes), authorization for personnel to operate shall be given in writing by the employer. This must be in accordance with a quality procedure that defines any employer-required job-specific training and examinations designed to verify the certificate holder's knowledge of relevant industry codes, standards, NDE procedures, equipment, and acceptance criteria for the tested products.

In a third party certification, the ICNDT guide states that the employer is responsible for introducing the candidates to the certification body and for documenting the candidate's education and prior experience.

Both certification standards define similar roles for contractors. In both cases, the contractor should prepare and implement a quality procedure or Written Practice as required by the operator. Divergences in the scope covered by the supporting documents exist, specifically regarding the details of the training course content. Furthermore, under both certification processes, the contractor has the ultimate responsibility to discharge the duties of the NDE personnel.

Nevertheless, it is important to maintain transparency and traceability in personnel certifications in order to foster trust and understanding between international parties. This could be achieved through clear and consistent documentation associated with all certifications.

6

Written Practice vs Quality Procedure

Second party based certification programmes can provide good transparency and traceability in personnel certification through internal procedures (the Written Practices), which details the company specific requirements for training, qualification and certification required to perform NDE functions. While not a requirement, ICNDT recommends companies certifying their personnel according to third party certification schemes to maintain similar documentation through a quality procedure.

The content of the quality procedure and Written Practice is described in Table 2.

Although differences exist in the scope of the Written Practice and quality procedures, these documents provide transparency and traceability of personnel's certification. This is particularly important when considering that ASNT-TC-1A is a recommendation and ISO Guide 21 may be applied to change the requirements for the ISO Standard.

Table 2: Requirements for quality procedures as defined by ICNDT and the Written Practice as defined by ASME BPVC (Section XI)

Quality Procedure (ICNDT Recommendations)	Written Practice

• Applicable codes and standards
• General responsibilities of level 1, 2 and 3
• Certification requirements (sector, method, level)
• Persons designated by the employer to be responsible for issuing the authorization to operate
• Control of in-house training and examination supplementary to that carried out during the ISO 9712 qualification and certification process. This will include job specific training for tasks outside the scope of the individual's certification and updating with respect to new equipment or techniques
• Responsibility for maintenance of records. The employer must maintain records for each of his NDE personnel including:
  • Training
  • Education
  • Work experience
  • Vision test results
  • Certification examination results
	a) Level of qualification
	b) Vision test requirements
	c) Training course content
	d) Required training time
	e) Experience time
	f) Administration and grading of examination
	g) Requirements for initial certification
	h) Requirements for recertification
	i) Revocation and suspension of certification
	j) Reinstatement of certification
	k) Limited certification

7

Industrial Application

A survey of the industry shows that throughout the world, the industry is forced to hold multiple certifications in order to conduct business. This is particularly true for vendors, component manufacturers and engineering services companies. Companies hold two or three certifications in order to perform business internationally. Details of certification held by companies, defined per geographical region, are presented in Table 3.

Table 3: Industrial practices for the certification of NDE personnel

Europe	**Within the European Union** Requirement to use third party such as COFREND, BINDT, etc. according to EN 473 and ISO 9712, which has to be a national body recognized by the national government. This leads to certification from the specific national body in order to be recognized by the regulator. For pressure equipment, non-destructive tests of permanent joints must be carried out by "suitably qualified personnel". For pressure equipment of categories III to IV, NDE personnel must be approved by a "third party organization" (RTPO) recognized by a member state pursuant to article 13. **Outside the European Union** International companies have multiple certifications, for example PCN/SNT-TC-1A.
Asia	**Japan** JIS Z 2305 (ISO 9712 MOD) for certification aimed at work for national projects ASNT-TC-1A in order to obtain the N-stamp according to ASME Section III and the U-stamp according to ASME Section VIII. Certification according to EN 473 is currently required for export of components to Europe. **People's Republic of China** HAF 602 for components that will be used within China. Certification granted by recognized third party organization to an equivalent standard meeting the specified regulatory requirements is used. **South Korea** Certification according to MEN A1 Mandatory 1 is required for inside Korea. These requirements are equivalent to ASME Section V for NDE personnel, with specific additions defined by Korean law. As alternative rules, the qualification requirements of ISO 9712 or SNT-TC-1A are acceptable to KEPIC (KEPIC Code Case QA-C-021). For export to the USA, SNT-TC-1A is required to obtain an ASME stamp and for export to Europe, EN 473 certification is required.
Russia	Certification must be carried our according to PNAEG-7-010-89 or similar document, following an internal procedure or an external organizations licensed by the Federal, Environmental, Industrial and Nuclear Supervision Service of Russia. The methods, procedures and responsibilities of the operator are defined in a supporting document. There is a trend to forbid inspector certification on the manufacturer`s (or installer`s) side and allow certification only in the certification centres.

North America	**USA** Only ASNT SNT-TC-1A is acceptable for the USA for nuclear grade components designed according to ASME Section III. ACCP and CP-189 are acceptable for non-nuclear components. **Canada** • Inside Canada: CAN/CGSB-48.97/ISO 9712 (modified ISO 9712:2005) for radiography, ultrasonic, magnetic particle, liquid penetrant and eddy current methods. • Outside Canada: certification according to standards acceptable to the licensee and authorized inspection agency for all methods. ASME-stamped components are acceptable in Canada and in this case the use of SNT-TC-1A for qualification of NDE personnel is acceptable, provided the AIA and the licensee accept its use.

8

Current Convergence Efforts

It is important to note that the code requirements for NDE personnel qualification are not static. There is currently a strong momentum behind convergence of NDE personnel certification, which is rooted in:

- The internationalization of the nuclear industry,
- Convergence in third party certification standards requirements
- Regulatory pressure to change the certification methodology for personnel certification for ISI of primary circuit components in the USA.

The EN standard and ISO standard for certification of NDE personnel have recently been harmonized into the EN ISO 9712:2012 standard. The latest revision of the ISO EN standard is in the process of being incorporated into the latest edition of the RCC-M Code. Furthermore, the latest update of the JIS Z 2305:2013 has been updated in accordance with EN ISO 9712:2012. This certification will nevertheless remain a modified version of EN ISO 9712, as the transition measures for EN 473 and 9712:2005 are omitted in the JIS standard.

KEPIC Code Case QA-C-021 will be updated to reference the latest version of the ISO 9712 standard and the CGSB will update its requirements to incorporate the latest ISO 9712 standard.

ASME is currently conducting the most visible efforts towards rationalising the requirements for NDE personnel, to make them consistent within its own code and more consistent with international practices.

A project is underway to allow all basic requirements for the certification of NDE personnel to be set out in BPVC Section V T-120, with all other code sections referencing the requirements set out in T-120, adding their own additional requirements. This would allow consistency between different pressure vessel industries, making the international convergence of requirements a lot easier.

Furthermore, a group within ASME BPVC has been designing a third party certification (ASME Non-destructive examination, ANDE) for ASME section XI. The developers of the code aim to push for all nuclear code sections to reference the ANDE standard as an acceptable alternative to the current requirements. The ANDE standard has been developed for the USA industry, and it is unclear at the moment if the standard will be compatible with the ISO 9712 requirements. WNA CORDEL CSTF representatives have attended the meetings in order to promote a minimum amount of divergences between the ANDE standard and EN ISO 9712. Although significant differences will exist between the ANDE certification and the ISO 9712:2012 certification, this avenue of convergence holds significant promise for the medium to long term convergence of requirements. It will reduce the biggest hurdle which exists at the moment, which is the requirement for third party certification. It is possible that the ANDE requirements will be included as a third party certification option in ASME Section III. The CORDEL CSTF will continue to actively interact with the ANDE drafting committee.

9

Conclusions

This report provides an analysis of the current state of certification requirements for personnel performing non-destructive examination procedures. In relation to CORDEL's objective to work towards worldwide convergence of reactor safety standards for reactor designs, industry wide consultation revealed an urgent need for international harmonization of NDE certifications.

Convergence of certification would allow vendors to have confidence that certified personnel have a broad knowledge of NDE methods, allowing better international transferability of personnel.

Currently, code requirements can be divided into two categories, those requiring third party certification and codes requiring second party certification in combination with a Written Practice. In this report, third party certification was identified as the preferred method to provide an internationally transferable certification methodology. The most consistently used standard requiring a third party certification scheme is ISO 9712:2012. Nevertheless, application of Guide 21 by national standards bodies when adopting ISO 9712:2012 can lead to issues in the transferability of the certifications.

In order to maintain transparency and traceability in personnel certification, clear and consistent documentation associated to all certifications is required. The use of a Written Practice or quality procedure detailing the training, test results and any application of Guide 21 would enable the transparency required for an internationally transferable certification.

As such, the CORDEL Codes & Standards Task Force recommends that each of the standards and code organizations provides a harmonized international alternative to the certification of non-destructive examination personnel that should be added to their nuclear grade mechanical code.

This alternative would require the certification of NDE personnel using a recognized third party certification body according to ISO 9712:2012 in combination with a Written Practice. The Written Practice should include:

- A description of each level of certification,
- A description of the training, experience and examination requirements for each level of certification,
- General responsibilities for each level of certification,
- Visual test requirements,
- Industry sector and NDE method certified to,
- Database with all job-specific training the certificate holder has done,
- Authorization to perform NDE.

In accordance with the above recommendations, the following steps should be taken by the industry:

- Advocate the convergence among the various national codes and standards through the inclusion of the detailed proposal defined in this section ("Proposal of Harmonized NDE Personnel Certification") in all relevant international codes.
- Meet with and work together with MDEP to communicate a united approach with the Standards Development Organizations and the individual code committees on the need to make these changes.
- Once implemented, review the effectiveness and use of the common international option by the nuclear industry.
- Work closely with other international groups investigating the convergence of NDE qualification such as the ICNDT.

Existing barriers to transferability of NDE certification can be overcome using a series of MOUs and MRAs

among each recognized qualification and regulatory bodies, allowing personnel certified according to one NDE certification programme to apply for a certification from another country without further examination, provided any additional qualification requirements are satisfactorily met. Consistency in certification requirements, in combination with MOUs and MRAs, could allow a significant reduction in international trade barriers and the simplification of the international nuclear supply chain.

Proposal for Harmonised NDE Personnel Qualification

It is proposed by the WNA CORDEL Codes & Standards Task Force that a harmonized international alternative to the certification of non-destructive examination personnel be included in all the nuclear mechanical codes. This includes but is not limited to the following nuclear codes: AFCEN RCC-M, ASME Section III, JSME, CSA N285.0, KEPIC and PNEA G.

This harmonized international alternative would require:

1) Personnel performing non-destructive examinations to be qualified and certified in accordance to ISO 9712:2012.

2) The employer to establish a Written Practice for the control and administration of NDE personnel training, examination and certification.

The Written Practice should include:

- A description of each level of certification to which the certificate holder is certified,
- A description of the training, experience and examination that the certificate holder has undergone to reach the level of certification,
- General responsibilities pertaining to the level of certification of the certificate holder,
- Visual test results,
- The industry sector and NDE method to which the person is certified,
- A database with all job-specific training the certificate holder has undergone,
- A database of experience,
- Authorization to perform NDE.

All details of the application of ISO Guide 21 should be included in the Written Practice. The Written Practice should be reviewed and approved by the employers NDT Level III or a third party providing the certification.

List of Acronyms

AFCEN	French Association for Design, Construction and In-Service Inspection Rules for Nuclear Island Components.
AIA	Authorized inspection agency
ANDE	ASME Non-destructive examination
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
BINDT	British Institute for Non-Destructive Testing
CEN	European Committee for Standardization
COFREND	Confédération Française des Essais Non-Destructifs
CSA	Canadian Standards Association
EFNDT	European Federation for Non-Destructive Testing
EMQ	ENIQ Methodology for Qualification
EN	European Standards
ENIQ	European Network for Inspection Qualification
ICNDT	International Committee for non-destructive Testing
IQB	Inspection qualification body
ISI	In-service-inspection
ISO	International Organization for Standardization
JSME	Japanese Society of Mechanical Engineers
JSNDI	Japanese Society for Non-Destructive Inspection
KEPIC	Korea Electric Power Industry Code
MDEP	Multinational Design Evaluation Programme
MOU	Memorandum of Understanding
MRA	Mutual Recognition Agreement
MRC	Ministry for Natural Resources Canada
NDE	Non-Destructive Examination
NDT	Non-Destructive Testing
NIKIET	Research and Development Centre for Nuclear Technology
PDI	Performance Demonstration Initiative (from EPRI)
PNEA-G	Regulations for Design and Safe Operation of Equipment and Piping of Atomic Power Plants
RPTO	Recognized third party organization
RCC-M	Design and Conception Rules for Mechanical Components of PWR Nuclear Islands
SDOs	Standards Developing Organizations

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