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Design and Construction Codes for Gen II to IV nuclear facilities (pilot case for process for evolution of AFCEN codes)

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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

CWA 17377:2019 has been developed in accordance with the CEN-CENELEC Guide 29 "CEN/CENELEC Workshop Agreements – The way to rapid agreement" and with the relevant provisions of CEN/CENELEC Internal Regulations - Part 2. It was approved by a Workshop of representatives of interested parties on 2018-09-24, the constitution of which was supported by CEN following the public call for participation made on 2018-05-10. However this CEN Workshop Agreement does not necessarily include all relevant stakeholders.

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The following organizations and individuals developed and approved this CEN Workshop Agreement:

Chairman: Didier Lelièvre, CEA-AFCEN, France
Vice-chairman: Martin Widera, VGB, Germany
Secretariat: Sylvie Picherit and Timothée Mace-Dubois, Afnor, France

Members of PG1
.Edouard Scott de Martinville, IRSN, France (Convener until December 2014)
.Bruno Autrusson, IRSN, France (Convener from January 2015)
.Stéphane Marie, Afcen France
.Philippe Malouines, Afcen France
.Matheus Abbt, Vattenfall, Sweden
.Micka Backström, STUK, Finland
.François Balestreri, IRSN, France
.Damien Couplet, Tractebel, Belgium
.Rauli Keskinen, STUK, Finland
.Oliver Martin, JRC, Europe
.Sven Reese, VGB, Germany
.Marc Scibetta, SCK-CEN, Belgium
.Paul Smith, Amec Forsterwheeler, Great-Britain
.Martin Widera, VGB, Germany
.Andrew Wasylyk, Cordel, Europe

Members of PG2
. Karl-Fredrik NILSSON, JRC, Europe (convener)
.Cécile Petesch, Afcen, France
.Massimo Angiolini, ENEA, Italy
.Micka Backström, STUK, Finland
.Jacques Belche, Tractebel, Belgium
.Davide Bernardi, ENEA, Italy
.Martine Blat-Yrieix, EDF, France
.Derek Buckhorpe, Amec Forsterwheeler, Great-Britain
.Sophie Dubiez-Legoff, Areva, France
.Stefan Holmstrom, JRC, Europe
.Damien Lamberts, SCK-CEN, Belgium
.Andrew Wisbey, Amec Forsterwheeler, Great-Britain

Members of PG3
.Pekka Välikangas, STUK, Finland (convener)
.Etienne Gallitre, Afcen, France
.Tim Viney, Amec Forsterwheeler, Great-Britain
.Ola Jovall, Scanscot Technology AB, Sweden
.Stephan Kranz, VGB, Germany
.Tomasz Piotrowski, PolNuclear BCC

.Anders Bergkvist, Vattenfall, Sweden
.Gilbert Guilhem, IRSN, France
.Jeroen Engelen, SCK CEN, Belgium
.Grégoire Louvet, CEA, France
.François Tarallo, IRSN, France
.Nicolas Dedeken, Tractebel, Belgium
.Corinne Piedagnel, IRSN, France

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Introduction

In the nuclear energy sector, codes for plant design and construction are a necessary complement to contracts between the operators, buyers of the equipment, and their suppliers. Such codes integrate the lessons learnt from prior builds, as well as those from currently implemented projects, thereby allowing any problems that arise (e.g. because of the unavoidable lack of accuracy of contracts) to be resolved between the technical experts by way of discussion held apart from the contracts themselves.

Naturally, the operators, as licensees, are concerned with nuclear safety and the codes reflect this concern. In this respect, the codes also play a role in the discussions with safety authorities, in particular during the licensing process, to demonstrate the adequacy of plant equipment in the context of the relevant safety requirements.

The operators are also concerned with equipment integrity, in the sense of life duration and functioning under severe operating constraints. This concern is also accommodated in the codes.

By providing guidelines plant design and construction, codes can be considered as risk-reduction tools for nuclear facility projects, thereby ensuring that the investments in a new build are used to best effect.

However, as the global development of the nuclear industry has been primarily at the national level, individual countries have developed and enriched national codes accordingly. Although some tentative efforts to harmonise existing codes have taken place at the international level, the process has proven very slow and to date has yielded relatively poor results.

On the other hand, at the European level there exist very few national codes. While a proportion of the reactor fleet has been constructed using ASME/ASCE codes, specific adaptation to local regulations as well as European standards has often proven necessary. Another significant part of the fleet has been constructed using either the French AFCEN codes or the German KTA codes. Both sets of codes are dedicated to nuclear facilities and are independent of conventional industry equipment, covering the essential parts of these facilities and referring to International and European standards.

Taking such set of codes as a basis, stakeholders in the nuclear energy sector have given consideration to developing a European set of codes that would take advantage of the lessons learnt from the whole European fleet of reactors. This gave rise to CEN Workshop 64, Phase 1 (CEN/WS 64) of which took place between 2011 and 2013 and Phase 2 (CEN/WS 64-II) between 2014 and 2018[1]. CEN/WS 64-II was established in anticipation of further developing three AFCEN codes, taken as pilot cases, in order to comply as widely as possible with European reactor fleet construction and maintenance requirements.

With this aim, experts from several European countries, delegated by utilities, suppliers, project-study companies, research and development bodies, as well as safety authorities and technical support organisations were gathered to elaborate such evolution proposals. AFCEN, as proposer of the Workshop, committed to delegate one of its experts for each of the codes taken as pilot case, to detail and explain the content of the code and to give a first indication on the feasibility of code evolution proposals.

[1] CEN/WS 64 - Phase 2 'Design and construction code for mechanical and civil engineering for Gen II to IV nuclear facilities'. Retrieved 19 April 2018 from https://www.cen.eu/work/areas/energy/nuclear/Pages/WS-64.aspx.

An interaction process between CEN/WS 64-II and AFCEN was also agreed as integral to the business plan[2]. This process consisted of the formal transmission to AFCEN of the code evolution proposals elaborated by CEN/WS 64-II; their review by the concerned AFCEN subcommittees; the formal return to CEN/WS 64-II; and thereafter CEN/WS 64-II consideration of the AFCEN review.

In addition to the harmonisation work on codes, it was considered that some R&D subjects could be identified as vital for the development of certain rules in a possible future European code. In this respect and with a view to providing input to the EC innovation programme, the elaboration of R&D programme proposals was also considered in the business plan.

This CEN/WS 64 II CWA (CEN Workshop Agreement) consists mainly of the Code Evolution proposals and the R&D programme proposals.

I. Scope and achievements

Taking the RCC M, RCC MRx and RCC CW AFCEN codes as a starting point, CEN/WS 64 II undertook to explore a generic pattern to “Europeanize” the codes so that they could be adopted for any nuclear project in the EU, primarily for new builds but also potentially for improvement and life extension of existing nuclear facilities. The domains covered by CEN/WS 64 II included mechanical equipment for GEN II-III reactors; mechanical equipment for GEN IV reactors; and civil works for all kind of nuclear facilities. The work was organized accordingly and undertaken by three CEN/WS 64 II working groups, namely PG1 (mechanical equipment for GEN II-III reactors), PG2 (mechanical equipment for GEN IV reactors) and PG3 (civil works).

For the Code Evolution proposals, CEN/WS 64 II adopted an interactive process with AFCEN, as follows:

- Elaborating code evolution recommendations through technical debates within expert groups, in consideration of cases not currently taken into account in the codes, such as the integration of new materials or practices or designs and improvements of safety, etc. or methodology.
- Submitting these recommendations to AFCEN for review in the framework of its specialised subcommittees and evaluation of the feasibility (including time required) of their being taken into account in the codes. On this basis, AFCEN gives a formal answer to the Workshop on its recommendations.
- Evaluating the answers made by AFCEN.

Prior to the implementation of the process, a phase of code knowledge attainments for the experts was scheduled in the CEN/WS 64 II business plan. Consequently, the whole process duration became properly understood and was planned accordingly.

In addition to this code evolution process and as already indicated, CEN/WS 64 II intended to identify possible R&D programmes of generic concern in support of the recommended evolutions, thereafter transmitting the proposals to EC Directorate General Research and Innovation (DG RTD) with a view to their being incorporated into the EURATOM R&D Work Programmes.

[2] CEN/WS 64-II Business Plan. Retrieved 19 April 2018 from ftp://ftp.cencenelec.eu/CEN/WhatWeDo/Fields/Energy/Nuclear/WS64_BP_final.pdf.

CEN/WS 64 II was primarily conceived to address medium and long term code evolutions and the associated R&D needs. However, the possibility to propose direct code amendments or extensions, as well as R&D projects, was open and provided the opportunity to address short or medium term needs as well.

A large number of topics have been addressed, including plant life management (PLM) and design for long-term operation (LTO), environmental degradation mechanism and guidelines for quality assurance.

Some recommendations for code modifications have been proposed by CEN/WS 64 II to AFCEN. These have been and/or continue to be examined by AFCEN and responses have been communicated accordingly.

The R&D proposals sent to DG RTD will be promoted through the implementation plan for the next decade of the SET-Plan established by the EC. In this respect, the importance of CEN/WS 64 II for the SET-Plan implementation has been acknowledged by the introduction of SET-Plan action n°10, entitled “Maintaining a high level of safety of nuclear reactors and associated fuel cycles during operation and decommissioning, while improving their efficiency”. Further, the key outcomes of CEN/WS 64 II were presented at the final SET-Plan Workshop.

This CWA compiles medium and long term recommendations for the evolution of the codes taken as pilot cases, namely RCC M, RCC MRx and RCC CW, as well as associated R&D needs. The CWA was subject to the usual review and balloting procedures, the results and comments of which are included as an appendix.

The CWA is completed with comments and appreciation by the Chairman, the Vice-Chairman and the conveners of the working groups on the work done and the role of AFCEN, noting that the late recommendations that could not be submitted to AFCEN or to which AFCEN has not had sufficient time to answer are included.

II. Terms and definitions

Nuclear codes: Compendiums of rules for the design, construction and in-service inspection of nuclear power plants (or more generally nuclear installations) equipment. They usually cover one specific aspect: mechanical equipment, electrical equipment, civil works, etc.

Licensee: Operating organization or individual authorized to operate a nuclear facility or conduct a nuclear activity.

Nuclear safety: Set of measures taken in nuclear facilities to protect people and the environment from harmful effects of ionizing radiation, resulting from their operation or a possible event that might lead to a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation.

Safety authority: Independent regulatory body established by the government of a country to establish or approve applicable safety objectives and requirements, and control their fulfilment.

Safety requirements: Basic dispositions to be implemented by licensees in order to achieve the fundamental safety objective.

ASCE, American Society of Civil Engineers