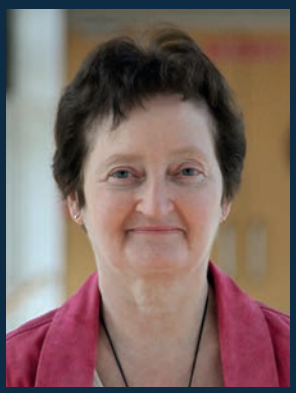
afcen

Shaping the rules for a sustainable nuclear technology

2016 ANNUAL REPORT

CONTENTS

FOREWORD BY AFCEN'S PRESIDENT



Claudie ANCELIN,
President

"In September 2016, I was appointed President of the Association by AFCEN's Board of Directors. I would like to thank them for the trust and confidence that they have shown in my abilities by confirming my new role at the helm of the Association.

On behalf of the Association, I would like to express our sincerest gratitude to the outgoing team for the tremendous work that they have accomplished over the last six years.

I am clearly impressed by the determination and commitment that this team has demonstrated in transforming AFCEN to better address the challenges of an increasingly international industry and of the digitized world, which in turn greatly benefits all AFCEN code users.

Throughout my presidency, AFCEN will remain true to its mission of establishing technical rules reflecting on-the-ground practices, feedback from industry and the latest knowledge in a bid to guarantee the superior level of quality and safety required for operating nuclear reactors. We will broaden the range of activities covered by our collaborative efforts around the world. We will step up AFCEN's ambitions and actions to help its members move forward with their industrial projects. There will be no shortage of challenges. We will need to gather the support and engagement of the entire international nuclear community.

Above all, our capacity for action can be credited to the ambition of all AFCEN members to join forces and work together in raising the bar on the quality, safety and competitive advantage of nuclear projects and facilities around the world.

I look forward to meeting many of you at the AFCEN Annual Congress between February 28 and March 2, 2017 in Lyon, France. I also hope to see you take part in the Association's different work meetings throughout 2017.

By becoming an AFCEN member and joining our working groups, you will be taking part in a forward-looking "collaborative development" strategy driven by its dedicated and passionate members and experts.

On behalf of all our members, it gives me great pleasure to present the 2016 AFCEN Annual Report. This report paints a clear picture of the many achievements and events that our Association has organized and supported over the previous year.

AFCEN's seven codes represent an exceptional asset that leverages the technical expertise and feedback that have been acquired over more than 40 years from manufacturing reactor equipment and also building and operating over 100 nuclear reactors around the world."

SIGNIFICANT EVENTS OF 2016

In 2016, AFCEN published three new editions of its mechanical and civil engineering codes.

In 2016, AFCEN released a new edition of the RCC-M, RSE-M and RCC-CW codes.

. The 2016 edition of RCC-M heralds a milestone in the work program focusing on the French ESPN Regulation (Nuclear Pressure Equipment). This edition also incorporates major changes about the fatigue of austenitic stainless steels, welding and inspections.

. A new 2016 edition of RSE-M has also been released. The last edition dated back to 2010. This new improved edition offers a more accessible reading and is suitable for use on EPR projects (FLA3).

. The 2016 edition of RCC-CW goes into greater detail on the anchoring systems presented in the 2015 edition, which itself marked a major editorial improvement on the 2010 and 2012 version of the ETC-C code.

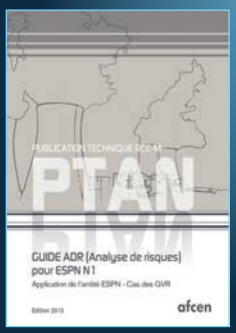
In 2016, AFCEN also released four technical publications on the application of the RCC-M code in accordance with the French ESPN Regulation.

EDITION 2016 OF RCC-M

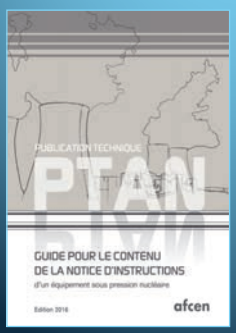
EDITION 2016 OF RSE-M

EDITION 2016 OF RCC-CW

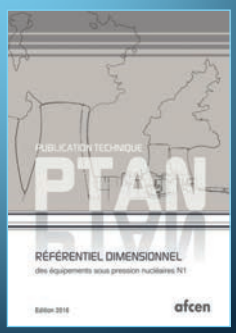
2016 NEW PUBLICATIONS



PTAN
RCC-M 2016 - 1
ANALYSE
DE RISQUES



PTAN
RCC-M 2016 - 2
GUIDE NOTICE
D'INSTRUCTIONS



PTAN
RCC-M 2016 - 3
GUIDE RDE

PTAN
RCC-M 2016 - 4
KV FAIBLES
ÉPAISSEURS

SIGNIFICANT EVENTS OF 2016

In 2016, AFCEN took part in the new build of the UK's nuclear program.

In 2016, The final investment decision which has been taken for the Hinkley Point C reactor project is very positive for AFCEN. AFCEN codes were involved in the design of the Hinkley Point C plant and are also being used for the proposed Sizewell C power station.

. From 2017 to 2012: AFCEN codes assessed by ONR (Generic Design Assessment phase)
. From 2013 to 2016: Launch of AFCEN Users Groups (RCC-M, RCC-CW)
. From 2016 onwards: New Users Groups expected: feedback expected on the use of AFCEN Codes during HPC detailed design and construction and along future projects.

ARTIST'S VIEW OF THE TWO HINKLEY POINT C UNITS

AFCEN'S CONTRIBUTION TO THE HPC PROJECT

2007

. ASSESSMENT OF AFCEN CODES
. GDA GRANTED FOR EPS
. UK COMPANIES BECOME AFCEN MEMBERS

2013

. ESTABLISHMENT OF FRAMEWORK FOR AFCEN UK USER GROUPS (AFCEN WITH NNB, SIGNED IN 2015)
. START OF RCC-M UK USER GROUP (2013, AGREEMENT WITH TWI SIGNED IN 2014)

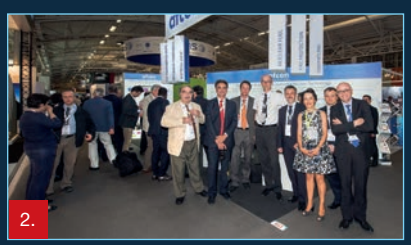
2016

. START OF RCC-CW UK USER GROUP (2016, AGREEMENT WITH AMEC UNDER PREPARATION)

In 2016, AFCEN increased its presence in the international arena in support of its industry members.

AFCEN's long list of members reflects the sheer drive of its commitment and its international development policy. The Chinese Users Groups held two meetings in 2016. In the United Kingdom, the RCC-M Users Group staged two meetings, while the RCC-CW Users Group held its first work meeting. AFCEN's stand at the 2016 World Nuclear Exhibition in Paris, France, attracted a steady stream of visitors.In 2016, AFCEN marked also its presence in Poland and India.


1.


2.


3.

4.


5.

1. ANNUAL GENERAL MEETING
2. AFCEN AT THE 2016 WNE
3. 2016 USERS GROUP IN BEIJING
4. AFCEN IN POLAND
5. AFCEN IN INDIA

SIGNIFICANT EVENTS OF 2016

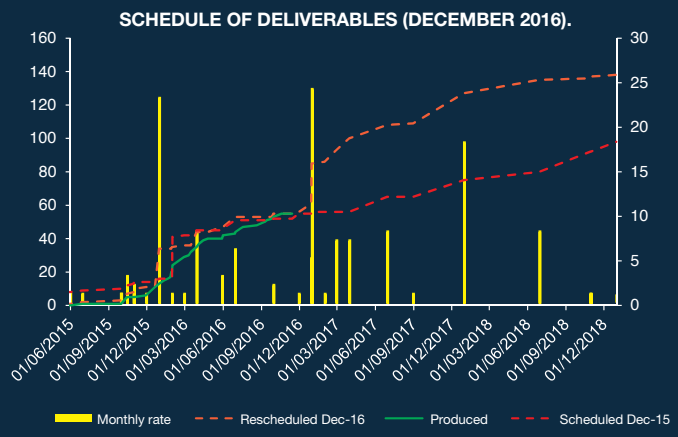
In 2016, AFCEN continued demonstrating the conformity with France's Nuclear Pressure Equipment Regulation

In 2016, as part of its program aimed at demonstrating conformity of its mechanical codes with the French Nuclear Pressure Equipment Regulation (ESPN), AFCEN incorporated a number of changes into the 2016 editions of the RCC-M and RSE-M codes, and published four guides.

The three-year work program runs from 2016 to 2018. 40% of the 136 deliverables have already been produced.

Target ESPN reference requirements 2018

. Program updated on December 2016,
. 136 deliverables scheduled until end 2018,
. 23 mandates launched for RCC-M, 4 for RSE-M, 1 for RCC-E,
. 3 new mandates to be launched,
. 40% of deliverables produced,
. Acknowledgement process on progress,
. Commitment of AFCEN members to be continued.



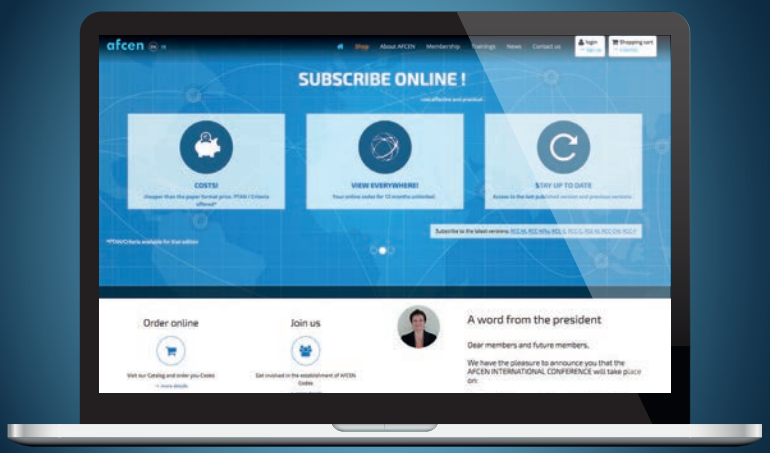
In 2016, AFCEN strengthened its organizational structure and improved the sale of its electronic publications

In 2016, AFCEN amended its publishing strategy to offer discounts to members according to the number of documents and the length of their subscription plan.

AFCEN also renewed its ISO 9001 certification in 2016.

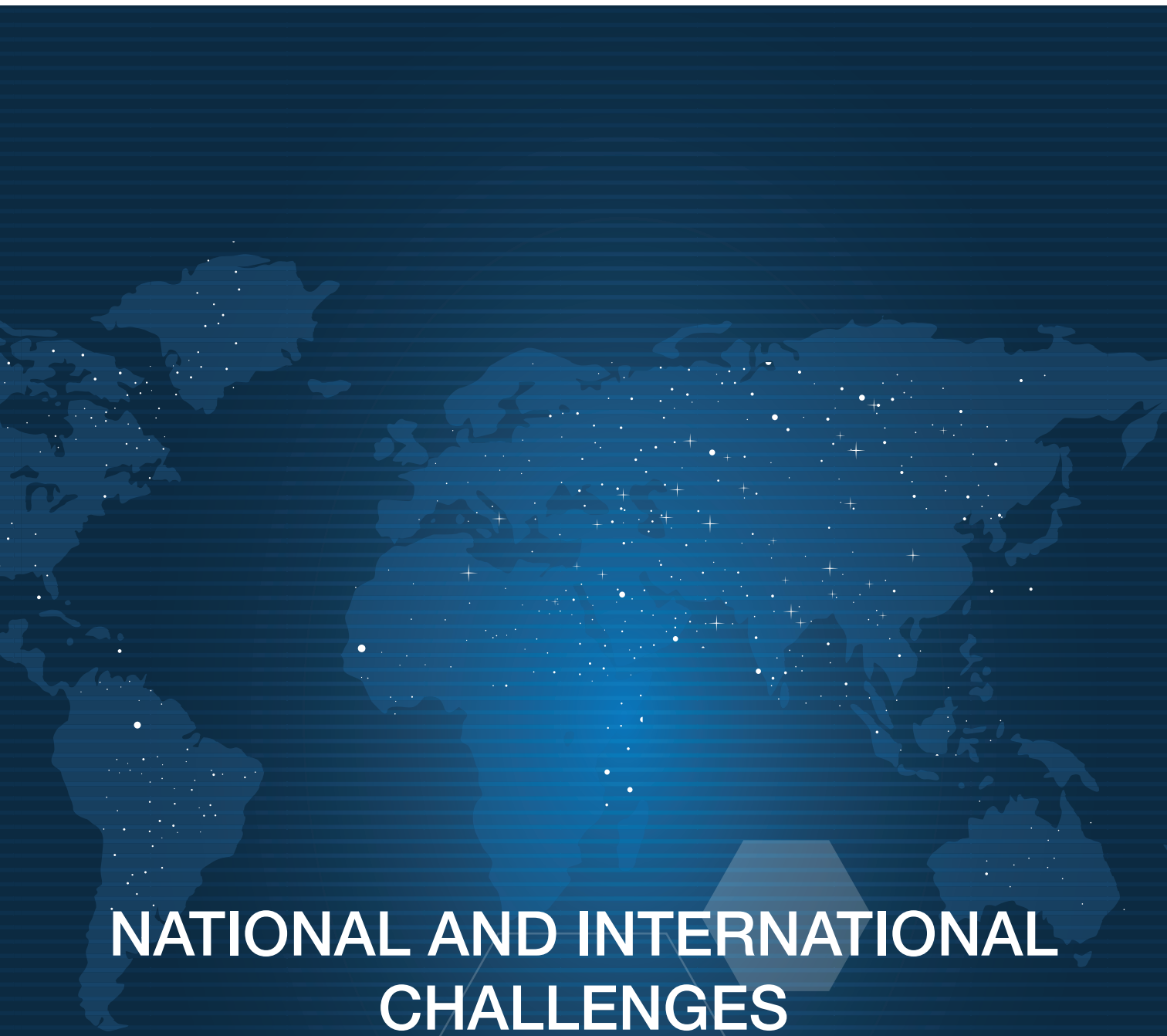
In 2016, AFCEN extended its training catalog to cover all codes and made its courses available to international members.

ISO 9001 CERTIFICATION



afcen

Shaping the rules for a sustainable nuclear technology



NATIONAL AND INTERNATIONAL CHALLENGES

1

1.1 USE OF AFCEN CODES AROUND THE WORLD

AFCEN codes are used as reference for nuclear components in over 100 power plants currently in operation (92), under construction (21) or in planning stages (7) around the world.

Since 1980, AFCEN codes have served as basis for the design and fabrication of specific Class 1 mechanical components (vessels, internals, steam generators, primary motor pump units, pressurizers, primary valves and fittings) and Class 2 and 3 components, and electrical components for France's last 16 nuclear units (P'4 and N4) as well as for the construction of nuclear civil engineering works in South Africa (Koeberg) and Korea (Ulchin). These reactors actually represent the first applications of AFCEN's codes. AFCEN codes were subsequently used to design, build and operate the Daya Bay and Ling Ao power plants in China.

The table hereafter summarizes how the different AFCEN codes are used around the world during the planning, design, construction and operation of the concerned reactors.

Project	Country	States of the reactors			Number of reactors	Number of reactors that are using or have used AFCEN codes		Codes used				
		P	C	E		for design and/or construction	before commissioning and/ or for operation	RCC-M	RSE-M	RCC-E	RCC-CW	RCC-C	RCC-F	RCC-MRx
Nuclear infrastructure	France			58	58	16	58	C, E	E	C, E	C, E	C, E		
CP1	Afrique du Sud			2	2	2		C			C			
	Corée			2	2	2		C			C			
M310	Chine			4	4	4	4	C, E	E	C, E	C			
CPR 1000 & ACPR1000	Chine		8	20	28	28	28	C, E	E	C, E	C			
CPR 600	Chine			6	6	6	6	C, E	E	C, E	C			
EPR	Finlande		1		1	1		C						
	France		1		1	1	1	C, E	E	C	C	C	C	
	Chine		2		2	2	2	C, E	E	C	C	C	C	
	UK	2	2		4	4	4	C, E	E	C	C	C	C	
HPR1000	Chine	2	4		6	6	6	C	E	C		C	C	
	UK	2			2	2		C	E	C		C	C	
PFBR	Inde		1		1	1								C
Jules Horowitz Reactor	France		1		1	1								C
ITER	France		1		1	1								C
ASTRID	France	1			1	1								P
		7	21	92	120	78	109							

SUMMARY OF THE USE OF AFCEN CODES AROUND THE WORLD

In addition to these formal applications of the codes and given their reputation, AFCEN codes have also served in France for designing many other nuclear research facilities and equipment, despite not being official standards.

Examples include:

. The design of certain mechanical components and specific civil engineering works in nuclear research facilities: Institut Laue-Langevin, Laser Mega Joule and European Synchrotron Radiation Facility.

. The design of nuclear steam supply systems for marine propulsion.

1.1.1 France

Nuclear power plants

AFCEN codes have gradually been used by France's nuclear industry with 1,300 MWe reactors: Cattenom 2 (first vessel manufactured with RCC-M) and Flamanville 2 (first steam generator and first pressurizer manufactured with RCC-M).

The RCC-M, RSE-M, RCC-C and RCC-E codes are used for the operation of all of France's nuclear power plants.

EPR

AFCEN codes serve as basis for licensing of the EPR project in France. The RCC-M (2000 edition + addenda), RSE-M (2010 edition), RCC-C (2005 edition + addenda) and RCC-E (2005 edition) codes are used.

Jules Horowitz Reactor

For the Jules Horowitz research reactor currently undergoing construction at the Cadarache site, the RCC-Mx code (predecessor to RCC-MRx) was chosen for designing and manufacturing the mechanical components that fall within the code's scope, i.e.:

. mechanical equipment with a sealing, partitioning, securing or supporting role,

. mechanical equipment that may contain or allow the circulation of fluids (vessels, tanks, pumps, exchangers, etc.) and their supporting structures.

For experimental facilities, application of the RCC-Mx code is recommended, but not mandatory.

ITER

ITER used the 2007 version of the RCC-MR code as a reference for its vacuum vessel and blanket cooling pipes. This code was chosen for the vacuum vessel on both technical grounds (the equipment and technology are covered by the code) and regulatory grounds (the code is adapted to French regulations).

OTHER USES OF AFCEN CODES

Nuclear marine propulsion in France

The construction of nuclear marine propulsion equipment, which is the responsibility of the DCNS Group (generally concerning the key equipment for the main primary and secondary systems), is based on a specific technical standard that refers to the RCC-M code for design. Standardization and fabrication conform to internal rules, which are technically highly similar to those of the RCC-M code.

This specific organization is related to the history of nuclear propulsion: this industry's expertise was long ago documented as a series of instructions and procedures, which have gradually been improved through feedback and external standardization. In particular, when the RCC-M code was published, the DCNS Group endeavored to bring its own rules into alignment with the code, and ensure overall consistency in terms of the design and fabrication process, while maintaining the specific features of marine propulsion equipment (dimensions, accessibility and dismantling difficulties, stress resistance requirements for equipment in military-type applications, radiation protection requirements due to the crew's constant proximity, etc.).

1.1 USE OF AFCEN CODES AROUND THE WORLD

1.1.2 China

AFCEN codes are widely used in China for the design, construction, preliminary inspection and in-service inspection of Chinese Generation II+ nuclear power plants (based on developments of the M310 technology introduced from France) and Generation III reactors (especially EPR units).

The decision to use AFCEN codes for Generation II+ nuclear projects in China is itself specified by a decision taken by the Chinese Safety Authority (NNSA) in 2007 (NNSA Decision n° 28).

By the end of 2016, 44 of the 56 units in operation or under construction in China were using AFCEN codes, with 30 in operation and 14 under construction. These units correspond to the M310, CPR-1000, ACPR-1000, HPR-1000, CPR-600 and EPR projects highlighted in blue in the table below.

During 2016:

. Work has started on the construction of one new reactor: one HPR-1000.

. Five reactors, all of which designed according to AFCEN codes, have been commissioned.

Type of reactor	Units in operation (no.)	Units under construction (no.)	Total number
300 MWe	Qinshan I (1)		1
M310	**Daya Bay (2)** **Ling'Ao (2)**		**4**
CPR1000 & ACPR1000	**Ling'Ao (2)** **Hongyanhe (4)** **Ningde (4)** **Yangjiang (3)** **Fangchenggang (2)** **Fuqing (3)** **Fangjiashan (2)**	**Hongyanhe (2)** **Yangjiang (3)** **Fuqing (1)** **Tianwan phase III (2)**	**28**
HPR 1000		**Fuqing (2)** **Fangchenggang (2)**	**2** **2**
CPR600	**Qinshan II (4)** **Changjiang (2)**		**6**
CANDU 6	Qinshan III (2)		2
AP1000		Sanmen (2) Haiyang (2)	4
EPR		**Taishan (2)**	**2**
AES-91	Tianwan (2)	Tianwan (2)	4
HTR-PM		Shidaowan (1)	1
Total number	**35**	**21**	**56**

LIST OF REACTORS CURRENTLY UNDER CONSTRUCTION OR IN OPERATION IN CHINA AS OF LATE 2016
(REACTORS HIGHLIGHTED IN BLUE ARE THOSE USING AFCEN CODES)

1.1.3 India

PFBR and FBR

The 2002 edition of the RCC-MR code is being used to design and manufacture the major components of India's PFBR reactor (Prototype Fast Breeder Reactor). The 2007 edition of the code is serving as a baseline for the FBR 1 and 2 projects. Feedback from the construction of the PFBR reactor is being incorporated into subsequent versions of the code and the RCC-MRx code, which replaces RCC-MR.

INDIAN PFBR REACTOR

1.1.4 United Kingdom

AFCEN's ambitions for the United Kingdom are tied to the development of EPR projects, starting with the two reactors at Hinkley Point C site (HPC) and two other plants at Sizewell C.

The future operator (NNB: Nuclear New Build) has chosen the following AFCEN codes for designing and building the reactors at HPC and also Sizewell C (based on the same technical choices):

. RCC-M 2007 edition + addenda,

. RCC-E 2005 edition (this edition is used for the GDA),

. ETC-C 2010 edition,

. ETC-F 2013 edition,

. RCC-C 2005 edition (this edition is used for the GDA), but the 2015 edition for the first fuel refills.

NNB has decided to use the 2010 edition of the RSE-M code for monitoring in-service mechanical components, while adapting certain rules to meet the context and operational requirements specific to the United Kingdom.

The project to build a reactor featuring Chinese technology (UK HUALONG) is undergoing the GDA process in the UK (Bradwell B). The design of this project is mainly based on a reactor that is currently being built in China according to AFCEN codes (Fangchenggang 3).

1.1 USE OF AFCEN CODES AROUND THE WORLD

1.1.5 Finland

For Finland's Olkiluoto 3 project, mechanical equipment from the highest safety classes (classes 1 and 2) are being designed and manufactured according to one of the three nuclear codes (RCC-M, ASME Section III and KTA). The RCC-M code was chosen as reference for designing and fabricating the main mechanical components, such as the vessel, pressurizer, steam generators, primary circuits, pressure relief valves and severe accident valves.

1.1.6 South Africa and South Korea

The first AFCEN codes were drafted in the 1980s for exports based on feedback from the CP1 design for 900 MWe class PWRs in France.

The first exported CP1 900 MWe class PWR was built in Koeberg, South Africa, and subsequently in Ulchin, South Korea. The RCC-M code has been used in South Africa and South Korea for mechanical engineering works. In terms of civil engineering works, the 1980 edition of the RCC-G code (RCC-CW code's predecessor) has been used for containment acceptance testing.

1.2 AFCEN'S ACTIVITIES AROUND THE WORLD

AFCEN's international activities are strongly focused on the five key objectives below:

1. Provide the nuclear industry with a working platform in each area where its codes are used, mainly Europe and China.
2. Pursue AFCEN's development around the world: Asia (China and India), the European Union (United Kingdom, Poland, Czech Republic, etc.), South Africa and the Middle East.
3. Build on the industrial practice of international users (the United Kingdom and China in particular) and the technical instructions relating to the licensing of projects that have used AFCEN codes as a reference (GDA UK, for example).
4. Be listening to the expectations of the international nuclear community.
5. Continue the policy of comparing AFCEN codes with the other nuclear codes within MDEP (Multinational Design Evaluation Program) and CORDEL (Cooperation in Reactor Design, Evaluation and Licensing).

1.2.1 France

Relationship with France's nuclear Safety Authority

With respect to AFCEN's relationship with France's nuclear Safety Authority, two points deserve a mention:

1. A progress report on the program aimed at demonstrating conformity of the RCC-M and RSE-M codes in France with the French Nuclear Pressure Equipment Regulation (ESPN) is regularly presented to ASN under the responsibility of AFCEN's Editorial Committee and attended by the relevant AFCEN members. This program is described in a frequently updated document that is shared with ASN (last revision: December 2016).
2. AFCEN's senior management meets the nuclear Safety Authority's executives every two years.

For instance, on January 5, 2017, AFCEN's Board of Directors was received by ASN's Chairman, the Directorate-General, the Nuclear Pressure Equipment Department (DEP) and its supporting body the French Institute for Radiation Protection and Nuclear Safety (IRSN).

Discussions were organised on two key topics:

. a review of the significant achievements in 2014 – 2016,

. a sharing on AFCEN's strategic directions for its publication activities and its international development.

The talks covered the progress of the ESPN program, the challenges of defining codes in France and Europe, and the value of comparing nuclear codes on a global scale.

In conclusion, ASN encouraged AFCEN to continue down the internationalization road and to continue to support the users of its codes. ASN measured the technical achievements and developments accomplished since 2014.

1.2 AFCEN'S ACTIVITIES AROUND THE WORLD

CSFN

In 2015, the CSFN (Strategic Committee of the Nuclear Industry) compiled a list of all professional entities in France (associations, clusters, platforms, etc.) specializing in or involved in the nuclear industry.

The CSFN subsequently created its own working group entitled "International Codes, Norms and Standards" (CNSI), and AFCEN has been an active contributor since July 2015. The group's operational agenda is clearly on the same page as AFCEN's own strategic directions and objectives, namely:

. promote its nuclear industry rules of practice around the world,

. develop local platforms for producing codes in the high-potential countries represented by AFCEN members (e.g. China),

. effectively incorporate the needs of all its members, particularly small and medium-sized enterprises.

AFCEN biennial congress

AFCEN held its last congress in Paris on March 24, 25 and 26, 2015. The congress was attended by 230 participants from across Europe, the United States and Asia to address issues relating to the use of the different codes published by AFCEN and their development at both the national and international levels.

AFCEN's next congress will be held in Lyon between February 28 and March 2, 2017.

1.2.2 European Union

In keeping with its international development strategy, AFCEN launched an exercise in "Europeanizing" a code in 2009 as part of a CEN workshop (WS 64).

The workshop used the case of RCC-MRx to prompt European partners to propose code modifications that would serve their projects. The workshop issued a stream of modification proposals, 20 of which were considered to have sufficient justification for inclusion into the code and constituted the workshop agreement. They were added to the 2012 edition of the code.

Based on what was considered a positive feedback by all partners, a continuation of the CEN Workshop was launched in 2014 to investigate the potential needs for creating a code for mechanical and civil engineering works for Gen II to Gen IV nuclear facilities. Workshop members submitted several proposed changes to the RCC-M, RCC-CW and RCC-MRx codes to AFCEN, which are currently being examined within the relevant Subcommittees.

This activity is in line with the general goal of harmonizing industry practices promoted by the European Commission's Directorate-General for Energy, which has lent its support accordingly. For more information, refer to Section 3.2.3.

1.2.3 China

Background

AFCEN's ties with China can be traced back to 1986 with the construction of the two Daya Bay 900 MW units in the Guangdong province of southern China. At that time, the power plant was based on the Gravelines 5/6 plant design.

AFCEN codes became increasingly widespread in China and gathered pace in 2007 when the Chinese Safety Authority (NNSA) imposed their use (via "Decision no. 28") for Generation II+ nuclear projects. This requirement prompted the CGN Group to translate the available editions of the codes following authorization from AFCEN between 2008 and 2012, and this initiative was strongly supported by various governmental organizations (NEA, NNSA, CMIF etc.).

In 2008 and 2013, Chinese users adopted the codes: technical seminars were organized between AFCEN and the codes main users, with discussions to clarify and interpret several aspects of the codes (several hundreds of interpretation requests).

To provide a coordinated response to such a high demand, several agreements and MOUs (memoranda of understanding) were signed in 2014, especially with CGN and CNNC, the two largest nuclear operators, as well as with CNEA, the largest association in China's nuclear industry (featuring operators, engineering firms, manufacturers, and so on). In 2014, these partnerships led to the creation of Chinese Users Groups and the first technical seminar between AFCEN and CNEA, which focused on regulations, codes and standards, qualification of equipment, I&C, etc.

Chinese experts strengthened their relationship with their French counterparts in 2015 by holding several technical sessions (Chinese Specialized Users Groups or CSUGs) to discuss the contents and interpretation of the codes, as well as a seminar with CNEA.

Activities in 2016

As of December 31, 2016, 30 plants in operation and 14 plants under construction were using or had used (during construction) AFCEN codes in China.

In 2016, AFCEN's main actions relating to activities in China were as follows:

a. During its General Meeting at the end of March in Paris, AFCEN received a Chinese delegation from NEA (National Energy Administration), CGN, CNNC and industrial groups. This delegation took part in AFCEN Subcommittee meetings and the welding workshop. Delegates visited the reprocessing plant in La Hague (France) and the Flamanville 3 EPR site (France).

b. In April, May and subsequently in October 2016, further meetings were held between AFCEN's experts and members of the Chinese Specialized Users Groups (CSUGs) in Wuhan, Chengdu and Beijing. AFCEN's experts and their counterparts continued discussing the content and interpretation of all the codes, as well as their use in China.

The different meetings were attended by several dozens of Chinese experts from engineering firms (particularly CGN and CNNC), industry and China's Safety Authority.

To coincide with the October sessions in Beijing, the CSUG Steering Committee held a meeting attended by NEA, NNSA (Chinese Safety Authorities) and AFCEN's new President, Claudie Ancelin. The parties considered the outcome of the expert meetings to be positive. The NNSA representative underlined that the work accomplished helped improve safety.

1.2 AFCEN'S ACTIVITIES AROUND THE WORLD

c. Talks continued with NEA in 2016 to forge a long-term cooperative arrangement between AFCEN and China's nuclear industry on nuclear codes and standards, following a joint statement released by the Chinese and French governments in June 2015 in Paris:

"China and France encourage cooperation in terms of harmonizing nuclear codes and standards, and wish to step up the cooperative ties between AFCEN, ISNI [Institute for Standardization of Nuclear Industry, CNNC Group] and SNPI [Suzhou Nuclear Power Research Institute, CNG Group], which will be conducive to reinforcing the good lessons learned on an international level from the experience acquired in the French and Chinese nuclear industries. The uptake, consultation and use of the respective standards by both parties will be supported to improve reciprocal recognition of French and Chinese standards."

d. The Chinese-language course on the RCC-M standard, which was subject to an agreement between SNPI and AFCEN, was approved in 2016. This is the first Chinese-language course officially approved by AFCEN's bodies.

e. AFCEN participated in the seminars organized by APAVE in Beijing and Shanghai on the opportunity of using codes to qualify equipment and more specifically for the Hinkley Point C project in the United Kingdom.

RCC-M FORMATION

Outlook for AFCEN in China in 2017

In 2017, AFCEN will pursue its policy of developing cooperation on codes and standards, and will continue honouring its commitments towards its Chinese partners. The main milestones and prospects are as follows:

a. Following the ratification of the first Chinese-language course on the RCC-M code, AFCEN and its partners will investigate the prospect of extending the approach to encompass other AFCEN codes.

b. Participation of AFCEN's Chinese members in the 2017 Congress, including the Subcommittee meetings and technical breakout sessions.

c. Organize meetings of the Chinese Specialized Users Groups to promote dialog on the use of AFCEN's codes in China, while encouraging technical discussions with particular emphasis on clarifying and interpreting specific aspects of the codes.

d. Hold a third CNEA-AFCEN Chinese-French seminar on feedback from the nuclear industry, spurred on by the rich discussions and success of the first two events.

e. Continue fostering cooperative ties with NEA in a bid to lay the foundations for a long-term cooperative arrangement.

f. Promote the use of the new editions of the AFCEN codes.

1.2.4 United Kingdom

Background and general objectives

AFCEN codes are being used in the United Kingdom as a reference for the design, construction and in-service inspection of the following PWR reactor projects:

. Hinkley Point C (HPC): two EPR units (for the detailed design and construction phases),

. Sizewell C: two EPR units (for the project design phase - identical design to HPC),

. Bradwell B: two HPR-1000 units ("UK Hualong", undergoing GDA).

The EPR design passed the GDA in the United Kingdom in 2013, and the AFCEN codes were approved by the British Safety Authority (ONR – Office for Nuclear Regulation). The final investment decision (FID) for the HPC project was taken in September 2016, paving the way for engineering and construction of the power plant. There are plans to build two reactors at the Sizewell C site based on the same design as the two HPC units.

The reactors' future operator (NNB – Nuclear New Build) is liaising with the Safety Authority. Outstanding issues are being examined according to AFCEN codes for mechanical components (RCC-M 2007 edition + 2008-2010 addenda), electrical equipment (RCC-E 2005 edition), civil engineering works (ETC-C 2010 edition) and fire protection (ETC-F 2013 edition). NNB has decided to use the RSE-M code for monitoring in-service mechanical components, while adapting certain rules to meet the context and operational requirements specific to the United Kingdom. The group of independent experts, which NNB commissioned to address ONR's concerns about the code, endorsed the methods for analyzing the impacts of defects detected during operation (Appendix 5.4, also used during the design phase) against current practices in the United Kingdom (R6 Rules).

The project to build a reactor featuring Chinese technology (UK HUALONG) is undergoing the GDA process in the UK (Bradwell B). The blueprint for this project is mainly based on AFCEN codes. The GDA for this reactor will take advantage of the lessons learned from the EPR project using AFCEN codes.

1.2 USE OF AFCEN CODES AROUND THE WORLD

Furthermore, dissemination of AFCEN's code culture within British industry is essential for simplifying understanding and use of the codes in projects and potentially aligning them with local regulations and industry practices.

With this aim in mind, the AFCEN code Users Groups (UK Users Groups) comprise the companies concerned and representatives from NNB and AFCEN, with a Steering Committee responsible for overseeing all groups and led by NNB. They provide industry with a working platform and have the following missions:

. facilitate uptake of AFCEN codes among industry and partners (designers, manufacturers, contractors, suppliers and consultants) by minimizing discrepancies caused by poor interpretation of the codes early into the project,

. determine training needs and facilitate appropriate solutions,

. establish effective communication channels with AFCEN's Subcommittees,

. collect users' requests and proposals (interpreting and modifying codes, drafting guides or appendices specific to the local context if necessary), building on industrial practices and making AFCEN codes even more robust.

Activities in 2016

The RCC-M Users Group has been coordinated by TWI (The Welding Institute) since 2013. This group currently has approximately 20 members representing manufacturers, engineering firms, consultants, inspection and training organizations, institutes, and so on. The group held sessions in 2013, 2014 (three times), 2015 (once) and 2016 (twice). During each session, AFCEN's experts and the group's corporate members share their views on a technical issue mainly concerning materials and fabrication, while also discussing quality and technical requirements (such as for pressure equipment). The group also aims to carry out an in-depth analysis of the code, particularly in relation to British regulations and practices, by organizing training initiatives, running workshops on specific topics and producing guides.

Plans to create an RCC-CW Users Group were confirmed in 2016. The inaugural session was attended by a dozen members in November 2016. The group is led by AMEC Foster Wheeler. An AFCEN-AMEC FW cooperation agreement will be formalized in February 2017.

The creation of an RCC-E Users Group is still under study.

The RCC-F code already has a UK-specific appendix to incorporate British fire protection regulations, but there are no plans to create a Users Group for this code.

1.2.5 Poland

On September 27 and 28, 2016, AFCEN organized the sixth code briefing session and forum at the French Embassy in Warsaw. The RCC-E and ETC-F codes were the focus of this new session.

During this sixth session, which was attended by approximately 20 participants, experts from AFCEN's members (including NUVIA, Effectis, ITB Poland, EDF and AREVA) shared their experiences with Polish representatives from the Ministry of Energy, the nuclear Safety Authority (PAA), the National Center for Nuclear Research (NCBJ), UDT (Office of Technical Inspection) and several industrial firms who had enrolled their engineers and technicians.

1.2.6 India

AFCEN travelled to the India Nuclear Energy show in Bombay on October 20 and 21, 2016 and met with companies operating in India's nuclear industry.

AFCEN has already forged ties with India's nuclear industry, especially through the use of the RCC-MR code (predecessor of the RCC-MRx code) during the design of the PFBR (Prototype Fast Breeder Reactor), which is currently undergoing construction in Kalpakkam.

In 2017, AFCEN is determined to pursue its policy of developing cooperation with India.

afcen

Shaping the rules for a sustainable nuclear technology

EDITORIAL ACTIVITY REVIEW

2

2.1 CODES AND OTHER EDITORIAL PRODUCTS

2.1.1 AFCEN's editorial activity

AFCEN's editorial activities involve authoring and updating codes.

In a number of cases, preliminary technical studies are required before codes can be revised. Such studies are performed as part of a collaborative effort.

Finally, AFCEN produces code-related documents:

. criteria, which present the reasons for the choices in the code,

. guides, which explain how to use the codes, especially according to applicable legislation.

2.1.2 AFCEN codes

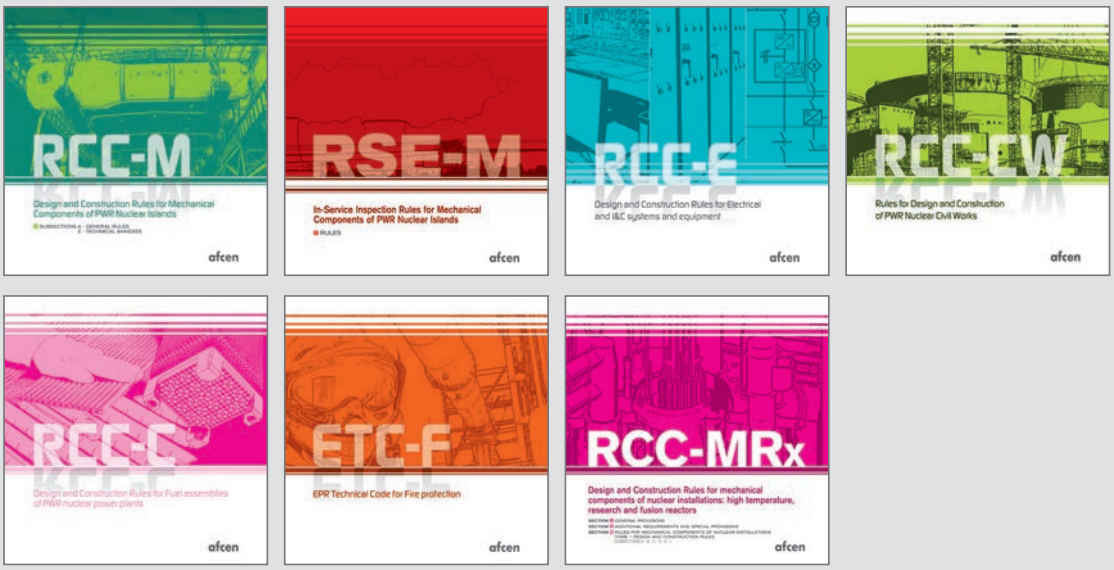
AFCEN's design and construction codes are generally prefixed with RCC-, while the in-service code is prefixed with RSE-.

In some cases, codes can only be used on the EPR design, in which case the code is prefixed with ETC-. This prefix is likely to be superseded by RCC-.

AFCEN currently publishes seven codes, including five RCC- codes, one RSE- code and one ETC- code.

Preparation of an eighth code for the deconstruction of nuclear facilities is currently under discussion. A working group led by an AFCEN member produced a draft in 2016. Further work will be required before a Subcommittee can be created.

THE SEVEN CODES CURRENTLY PUBLISHED BY AFCEN



2.1.3 Codes updates

There are several reasons for updating AFCEN codes: the need to incorporate feedback, R&D work, changes to legislation and standards, and extension of the subject matter covered by the codes.

Incorporation of feedback

Incorporating feedback is a major reason for updating codes. Several examples will be provided in the following sections which describe each of the codes, but one notable example is the change to the "Liner" chapter in the RCC-CW code to reflect feedback from the Flamanville 3 plant.

New developments, scientific breakthroughs and R&D work

These also represent major reasons for updating the codes.

For example, the 2016 edition of the RSE-M code has been updated to describe the loading history effect on the resistance to the cleavage brittle fracture of RPV steel by taking account of the warm pre-stressing phenomenon (WPS) as well as the associated criteria that were proposed and which are currently being defined within a probationary phase rule (RPP).

To drive the continual improvement process, AFCEN is involved in a R&D focus group on a European level for three codes (RCC-M, RCC-CW and RCC-MRx), with the aim of producing proposals for Gen II-III mechanical engineering, Gen IV mechanical engineering and civil engineering works (see Section 3.2.3).

Regulatory changes

Changes to regulations in the various countries in which the codes are used constitute a major reason for updating the codes.

For example, efforts are being made to ensure that the mechanical codes can be applied to guarantee compatibility with the essential safety requirements of French regulations governing nuclear pressure equipment (ESPN Regulation).

Depending on the type of change, regulatory-related modifications are either introduced into the body of the text or as an appendix specific to the country in question.

For instance, AFCEN's work on France's Nuclear Pressure Equipment Regulation will either lead to modifications to the body of the code (such as the toughness of low-thickness materials), or the creation of a French appendix.

Changes in standards

AFCEN codes are updated to reflect changes to the standards on which they are based. ISO international standards are the first to be called when available. Otherwise, European EN standards are used.

AFCEN regularly analyzes the standards to determine whether any revisions have been made and updates the codes accordingly (see Section 3.1).

For example, RCC-M was updated in 2014 to introduce the new ISO 9712 standard for the qualification of non-destructive testing personnel, while the 2016 edition of RCC-CW incorporates the recent changes to EN 1992-4.

Extensions of the subject matter

AFCEN codes may be revised if the subject matter is extended.

One example is the future inclusion of a new chapter in the 2017 edition of RCC-M to cover the qualification of mechanical components under accidental conditions.

2.1 CODES AND OTHER EDITORIAL PRODUCTS

2.1.4 AFCEN's technical publications (PTAN): studies, criteria and guides

PTAN: AFCEN's technical publications

AFCEN's Technical Publications (PTAN) include its published studies, criteria and guides.

Studies

AFCEN may carry out code-specific studies. Such studies may be aimed at reviewing industry best practices before requirements are integrated into the code.

The following publication for civil engineering is just one example: "French experience and practice of seismically isolated nuclear facilities".

Studies may also focus on several codes at the same time.

They may describe how AFCEN codes are drafted or the technical interfaces between codes (anchoring systems, penetrations, materials, etc.).

Other examples include updating codes in the wake of the Fukushima accident, introducing IAEA GS-R-3 safety requirements into the codes, and introducing the qualification of mechanical components under accidental conditions into RCC-M in line with RCC-E...

Criteria

AFCEN is strongly committed to explaining the key reasons underlying the rules in its codes. Therefore, AFCEN aims to publish documents called criteria for each code to clearly explain the reasons for the choices made when preparing the code.

To date, criteria have been published for the RCC-M code and Appendix 5.5 of the RSE-M code.

Guides

There may be grounds to produce a guide to explain how to apply the code without necessarily introducing additional requirements into that code.

For example, the following guides were published in 2016 for the fields covered by RCC-M:

. Guide specifying the contents for instructions manuals for nuclear pressure equipment.

. Risk analysis guide for N1 nuclear pressure equipment.

2.1.5 AFCEN's editorial situation

AFCEN's editorial activities in 2016 were mainly marked by the following events:

. publication of the 2016 edition of the RCC-M code,
. publication of the 2016 edition of the RSE-M code,
. preparation of the 2016 edition of the RCC-E code,
. publication of the 2016 edition of the RCC-CW code,
. preparation of the 2017 edition of the RCC-C code,
. preparation of the 2017 edition of the RCC-F code,
. preparation of the 2018 edition of the RCC-MRx code.

Furthermore, AFCEN launched a three-year work program focusing on the ESPN Regulation, with support from 17 working groups specializing in different aspects of the regulation's implementation.

Since 2016, AFCEN has been committed to releasing an annual edition for each code. The modification files approved during the year by the Editorial Committee will be incorporated into each new annual edition, meaning that addenda are no longer published.

The table below summarizes AFCEN's editorial situation and the main objectives pursued as part of AFCEN's editorial program as of late 2016.

The next table lists AFCEN's technical publications.

Appendix B contains a detailed presentation of all the codes and technical publications available for sale as of late 2016.

AFCEN'S EDITORIAL SITUATION AND EDITORIAL PROGRAM AS OF LATE 2016
(DETAILS ARE PROVIDED IN SECTIONS 2.2 TO 2.8)

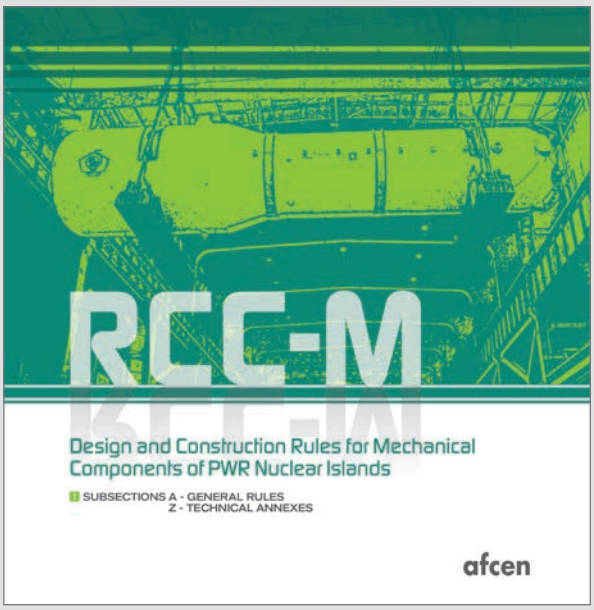
CODE		EDITORIAL SITUATION AS OF DECEMBER 31, 2016	EDITORIAL OBJECTIVES (work topics)
RCC-M	PWR mechanical components	. 2012 edition, with addenda in 2013, 2014, 2015 . 2016 edition (ESPN) . Next editions: 2017 and 2018	. Qualification of active mechanical components . Feedback of the ESPN program . Non-linear analyses . Flanged connections . Seismic design of pipelines
RSE-M	In-service inspection for PWR mechanical components	. 2010 edition, with addenda in 2012, 2013, 2014 and 2015 . 2016 edition (ESPN) . Next editions: 2017 and 2018	. Feedback of the ESPN program (2017 and 2018 editions) . Certification of non-destructive testing personnel . Stray indications . Inspection of pressure accessories and safety devices . Spare parts . New materials
RCC-E	Electrical equipment and Instrumentation and Control	. 2012 edition . 2016 edition (currently being published) . Next editions: 2019	. Feedback from the application of RCC-E 2016 . Measurement, inspection and control systems . Design extension situations . IT security
RCC-CW	Civil engineering	. ETC-C editions 2010 and 2012 . RCC-CW editions 2015 and 2016 . Next editions: 2017 and 2018	. Composite steel and concrete structures . Pile foundations . Improved reinforcement rates . Maintenance . Anchor channels . Tolerances
RCC-C	Fuel	. 2005 edition, with addenda in 2011 . 2015 edition . Next edition: 2017	. Feedback from the use of RCC-C 2015 . Fuel performance criteria . New fabrication processes and products
RCC-F	Fire	. 2010 edition, then 2013 (ETC-F) . Next edition: 2017	. Removal of the code's adherence to EPR design . Relations with safety requirements . Precision on the role of human intervention . Link with risks on conventional islands
RCC-MRx	Mechanical components for experimental reactors and fast-neutron reactors	. 2012 edition, with an addendum in 2013 . 2015 edition . Next edition: 2018	. Feedback from the RJH project . Improvements in fast fracture resistance . Improvements in progressive deformation . Ultrasonic non-destructive inspection methods . Lessons learned from the CEN/WS 64 workshop

2.1 CODES AND OTHER EDITORIAL PRODUCTS

BOX - TECHNICAL PUBLICATIONS AVAILABLE FOR SALE AS OF DECEMBER 31, 2016

Subcommittee	PTAN / Criteria / Guide
RCC-M	. CRITERIA RCC-M 2014 Prevention of damage in mechanical components. Introduction to the design, analysis and construction rules of the RCC-M (French and English) . PTAN RCC-M 2015 Radiation protection guide for the design of nuclear pressure components in PWR plants in France (French and English) . PTAN RCC-M 2016-1 Risk analysis guide for N1 nuclear pressure equipment (French) . PTAN RCC-M 2016-2 Guide to the contents of instructions manuals for nuclear pressure equipment (French) . PTAN RCC-M 2016-3 Sizing Standard Guide - Sizing standard for N1 nuclear pressure equipment (French) . PTAN RCC-M 2016-4 Toughness of low-thickness materials - Justification for exemption from pendulum impact testing for low-thickness components made from austenitic stainless steel and nickel-based alloys (French)
RSE-M	. CRITERIA RSE-M 2014 Principles of and background to the formulation of the criteria in Appendix 5.5 of RSE-M, relating to the fast fracture resistance of pressure equipment presenting an operational planar defect (French and English) . PTAN RSE-M 2016 WPS: Principle and justification for including warm pre-stressing in the criterion for the fast fracture resistance of a PWR vessel (French)
RCC-CW	PTAN RCC-CW 2015: French experience and practice of seismically isolated nuclear facilities (French and English)

2.2 MECHANICAL FIELD FOR PWR: RCC-M



THE RCC-M CODE

2.2.1 Purpose and scope

AFCEN's RCC-M code concerns the mechanical components designed and manufactured for pressurized water reactors (PWR).

It applies to pressure equipment in nuclear islands in safety classes 1, 2 and 3, and certain non-pressure components, such as vessel internals, supporting structures for safety class components, storage tanks and containment penetrations.

RCC-M covers the following technical subjects:

. sizing and design,

. choice of materials and procurement.

. fabrication and control, including:

  . associated qualification requirements (procedures, welders and operators, etc.),

  . control methods to be implemented,

  . acceptance criteria for detected defects,

  . documentation associated with the different activities covered, and quality assurance.

The design, manufacture and inspection rules defined in RCC-M leverage the results of the research and development work pioneered in France, Europe and worldwide, and which have been successfully used by industry to design and build PWR nuclear islands. AFCEN's rules incorporate the resulting feedback.

2.2 MECHANICAL FIELD FOR PWR: RCC-M

2.2.2 Use and background

Use

The RCC-M code has been used or served as a baseline for the design and/or fabrication of some Class 1 components (vessels, internals, steam generators, primary motor pump units, pressurizers, primary valves and fittings, etc.), as well as Class 2 and 3 components for:

. France's last 16 nuclear units (P'4 and N4).

. 4 CP1 reactors in South Africa (2) and Korea (2).

. 44 M310 (4), CPR-1000 (28), CPR-600 (6), HPR-1000 (4) and EPR (2) reactors in service or undergoing construction in China.

. 4 EPR reactors in Europe: Finland (1), France (1) and UK (2).

Background

AFCEN drafted the first edition of the code in January 1980 for application to France's second set of four-loop reactors with a power rating of 1,300 MWe (P'4).

Export requirements (Korea, China and South Africa) and the need to simplify contractual relations between operators and building contractors quickly prompted the code to be translated and used in English, followed by Chinese and Russian.

Subsequently, the code was thoroughly updated and modified to reflect the feedback from France's nuclear industry, as well as through regular interactions with international stakeholders. Six editions ensued (1981, 1983, 1985, 1988, 1993 and 2000) with a number of addenda between each edition.

The 2007 edition took account of changes to European and French regulations (Pressure Equipment Directive 97/23/EC and France's Nuclear Pressure Equipment Regulation), with the harmonized European standards that were subsequently released.

To date, the 2007 edition is widely used in France and China for EPR projects and replacement steam generators.

The 2012 edition, with three addenda in 2013, 2014 and 2015, incorporated initial feedback from EPR projects. The 2013 addendum also included Probationary Phase Rules (RPP) as a way of providing an alternative set of rules in cases where industry feedback has not been sufficiently consolidated for permanent inclusion in the code.

2.2.3 Edition available as of January 1, 2017

The 2016 edition is the most recent version of the code. It integrates 114 modification files.

The majority of these modification files were produced after testing the code for conformity with the essential requirements of France's Nuclear Pressure Equipment Regulation.

This edition also includes a host of significant changes, such as:

. evolution of the fatigue curve for austenitic stainless steels and consideration of environmental effects on the fatigue analysis of those steels in the form of two Probationary Phase Rules (RPP),

. the introduction of complete quality requirements for fusion welding in accordance with international standard ISO 3834-2, which builds on ISO 9001,

. the introduction of welding coordination requirements in conformity with ISO 14731 “Welding coordination - tasks and responsibilities”,
. the introduction of the new standards for the qualification testing of welders (ISO 9606-1) and welding operators (ISO 14732),
. the introduction of advanced inspection methods (TOFD and multi-element ultrasonic testing) as an alternative to radiographic examination.

CONTENTS OF THE 2016 EDITION OF THE RCC-M CODE

SECTION I - NUCLEAR ISLAND COMPONENTS . SUBSECTION “A”: GENERAL RULES A . SUBSECTION “B”: CLASS 1 COMPONENTS B . SUBSECTION “C”: CLASS 2 COMPONENTS C . SUBSECTION “D”: CLASS 3 COMPONENTS D . SUBSECTION “E”: SMALL COMPONENTS E . SUBSECTION “G”: CORE SUPPORT STRUCTURES G . SUBSECTION “H”: SUPPORTS H . SUBSECTION “J”: LOW PRESSURE OR ATMOSPHERIC STORAGE TANKS J	. SUBSECTION “P”: CONTAINMENT PENETRATION P . SUBSECTION “Z”: TECHNICAL APPENDICES Z **SECTION II - MATERIALS M** **SECTION III - EXAMINATION METHODS MC** **SECTION IV - WELDING S** **SECTION V - FABRICATION F** **SECTION VI - PROBATIONARY PHASE RULES**

2.2.4 Next editions

In accordance with the new sales model, AFCEN will now publish annual editions instead of addenda.

2017 edition

The major change with the 2017 edition is the new “Q” subsection to address the qualification of active mechanical components.

Work began on developing this subsection in 2014 with the creation of a new drafting group within the RCC-M Subcommittee to address the functional qualification of active mechanical components (valves and pumps) in close liaison with the RCC-E Subcommittee.

The scope of the code, which is currently restricted to the integrity of pressure-bearing structures, is being broadened to encompass the operability and functionality of so-called “active” mechanical components. The first edition of the Q subsection will be restricted to pumps and valves.

2018 edition

The 2018 edition will incorporate a significant change in the code, since it will be compatible with all the findings from the commissioned studies related to the Nuclear Pressure Equipment Regulation. Those findings will be worked into the body of the code, featured in a specific appendix for France or described in technical publications.

This edition, along with its specific appendix and technical publications, will enable French industry to address the requirements of the new Nuclear Pressure Equipment Regulation of December 30, 2015.

The new 2018 edition of the code will also incorporate the feedback on the code’s use in current projects (EPR UK, TSN, FA3, replacement steam generators) and on the results of the studies of international groups (UK, China, Europe and MDEP), which are monitored by ASN.

2.2 MECHANICAL FIELD FOR PWR: RCC-M

2.2.5 Proof of compliance with the PED Directive / France's Nuclear Pressure Equipment Regulation

The Editorial Committee has launched 17 working groups to demonstrate how the RCC-M code can be used to meet the essential safety and radiation protection requirements stipulated in France's Nuclear Pressure Equipment Regulation and the European PED Directive.

These groups have the following missions:

. risk analyses,

. inspectability and vulnerability criteria,

. uncertainties and safety factors,)

. the dimensions required to ensure conformity with requirements,

. fatigue damage,

. specific evaluations for nuclear components,

. toughness of low-thickness materials,

. unacceptable defects (including defects beneath the cladding and sequential penetration),

. visual inspections during fabrication,

. proof of compliance with essential safety and radiation protection requirements,

. definition of a component's admissible limits,

. instructions manual,

. fabrication of assemblies,

. developments in technologies and practices,

. safety devices and pressure accessories,

. technical qualification,

. code compliance for N2 and N3 equipment.

The mission facing the last group is to extend the previous topics to encompass N2 and N3 equipment, since work initially focused on N1 equipment. The group began to work late 2015 and features AFCEN members who manufacture N2 and N3 equipment in order to draw on their feedback and deliver an appropriate and graded response for this type of equipment compared to the responses provided for N1 equipment.

The groups' findings were published in 2016 as:

. Generic modifications introduced into the body of the code.

. Modifications specific to French regulations and introduced in non-generic appendices ZY and ZZ exclusively for France.

. Technical publications in the form of guides and criteria.

The aim of the working groups is to produce all the requested changes and evidence to ensure that the 2018 edition of RCC-M conforms to the requirements of France's Nuclear Pressure Equipment Regulation. This aim and the associated milestones have been shared with ASN.

The results of the work related to N1 equipment are to be submitted to ASN.

The results of the work related to N2 and N3 equipment are to be submitted to GSEN (Group for Safety of Nuclear Equipment).

2.2.6 Preparation of future changes to the code

In addition to the ESPN program, several focus groups have been set up since 2015 to pave the way for the code's significant changes:

. A draft appendix addressing non-linear finite element analyses was prepared by 14 experts from 7 member companies. This appendix covers excessive deformation damage, plastic instability, fatigue and fast fracture. It defines best practices for performing and validating non-linear finite element analyses and interpretation methods for verifying RCC-M criteria. The draft is being examined by the RCC-M Subcommittee. The group will subsequently turn its attention to progressive deformation.

. A working group comprising 18 experts from nine companies is currently carrying out a complete overhaul of the design rules for flanged connections (including Appendix Z V of RCC-M). This work will range from updating sizing rules through to joint characterization testing.

. A new appendix on the seismic design of pipelines has been prepared and is currently being analyzed by a working group of subject-matter experts.

. The "Inspection Methods" editorial group elaborates an appendix describing the procedure for preparing an equivalence report, the principles of which were introduced into the 2016 edition.

2.2.7 PTAN (AFCEN Technical Publications)

Guides

In 2015, AFCEN published a radiation protection guide for the design of nuclear pressure components in PWR plants in France.

Commissioned studies into the ESPN Regulation led to a series of guides, some of which were published in 2016:

. a guide featuring a set of methods for preparing risk analyses focusing specifically on steam generators,

. a guide for defining dimensions in accordance with ESPN requirements and measuring dimensions while quantifying uncertainties,

. a methodological guide specifying the contents for instructions manuals in keeping with the guide defining risk analyses.

Commissioned studies related to the ESPN Regulation should lead to the publication of new PTANs in 2017:

. a guide for examining inspectability during equipment design in relation to the risk analysis performed according to the AFCEN guide and based on sheet COLEN 37 issued by the Nuclear Pressure Equipment Liaison Committee (currently being revised),

. a guide defining visual examinations and visual inspections during fabrication in association with the risk analysis,

. a methodological guide to accompany the risk analysis guide for identifying the admissible limits of a given item of equipment.

RCC-M criteria:

The RCC-M criteria, prepared by Jean-Marie Grandemange and approved by the Subcommittee members, were published late 2014.

This 550-page document, produced in both English and French, takes a look back at the code's background since the decision was taken for its creation.

2.2 MECHANICAL FIELD FOR PWR: RCC-M

The technical origins of the code and the changes made to the recommendations until publication of the 2007 edition are explained from the point of view of an engineer who was required to draft a design specification in alignment with the RCC-M code.

A PTAN was also published in 2016 to justify the absence of any requirements for measuring resilience in austenitic stainless steels and nickel-based alloys, and their welds as defined in RCC-M for products less than 5 mm thick.

2.2.8 International challenges

The RCC-M Subcommittee is continuing to scale up its activities on an international level by arranging events, carrying out communication initiatives and taking part in technical work sessions within the different organizations influencing the standardization process.

Events in 2016:

. On March 27, 2016, a seminar was held to compare international welding practices. The seminar was organized as part of the 2016 AFCEN Days event in Paris and was attended by over 60 experts, who carried out a thorough review of the different approaches in this particular field and proposed equivalent practices.

. During the WNE World Nuclear Exhibition in June 2016, users from all countries in which the code is used were able to chat directly with the RCC-M experts present on the AFCEN stand.

Active Users Groups:

. The RCC-M Subcommittee engaged with players from China's nuclear industry. On two occasions (in May and October), four experts traveled to China to field questions on design and construction issues from members of the Specialized Chinese Users Group (CSUG). These two sessions resulted in over 30 code interpretation and modification requests, which are currently being examined. The trip gave the experts chance to audit the RCC-M training courses provided by the Chinese partners, CNEA/SNPI, in Chinese language by Chinese trainers, which enabled CNEA/SNPI to obtain the AFCEN training certification for the second session.

. Acting on an initiative by TWI, the United Kingdom Users Group (RCC-M UK UG) held sessions in February and December to compare the RCC-M code against other nuclear and non-nuclear mechanical engineering standards. These sessions attracted over 35 companies.

In 2016, the RCC-M Subcommittee also took part in several international working groups and participated in the associated events, including the following :

. RCC-M experts play an active role in the Convergence Board of Mechanical Standards Developing Organizations (SDO Convergence Board), which gives them chance to meet the authorities during a joint meeting with the MDEP Codes & Standards Task Force (CSWG-MDEP) in November in Saint-Louis, which was also attended by the CORDEL/WNA Codes & Standards group.

. Participation in the different CORDEL working groups covering welding, inspections, non-linear analysis methodologies, fatigue and quality management systems.

. Non-nuclear standards, especially European standards, are relevant to the inspections, welding operations and materials used in the construction of nuclear equipment. That is why they are subject to specific requests within the Gen II/III Prospective Group (PG1), as part of CEN Workshop 64 Phase 2. Subcommittee members were also involved in the report that IRSN prepared for the European Commission's Directorate-General for Energy on the topic of "Modernization & Optimization of the European Nuclear Supply Chain". Such was their involvement in the first stakeholder meeting in October 2016 that the Directorate-General for Energy has scheduled further meetings to finalize the topic in 2017.

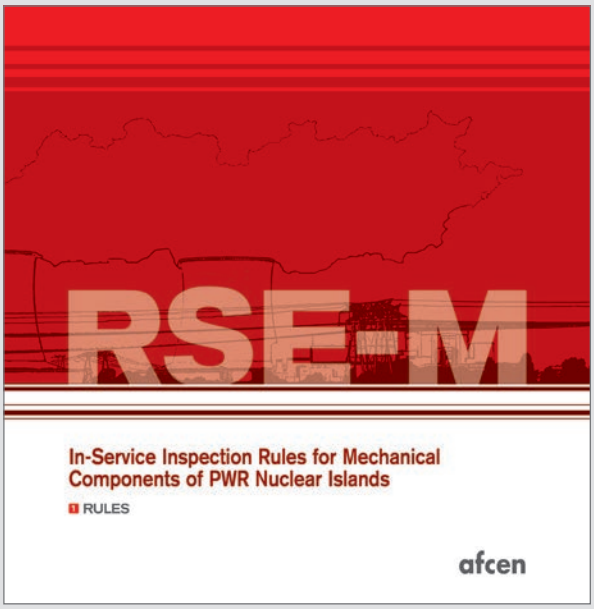
In 2017, there are plans to maintain international initiatives:

. At the European level by extending Phase 2 of the CEN Workshop 64 by one year and examining the prospect of a subsequent Phase 3 to factor in the findings of the study on the Modernization & Optimization of the European Nuclear Supply Chain.

. Focusing on international comparisons by publishing the studies launched by CORDEL and the SDO Convergence Board.

. By leading the Chinese and UK Users Groups, and the corresponding international training courses.

2.3 IN-SERVICE INSPECTION: RSE-M



THE RSE-M CODE

2.3.1 Purpose and scope

The RSE-M code defines in-service inspection operations. It applies to pressure equipment used in PWR plants, as well as spare parts for such equipment.

The RSE-M code does not apply to equipment made from materials other than metal. It is based on the RCC-M code for requirements relating to the design and fabrication of mechanical components.

2.3.2 Use and background

Use

The inspection rules specified in the RSE-M code describe the standard requirements of best practice within the French nuclear industry, based on its own feedback from operating several nuclear units and partly supplemented with requirements stipulated by French regulations.

To date:

. The 58 units in France's nuclear infrastructure enforce the in-service inspection rules of the RSE-M code.

. Operation of 30 commissioned units in China's nuclear infrastructure, corresponding to the M310, CPR-1000 and CPR-600 reactors, is based on the RSE-M code (since 2007, use of AFCEN codes has been required by NNSA for Generation II+ reactors).

Background

AFCEN drafted and published the first edition in July 1990.

This initial edition served as a draft for preparing the 1997 edition, which extended the code's scope to encompass elementary systems and supporting structures for the mechanical components concerned.

This edition was updated on a number of occasions (in 2000 and 2005) before undergoing a complete overhaul in 2010.

2.3.3 Editions available as of early 2017

AFCEN is aiming to prioritize development of the RSE-M code in the following directions:

. incorporate developments in technology and legislation,

. factor in the constraints facing operators-partners,

. deliver support for all international practices.

2010 edition

The 2010 edition is supplemented by addenda in 2012, 2013, 2014 and 2015.

2016 edition

The 2016 edition is in keeping with the work that has been pursued since the 2010 edition by continuing to update the existing version and incorporating EPR aspects (FLA3).

The changes made to this new edition mainly involve:

1. Restructuring Sections A/B/C/D: Section A still contains the rules that apply to all pressure equipment, while Sections B, C and D describe the specific rules for components depending on their class.

2. Changes to make the text easier to understand:

. difference between “maintenance operations” and “inspection operations”,

. set of rules relating to cleanliness,

. procedure for performing hydraulic tests,

. surveillance of main primary system leaktightness,

. recommendations for maintenance operations,

. new chapters on spare parts,

. quality system requirements,

. requalification hydraulic test methods,

. classification method for maintenance operations,

. inspection of safety devices,

. classification of maintenance operations.

3. Enhancement of the code for simplified implementation with EPR projects (FLA3).

Additional information to be included in the next editions

1. Technical developments:

. for the qualification and certification of testing personnel, the certificate is issued by a recognized third-party organization (RTPO) for personnel certified according to ISO 9712,

. further details are required concerning significant variations and stray indications.

2.3 IN-SERVICE INSPECTION: RSE-M

2. Appendices must be adapted to reflect these changes:

. Appendix 1.1: revision of the glossary,
. Appendix 1.3: referral to RCC-M 2016 and replacement of standards,
. Appendix 1.8: fluid groups aligned with European rules,
. Appendix 5.4: improved consideration for the global bending moment,
. Appendix 5.5: improvement for the material's mechanical characteristics,
. Appendix 5.6: new characteristic values for ductile tearing resistance,
. Appendix 3.1.I: inspection program for the FLA3 EPR pre-service inspection,
. Appendix 3.1.II: review of Class 2 or Class 3 vessel inspections,
. Appendix 3.2: methodology for defining an inspection plan.

2.3.4 Outlook and next edition

2017 edition

The 2017 edition has the objective to consolidate and build on the technological, legislative and international developments that occurred in 2016.

With this aim in mind, special attention will be paid to the following points:

. update of the references specified in the list of applicable standards and codes (Appendix 1.3), especially by analyzing any impacts from the changes made to RCC-M,
. further information for the parts marked "pending publication" in relation to in-service surveillance and the associated methods (§6000 and §7000),
. summary of the measures taken for inspecting pressure accessories and safety devices,
. completion of the process of revising the sections addressing the examination techniques used for visits (B 4000), especially the sections covering:
  . piping, tapping and valves for the main primary and secondary systems,
  . global examination of the main primary system,
. revision of the appendix entitled "NDE, surveillance and inspection methods" (Appendix 4.4 associated with B 4000),
. continued enhancement of the mechanical and material data (Appendices 5), including:
  . Appendix 5.4: Kth2, K-beta for nozzle corner defects, distinction for KI between cladded and non-cladded components,
  . Appendix 5.6: EPR materials, carbon-manganese steels (resistance in the T-L orientation),
. further analysis of the content of sections 5000 (indication processing/defects),
. incorporation of regulatory changes as applicable to repairs / modifications (§ 8000 and Appendix 1.6 concerning the associated documents),
. development of the section covering spare parts.

Work relating to France's Nuclear Pressure Equipment Regulation (ESPN)

As part of its involvement in France's ESPN Regulation, the RSE-M Subcommittee has commissioned four studies on the following topics:

. guide to classifying maintenance operations on nuclear pressure equipment (not including Class 1 equipment),

. documentation associated with repaired / modified nuclear pressure equipment,

. methodology for the periodic requalification of Class 2 or Class 3 piping,

. constitution of nuclear facilities.

2.3.5 AFCEN criteria and technical publications for RSE-M

"Appendix 5.5" criteria

The publication entitled "Principles of and background to the formulation of the criteria in Appendix 5.5 of RSE-M", relating to the fast fracture resistance of pressure equipment presenting an operational planar defect, describes the basic principles and background to the process of defining the criteria for Appendix 5.5 of the RSE-M code, especially the characteristic values of the main variables and the partial safety factors. These criteria were published in 2014 and are currently being revised.

"WPS" criteria (relating to Probationary Phase Rule 2 of RSE-M)

The purpose of this publication is to describe the loading history effect on the resistance to the cleavage brittle fracture of RPV steel by taking account of the warm pre-stressing phenomenon as well as the associated criteria that were proposed and which are currently being defined within a probationary phase rule (RPP2) in RSE-M.

2017 criteria

Other AFCEN criteria and technical publications (PTAN) are being prepared:

. criteria "Appendix 5.4" for offering a clearer insight into mechanical analyses such as described in Appendix 5.4 of the RSE-M code,

. criteria "Appendix 1.4" for helping control the specific provisions for applying RCC-M for modifications / repairs,

. technical publications associated with work on the ESPN Regulation (see point above).

2.3 IN-SERVICE INSPECTION: RSE-M

2.3.6 Work of the IEWG

In the United Kingdom, when evaluating the risk of a fast fracture in non-breakable piping and major mechanical components, the critical defect size must be assessed for comparison against the size of detectable defects.

An Independent Expert Working Group (IEWG) carried out a review to determine whether application of the mechanical fracture methods specified in Appendix 5.4 of RSE-M was suitable for a safety case demonstration for the fast fracture preclusion in the United Kingdom.

In the review's conclusions, operator NNB GenCo has chosen to use Appendix 5.4 of the RSE-M code and the associated supplements for mechanical fracture assessments for the Hinkley Point C EPR in the United Kingdom.

Discussions continued in 2016, and the data resulting from these discussions should be incorporated into the 2017 edition.

CONTENTS OF THE 2016 EDITION

VOLUME I - RULES

. SECTION A - GENERAL RULES
. SECTION B - SPECIFIC RULES FOR CLASS 1 COMPONENTS
. SECTION C - SPECIFIC RULES FOR CLASS 2 OR 3 COMPONENTS
. SECTION D - SPECIFIC RULES FOR COMPONENTS NOT ASSIGNED TO ANY PARTICULAR RSE-M CLASS

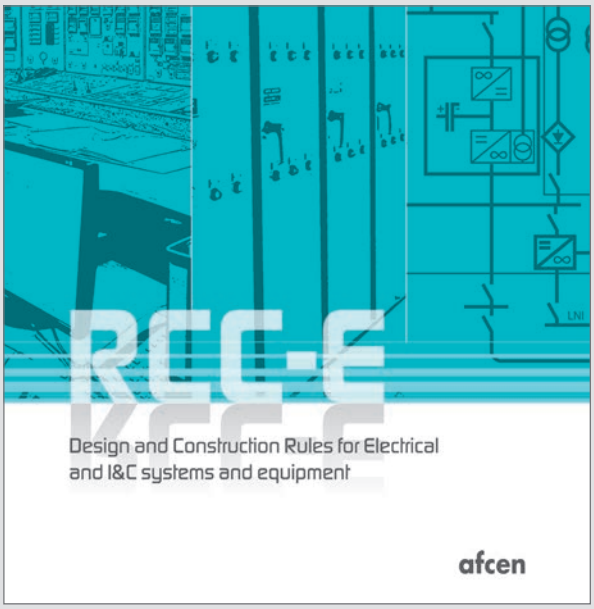
VOLUME II - APPENDICES 1 to 8

. APPENDICES 1.0 to 1.9: supporting appendices for the general requirements
. APPENDIX 2.1: appendix associated with § 2000 Requalifications, Hydraulic Proof Tests and Hydraulic Tests
. APPENDICES 4.1 to 4.4: appendices associated with § 4000 Examination techniques
. APPENDICES 5.1 to 5.8 and RPP2: appendices associated with § 5000 Mechanical and Materials
. APPENDICES 8.1 to 8.2: appendices associated with § 8000 Maintenance Operations

VOLUME III -

. APPENDIX 3.1 - VISIT TABLES: main primary and secondary systems, EPR pre-service inspection program, Class 2 or 3 vessels
. APPENDIX 3.2 - INSPECTION PLANS FOR NON-NUCLEAR PRESSURE EQUIPMENT

2.4 ELECTRICAL AND I&C SYSTEMS: RCC-E



THE RCC-E CODE

2.4.1 Purpose and scope

RCC-E describes the rules for designing, building and installing electrical and I&C systems and equipment for pressurized water reactors.

The code was drafted in partnership with industry, engineering firms, manufacturers, building control firms and operators, and represents a collection of best practices in accordance with IAEA requirements and IEC standards.

The code's scope covers:

. architecture and the associated systems,

. materials engineering and the qualification procedure for normal and accidental environmental conditions,

. facility engineering and management of common cause failures (electrical and I&C) and electromagnetic interference,

. testing and inspecting electrical characteristics,

. quality assurance requirements supplementing ISO 9001 and activity monitoring.

2.4 ELECTRICAL AND I&C SYSTEMS: RCC-E

2.4.2 Use and background

Use

RCC-E has been used to build the following power plants:

. France's last 12 nuclear units (1,300 MWe (8) and 1,450 MWe (4)),

. 2 M310 reactors in Korea (2),

. 44 M310 (4), CPR-1000 (28), CPR-600 (6), HPR-1000 (4) and EPR (2) reactors in service or undergoing construction in China,

. 1 EPR reactor in France.

RCC-E is used for maintenance operations in French power plants (58 units) and Chinese M310 and CPR-1000 power plants.

RCC-E has been chosen for the construction of the EPR plants in Hinkley Point, UK.

Users include:

. equipment suppliers,

. engineering firms responsible for designing, building and installing equipment and systems,

. control and inspection organizations,

. Safety Authorities.

Background

The editions published between 1981 and 2002 address Generation II reactors.

The 2005 edition incorporated the requirements stipulated in the design codes specific to the EPR project - ETC-I and ETC-E, which focus on I&C and electrical systems respectively (ETC: EPR Technical Code Instrumentation and Electrical).

The 2005 and 2012 editions concern Generation II and III reactors. As from the 2005 edition, project specifications must be written to supplement and implement the rules in RCC-E and allow the code to be used in the project.

The various editions of the code have been published in French and English.

The 2005 edition was translated into Chinese and published under CGN's authority in 2009.

2.4.3 Edition available as of January 1, 2017

The RCC-E 2012 edition is the most recent version.

2.4.4 Edition pending publication in 2017

The 2016 edition will be available in French and English during the first quarter of 2017.

The following sources are used when revising the code:

. feedback from facilities under construction and in operation,

. the Safety Authorities' investigation process,

. users inquiries,

. changes in the standards used and IAEA's requirements,

. changes in industry's maturity.

The 2016 edition:

. represents a departure from previous editions, which have been updates instead of overhauls,

. addresses Generation II, III and IV reactors, research reactors and naval reactors,

. organizes requirements into four key areas for easier identification and greater clarity: monitoring, systems, equipment, and component and systems installation. Each key area covers all lifecycle activities,

. takes account of IAEA requirements as applicable to the scope of the code,

. clearly defines the supplements to the requirements in the chosen IEC standards for I&C systems.

Reasons for overhauling the code include:

. changes to IAEA requirements SSR-2/1, GSR Parts 2 and 4, and recommendations for designing and building electrical and I&C systems (SSG 34 and SSG 39), which are used as inputs to the drafting process,

. the WENRA handbook on the design of new reactors,

. changes to IEC standards relating to the SC 45 Technical Committee and IEC industry standards.

. feedback from current projects: EPR, ITER, RJH and ASTRID,

. lessons learned following the British Safety Authorities' investigation into the UK's EPR as part of the generic design assessment into the electrical and I&C systems,

. feedback following Fukushima.

Requirements are:

. adapted so that they can be applied to nuclear projects other than pressurized water reactors,

. harmonized and coordinated with the requirements of the relevant IEC international standards.

The structure of the code has changed to include seven volumes.

2.4 ELECTRICAL AND I&C SYSTEMS: RCC-E

CONTENTS OF THE 2016 EDITION OF THE RCC-E CODE

VOLUME 1 - GENERAL REQUIREMENTS AND QUALITY ASSURANCE
VOLUME 2 - SPECIFICATION OF REQUIREMENTS
VOLUME 3 - I&C SYSTEMS
VOLUME 4 - ELECTRICAL SYSTEMS
VOLUME 5 - MATERIALS ENGINEERING
VOLUME 6 - INSTALLATION OF ELECTRICAL AND I&C SYSTEMS
VOLUME 7 - INSPECTION AND TEST METHODS

2.4.5 Technical publication of the RCC-E Subcommittee:

Contribution to the ESPN program

The RCC-E Subcommittee commissioned a study on the following topic:

SRMCR (Safety Related Measurement, Control and Regulation): the purpose of this study is to define the practical rules for designing an SRMCR in compliance with the applicable requirements for safety devices.

Editions gap analysis

AFCEN has produced a document that compares the 2012 and 2005 editions of the code entitled: “Nuclear Codes & Standards: RCC-E 2012 Gap analysis with the RCC-E 2005”




2.4.6 Outlook

The work topics for the next editions will include:

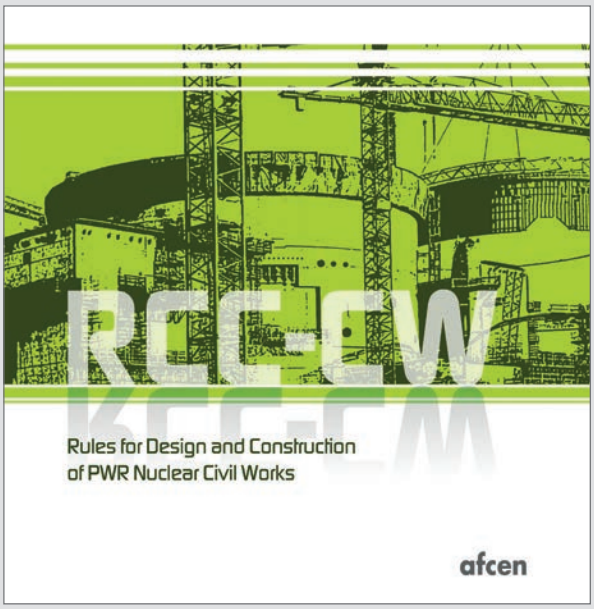
. feedback from the application of RCC-E 2016,

. measurement, control and regulation systems,

. design extension situations,

. IT security.

2.5 CIVIL WORKS: RCC-CW



THE RCC-CW CODE

2.5.1 Purpose and scope

RCC-CW describes the rules for designing, building and testing civil engineering works in PWR reactors.

It explains the principles and requirements for the safety, serviceability and durability of concrete and metal frame structures, based on Eurocode design principles (European standards for the structural design of construction works) combined with specific measures for safety-class buildings.

The code is produced as part of the RCC-CW Subcommittee, which includes all the parties involved in civil engineering works in the nuclear sector: clients, contractors, general and specialized firms, consultancies and inspection offices.

The code covers the following areas relating to the design and construction of civil engineering works that play an important safety role:

. geotechnical aspects,

. reinforced concrete structures and galleries,

. prestressed containments with metal liner,

. metal containment and pool liners,

. metal frames,

. anchors,

. concrete cylinder pipes,

. containment leak tests.

The RCC-CW code is available as an ETC-C version specific to EPR projects (European pressurized reactor).

2.5 CIVIL WORKS: RCC-CW

2.5.2 Use and background

AFCEN published the first civil engineering code (RCC-G) in 1980. This edition included feedback from France's 900 MWe nuclear reactors and mainly drew inspiration from the French BAEL regulation (limit state design of reinforced concrete) and BPEL regulation (limit state design of prestressed concrete). It has been used for the Ulchin project in Korea and the M310 project in China.

AFCEN updated the edition in 1985 and again in 1988 to reflect the latest developments in civil engineering technology.

In particular, the 1988 edition served for France's 1,450 MWe PWRs. In April 2006 in response to the specific needs of its Flamanville 3 EPR project in France, EDF published a reference document called ETC-C for the design and construction of civil engineering works.

The reasons that prompted the development of the ETC-C code are as follows:

. cover both French and German legislative requirements and practices,

. consider new load cases to represent severe accident conditions or events of a more serious nature,

. integrate application of Eurocodes into the design of nuclear structures,

. take account of the latest feedback on the operation of in-service nuclear power plants and updated requirements for safety analyses,

. incorporate the latest knowledge on the behavior of materials and structures (obtained through laboratory and model testing).

The EDF document was not published by AFCEN, but acted as a blueprint for a civil engineering code that AFCEN produced in 2009 as part of the RCC-CW Subcommittee, which led to:

. initially, the publication of a specific code for EPR projects: ETC-C edition 2010, followed by ETC-C edition 2012,

. subsequently, the publication of a generic civil engineering code, called RCC-CW, that is not specific to any given project. Two successive editions of RCC-CW were published in 2015 and 2016.

The ETC-C 2010 edition, which was the first version prepared and published by AFCEN, was used for the generic design assessment of the EPR project in the United Kingdom.

The RCC-CW 2015 edition is being used for the NM EPR project in France.

2.5.3 Edition available as of January 1, 2017

The RCC-CW 2016 edition is the most recent version

As from the 2015 edition, this code no longer adheres to the EPR project and can be used for PWR reactors featuring a prestressed containment with a metal liner.

RCC-CW 2015 includes all the relevant proposals based on the experience acquired during current projects:

. technical discussions concerning the licensing process for Flamanville 3 and the generic design assessment of the EPR project in the United Kingdom,

. the experience acquired by members through their participation in the Olkiluoto, Flamanville and Taishan projects.

Publication of the RCC-CW 2015 code early 2015 is the first edition that AFCEN has prepared and published of a generic civil engineering code that does not relate to any specific project.

It takes account of the latest changes in European standards. It includes technological openings and improvements:

. bonded prestressing has been supplemented with unbonded prestressing,

. the code covers the design and development of seismic isolation devices,

. the section on external hazards has been updated to include tornadoes.

The design approach has been expanded to provide greater focus on design extension situations.

The following improvements have been incorporated into the 2016 edition of RCC-CW:

. Correction of various editorial mistakes.

. Thorough revision of the DANCH chapter on anchors and inclusion of the latest changes to EN 1992-4.

CONTENTS OF THE 2016 EDITION OF THE RCC-CW CODE

2.5 CIVIL WORKS: RCC-CW

2.5.4 Outlook

As already initiated by AFCEN in preparing the RCC-CW code, the development of the civil engineering code is continuing in the following directions:

. integrate feedback from projects currently under development or construction,

. broaden the scope of robust technologies covered by the code (anchors, metal liners, and so on),

. encourage application of the code in the European and international arena by offering greater coverage of the latest international standards and promote the code as a civil engineering benchmark for the Prospective Groups that CEN set up to prepare the future nuclear codes,

. according to AFCEN's requirements and development objectives, develop appendices and addenda specifically addressing how the code can be adapted to the countries targeted by AFCEN.

The work program includes the following core topics:

. design extension situations and the associated criteria,

. composite steel and concrete structures,

. pile foundations,

. improved reinforcement rates,

. maintenance,

. anchor channels,

. tolerances.

2.5.5 Technical publication on seismic isolation

Technical publication "PTAN – French Experience and Practice of Seismically Isolated Nuclear Facilities" was published in 2014.

It presents the best practices and experience of French industry resulting from the last 30 years in designing and installing seismic isolation systems beneath nuclear facilities.

This publication enables European industry to:

. codify the industrial design and construction practices according to AFCEN: in this respect, RCC-CW 2015 includes a section on seismic isolation,

. showcase its experience within international organizations and bodies (IAEA, OECD, WENRA, etc.).

At the same time, experts are working on dissipation systems to reinforce the seismic resistance of existing structures.

2.5.6 International activities

CEN/WS 64

The Subcommittee is involved in the activities of CEN Workshop 64.

The RCC-CW code is being shared with the other European participants.

During the workshop's activities, AFCEN will examine all requests to update the code.

Chinese Users Group (CSUG)

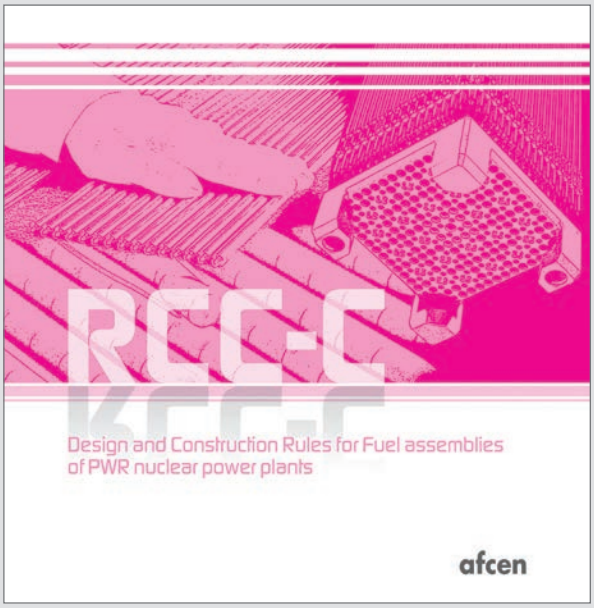
The ETC-C and RCC-CW codes are being shared within the Chinese Users Group, which held a meeting in 2015 and another meeting in 2016 attended by 30 Chinese experts.

Any interpretation requests for AFCEN codes issued during the meetings are examined by the Subcommittee.

UK Users Group

On November 22, 2016, the preliminary kick-off meeting was held for the UK Users Group on civil engineering codes. The meeting was attended by the main companies involved in the Hinkley Point C project. The Users Group should be officially launched during the AFCEN 2017 Congress.

2.6 NUCLEAR FUEL: RCC-C



THE RCC-C CODE

2.6.1 Purpose and scope

The RCC-C code contains all the requirements for the design, fabrication and inspection of nuclear fuel assemblies and the different types of core components (rod cluster control assemblies, burnable poison rod assemblies, primary and secondary source assemblies and thimble plug assemblies).

The design, fabrication and inspection rules defined in RCC-C leverage the results of the research and development work pioneered in France, Europe and worldwide, and which have been successfully used by industry to design and build nuclear fuel assemblies and incorporate the resulting feedback.

The code's scope covers:

. fuel system design, especially for assemblies, the fuel rod and associated core components,

. the characteristics to be checked for products and parts,

. fabrication methods and associated inspection methods.

2.6.2 Use and background

Use

The RCC-C code is used by the operator of the PWR nuclear power plants in France as a reference when sourcing fuel from the world's top two suppliers in the PWR market, given that the French operator is the world's largest buyer of PWR fuel.

Fuel for EPR projects is manufactured according to the provisions of the RCC-C code.

The code is available in French and English. The 2005 edition has been translated into Chinese.

Background

The first edition of the AFCEN RCC-C code was published in 1981 and mainly covers fabrication requirements. The second edition of the code was released in 1986 and supplemented the first edition by including design requirements in a specific section at the end of the code. This structure remained unchanged and prioritized the fabrication aspects.

In recent years, the RCC-C Subcommittee has been busy overhauling the code to implement a new structure for improved clarity as well as to reflect the requirements of the latest quality assurance standards and describe all technical requirements that have been missing from previous editions. 45 nuclear fuel experts were involved in these activities.

2.6.3 Edition available as of January 1, 2017

The RCC-C 2015 edition is the most recent version

CHANGES TO THE PLAN OF THE RCC-C CODE, FROM THE 1981 EDITION TO THE 2015 EDITION

Plan of the 1981 code	Plan of the 1986 - 2005 code	Plan of the 2015 code
1 - General provisions 2 - Product and part characteristics 3 - Fabrication and related testing and inspection 4 - Tables of inspection requirements 5 - Inspection methods Appendices	1 - General provisions 2 - Product and part characteristics 3 - Fabrication and related testing and inspection 4 - Tables of inspection requirements 5 - Inspection methods 6 - Design Appendices	1 - General provisions 2 - Description of the fuel 3 - Design 4 - Manufacturing 5 - Handling and storage

Review of the changes between the 2005 and 2015 versions

In terms of the general requirements and description of the fuel:

. Quality assurance requirements have been improved compared to previous requirements by including the requirements of the IAEA GS-R-3 standard.

. the definitions used for fuel assemblies have been enhanced,

. the procedure for managing nonconformities has been described,

. the fuel description has been improved.

In terms of design:

The design chapter has been updated to reflect comments from the French nuclear Safety Authority in 2009 following discussions about the prospect of a draft fuel regulation. The chapter has been restructured for improved clarity. The statement of functional requirements for assemblies and core components has been improved. Paragraphs on thermal hydraulics requirements and neuron transport have been added. A paragraph covering stress corrosion cracking/pellet-cladding interaction studies has been added.

Changes have also been introduced to take into consideration the findings of the French Permanent Working Group on Loss-of-Coolant Accidents in April 2014.

2.6 NUCLEAR FUEL: RCC-C

In terms of manufacturing:

. The paragraphs in the manufacturing chapter covering zirconium alloys have been updated to include commercial alloys other than Zircaloy 4. The paragraphs on stainless steel and inconel materials have been structured according to the same plan as that used for zirconium alloys. The paragraphs covering absorbents and fuel pellets have been enhanced.

. The code now includes requirements for the following inspection and fabrication processes: automatic sorting of pellet diameters, tube expanding, lost-wax casting, component marking, thermal treatment and surface treatment.

The following parts have been defined, as well as their qualification requirements: assemblies, skeleton assemblies, grids, fuel rods, bottom end fittings, rod cluster control assemblies and absorber rods.

The overall summary of the code in its 2015 version is detailed in Figure 12.

The work of the RCC-C Subcommittee in 2015 involved translating the 2015 master version from French into English. The entire document has been retranslated (354 pages) to incorporate the wealth of modifications between the 2005 and 2015 versions. The English version of the code has been available since the first quarter of 2016.

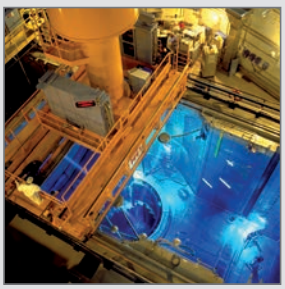
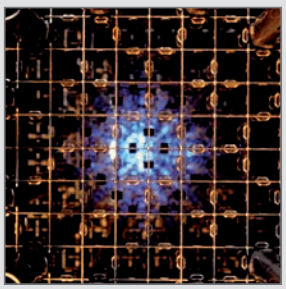
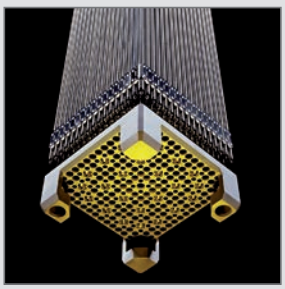
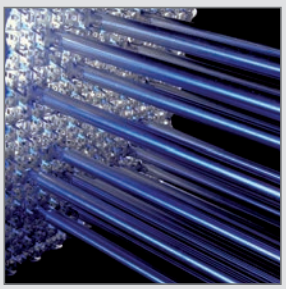
CONTENTS OF THE 2015 EDITION OF THE RCC-C CODE

Next edition

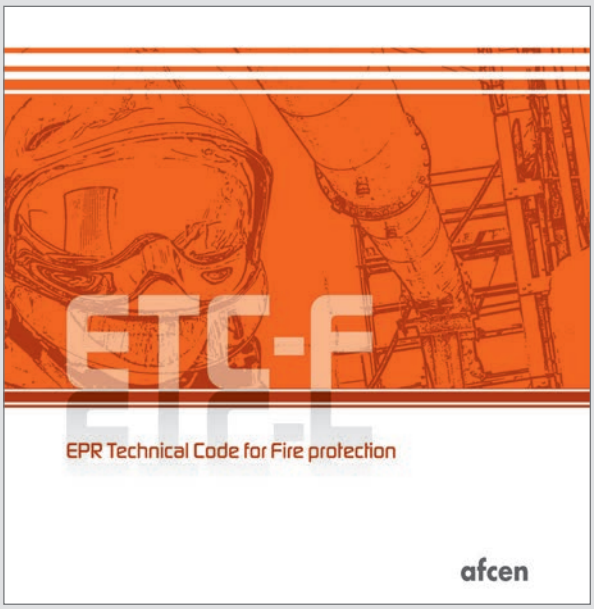
The next edition (French and English) is scheduled for 2017.

2.6.4 Outlook

The RCC-C Subcommittee is continuing its work in 2017 to adapt the design requirements to the next French “Groupe Permanent” on fuel performance criteria (planned for 2017). The code will also be amended to reflect the changes in products and manufacturing processes required by suppliers.

2.7 FIRE PROTECTION: RCC-F



THE ETC-F VERSION OF THE RCC-F CODE APPLICABLE TO EPR PROJECTS

2.7.1 Purpose and scope

The RCC-F code defines the rules for designing, building and installing the fire protection systems used to manage the nuclear hazards inherent in the outbreak of a fire inside the facility and thereby control the fundamental nuclear functions.

This code's target readership is therefore:

. suppliers of fire protection equipment,

. engineering firms responsible for designing, building and installing fire protection systems,

. laboratories carrying out qualification testing of fire protection equipment,

. Nuclear Safety Authorities responsible for approving the safety demonstration.

The code defines fire protection systems within a finite scope of service buildings in a light water nuclear power plant.

To satisfy the code's requirements, design studies can be performed.

The code provides fire protection recommendations in terms of:

. the industrial risk (loss of assets and/or operation),

. personnel safety,

. the environment.

The code is divided into five main sections:

. generalities,

. design safety principles,

. fire protection design bases,

. construction provisions,

. rules for installing the fire protection components and equipment.

The RCC-F code is available as an ETC-F version specifically for EPR projects (European pressurized reactor).

2.7.2 Use and background

In response to the needs of its Flamanville 3 EPR project in France, EDF published a reference document called ETC-F for the design of fire protection systems.

The EDF document was not published by AFCEN, but acted as a blueprint for a fire protection code that AFCEN produced in 2009 as part of the RCC-F Subcommittee, which led to:

. Initially, the publication of the 2010 edition of the ETC-F code for EPR projects, followed by the 2013 edition, which gave less focus to the specifics of EPR projects but which still addresses the main EPR safety principles.

. Subsequently, the publication of a generic fire protection code, called RCC-F, that is not specific to any given project and which promotes the code's application on an international level.

The 2013 edition is compatible with British requirements and has been chosen for the EPR plants in Hinkley Point, UK.

2.7.3 Edition available as of January 1, 2017

The ETC-F 2013 edition is the most recent version

The 2013 edition of the ETC-F code incorporated two major changes:

. partial removal of the code's adherence to the specifics of EPR,

. inclusion of British regulations, which prompted a significant overhaul to the body of the text, as well as the creation of a local appendix specifically addressing such regulations and designed to improve understanding thereof.

This exercise in anglicizing the code gave AFCEN hands-on experience in updating the code to reflect foreign regulations (in terms of the time, processes and skills required).

It also served as the ideal opportunity to integrate British best practices.

2.7 FIRE PROTECTION: RCC-F

CONTENTS OF THE 2013 EDITION OF THE ETC-F CODE

VOLUME A - GENERALITIES

STRUCTURE OF ETC-F GENERAL POINTS
DOCUMENTATION (IN PROGRESS)
CHAPTER (PROVISION) QUALITY ASSURANCE

VOLUME B - DESIGN SAFETY PRINCIPLES

DESIGN NUCLEAR SAFETY PRINCIPLES

VOLUME C - FIRE PROTECTION DESIGN BASES

FIRE PROTECTION DESIGN BASES

VOLUME D - CONSTRUCTION PROVISIONS

CONSTRUCTION PROVISIONS

VOLUME E - INSTALLATION RULES FOR FIRE PROTECTION

RULES FOR INSTALLING THE FIRE PROTECTION COMPONENTS AND EQUIPMENT

2.7.4 International activities

In 2016, the RCC-F Subcommittee held a meeting with the CSUG (Chinese Specialized Users Group):

. The Chinese working group comprises 19 permanent members and was created during the first meeting in March 2015. A work meeting was held in Beijing in May 2016. Participants discussed the contents and interpretation of the code, as well as addressed the various technical questions raised by the CSUG.

. Two new meetings with the CSUG have been lined up for 2017.

2.7.5 Outlook and preparation of the RCC-F 2017 edition

Outlook

AFCEN is aiming to develop the code in the following directions:

. integrate feedback from projects currently under development or construction,

. drive the code's application on a European and international level by including international standards and regulations. According to requirements, this will prompt AFCEN to develop appendices and addenda specifically addressing how the code can be adapted to local regulations (refer to the exercise already carried out for the United Kingdom).

RCC-F 2017 edition

In 2016, efforts focused on preparing the next edition ahead of its publication in September 2017. Amendments have been made based on the 2013 edition.

AFCEN's aim with the 2017 edition is to make the RCC-F code usable for any project, accounting for applicable safety rules.

The initial 2013 version of the ETC-F code featured two types of adherence:

. EPR adherence (specific characteristics of EPRs, mainly semantics (PCC, F2, etc.)).

. Safety adherence, which is also contained in all other EDF fire codes (RCC-I, fire directives, etc.) used on France's other power plants.

The new edition of the code will be formatted and revised to identify the impact of safety principles on the content of the design, construction and installation rules defined within the code.

Current work is organized according to the following five subject areas

1. Analysis of adherence to safety principles (sizing and stresses)

The aim is to analyze adherence to safety principles, which involves identifying the safety criteria and principles in the code by examining any given principle (aggravating event, fire combined with thermal-hydraulic transients, combined stresses, fire outbreak following an earthquake, and so on) and how it is addressed by the code.

The analysis of adherence to safety principles may be documented in a safety principle appendix featuring two objectives: to improve the code's legibility to better understand the links with nuclear safety principles ; to provide elements to ensure that the code can be tailored to the safety principles chosen within a specific context.

The specific technical features of the EPR NM basic design will also be included.

2. Improved traceability of requirements

The purpose of this subject area is to satisfy users' need to easily identify the source of the requirements that led to the rules defined within the code.

3. Development of requirements on conventional islands

The idea with this subject area is to inject greater flexibility into the rules for designing fire protection systems by adapting and therefore clarifying the rules applied to nuclear islands to reflect the risks relating to the conventional part of the plant (challenge of protecting the facility's production assets).

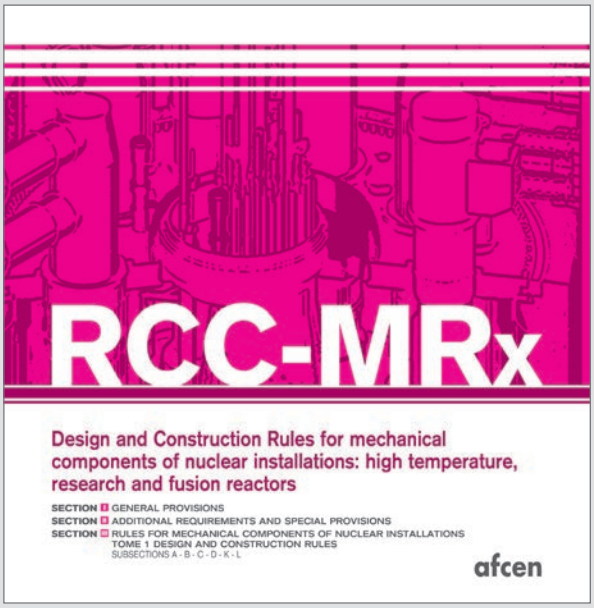
4. Clarification of human intervention

The aim is to clarify human intervention within the code, even though such intervention is not evaluated in respect of demonstrating safety. However, human intervention can be used (evaluated) in the safety analyses. The specific prerequisites arising from international practice will need to be integrated.

5. Update to Appendix A

Appendix A incorporates the recent specific changes to French and English regulations.

2.8 MECHANICAL FIELD FOR HIGH-TEMPERATURE, EXPERIMENTAL AND FUSION REACTORS: RCC-MRx



THE RCC-MRx CODE

2.8.1 Purpose and scope

The RCC-MRx code was developed for sodium-cooled fast reactors (SFR), research reactors (RR) and fusion reactors (FR-ITER).

It provides the rules for designing and building mechanical components involved in areas subject to significant creep and/or significant irradiation. In particular, it incorporates an extensive range of materials (aluminum and zirconium alloys in response to the need for transparency to neutrons), sizing rules for thin shells and box structures, and new modern welding processes: electron beam, laser beam, diffusion and brazing.

2.8.2 Background and use

Since 2009, the RCC-MRx code created by AFCEN's RCC-MRx Subcommittee has been an inclusion of two documents:

. The RCC-MR code, drafted by AFCEN's RCC-MR Subcommittee together with the Tripartite Committee formed on March 16, 1978 by the Commissariat à l'Energie Atomique, Electricité de France and Novatome, to establish the applicable rules for designing components working at high temperatures. AFCEN published four editions of RCC-MR in 1985, 1993, 2002 and 2007.

. The RCC-MX code, drafted by the RCC-MX Approval Committee formed on March 31, 1998 by the Commissariat à l'Energie Atomique, AREVA-TA and AREVA-NP for the specific needs of the RJH project (Jules Horowitz reactor). This code applies to the design and construction of experimental reactors, auxiliary systems and associated experimental devices. It can also be used for the design and construction of components and systems for existing facilities. CEA published two editions of RCC-MX in 2005 and 2008.

An unpublished preliminary version of RCC-MRx created in 2010 by AFCEN was chosen as the baseline for the CEN CWA European Workshop (entitled “CEN-WS-MRx, Design and Construction Code for mechanical equipment of innovative nuclear installations”), which was intended to familiarize European partners with the RCC-MRx 2010 code and propose modifications to satisfy the needs of their projects. The results of the workshop were incorporated into the 2012 edition of RCC-MRx published by AFCEN.

The RCC-MR code was used to design and build the prototype Fast Breeder Reactor (PFBR) developed by IGCAR in India and the ITER Vacuum Vessel.

The RCC-Mx code is being used in the current construction of the RJH experimental reactor (Jules Horowitz reactor).

The RCC-MRx code is serving as a reference for the design of the ASTRID project (Advanced Sodium Technological Reactor for Industrial Demonstration), for the design of the primary circuit in MYRRHA (Multi-purpose hYbrid Research Reactor for High-tech Applications) and the design of the target station of the ESS project (European Spallation Source).

2.8.3 Edition available as of January 1, 2017

CONTENTS OF THE 2015 EDITION OF THE RCC-MRx CODE

2.8 MECHANICAL FIELD FOR HIGH-TEMPERATURE, EXPERIMENTAL AND FUSION REACTORS: RCC-MRx

The 2015 edition is the most recent version

A new edition of the RCC-MRx code was released in 2015.

This edition reflects feedback on the use of the 2012 edition and/or its 2013 addendum, especially in current projects and mainly the Jules Horowitz reactor and the Astrid project. Examples include the inspection and welding procedures for aluminum, as well as the code's improvements and new structure relating to components used at high temperatures (design rules, welded assemblies and material properties).

Initial feedback on the code's application also helped analyze and integrate additional data on the Eurofer material used by the fusion community.

Furthermore, this edition pays special attention to ensuring consistency between RCC-MRx and the other reference documents that interact with the code, including RCC-M, European and international standards.

2.8.4 Outlook

In 2016, efforts centered on incorporating feedback from the use of the 2015 edition of the code and finalizing the two commissioned studies in progress. Throughout 2017, the focus will be on preparing the new edition of RCC-MRx, which is scheduled for publication mid-2018. This edition will include:

. the findings of CWA 64,
. a new organization for the chapters addressing fast fracture,
. a new organization for the chapters addressing progressive deformation.
. feedback from the RJH project,
. advanced ultrasonic inspection methods as an alternative to radiographic examination.

2.8.5 Technological commissioned studies

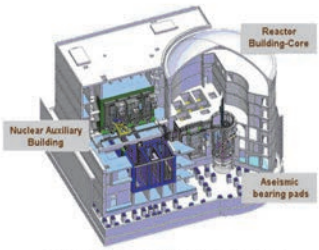
The RCC-MRx Subcommittee launched two commissioned studies in 2014:

. Improvement to the rules to take account of irradiation when levels become significant. This commissioned study is aimed at assessing the rules currently featured in the code with a view to their improvement. The first request for modification relating to an adjustment to the toughness values of 316L(N) was issued following the group's work. A second request defining the fields to which the code applies in respect of irradiation will be included in the forthcoming 2018 edition. The commissioned study has achieved its objectives and has therefore been closed.

. Terms for introducing a new material into RCC-MRx, in keeping with what had already been introduced into the code (concept of a material record). The aim of this commissioned study is to produce a methodological guide that will be released as an AFCEN technical publication. This guide is currently being finalized and explains, when introducing a non-coded material into RCC-MRx, the definition of the methods for obtaining the characteristics in Appendices A3 (expected / possible tests, meaning of the data). This guide is due to be released as a technical publication in 2017.

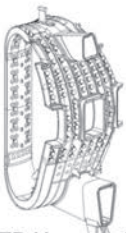
USE OF AFCEN CODES IN HIGH-TEMPERATURE, EXPERIMENTAL AND FUSION REACTORS

RCC-Mx 2008



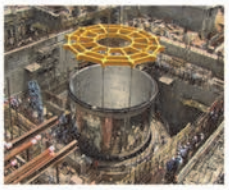
Jules Horowitz Reactor

RCC-MR 2007



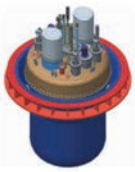
ITER Vacuum Vessel

RCC-MR 2002

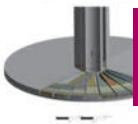


Indian PFBR

RCC-MRx 2012

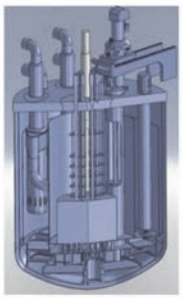


MYRRHA primary system



RCC-MRx 2012

European Spallation Source target

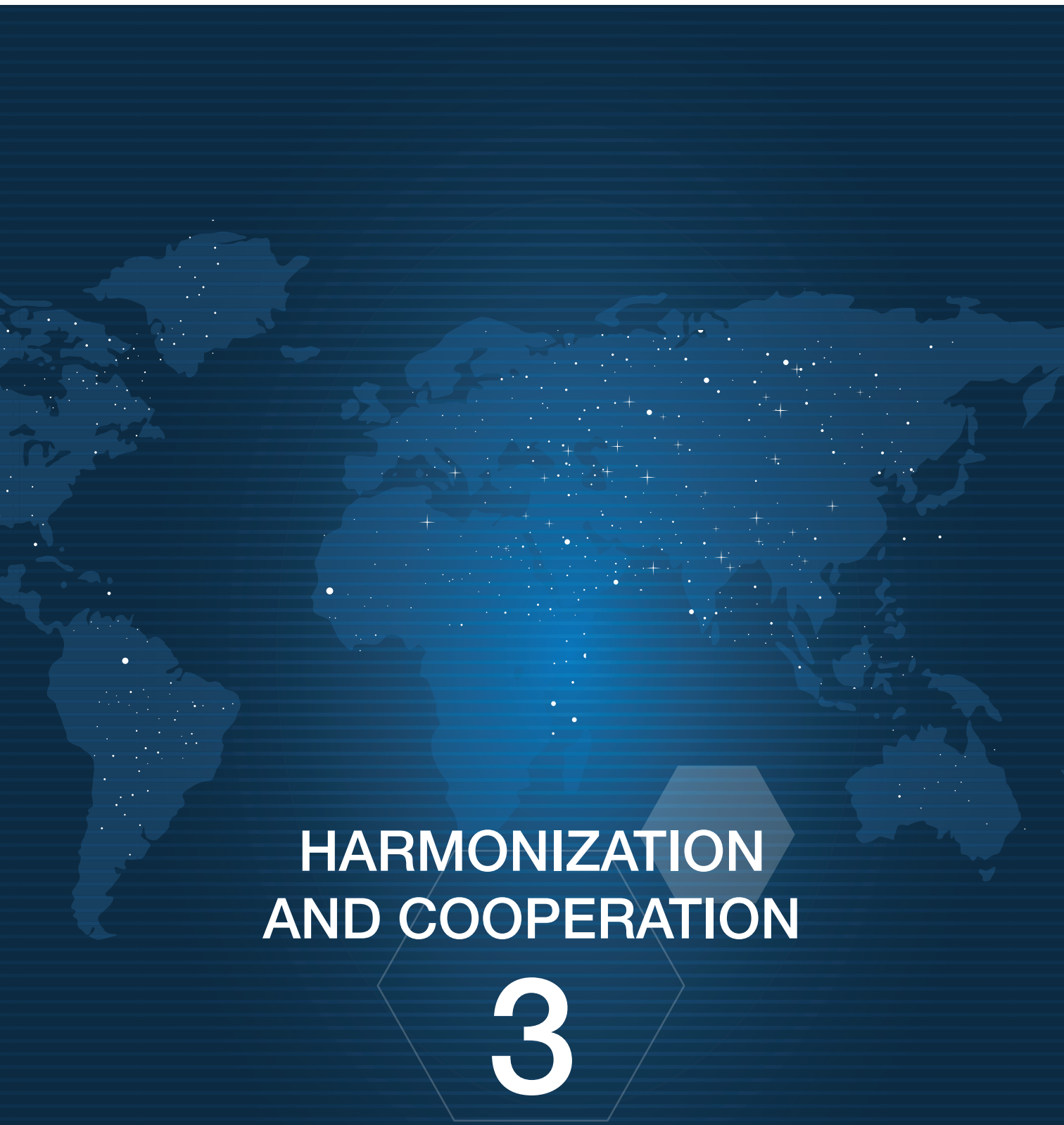


ASTRID

RCC-MRx 2012

afcen

Shaping the rules for a sustainable nuclear technology



HARMONIZATION AND COOPERATION

3

3.1 STANDARDS

AFCEN codes are based on standards. When drafting codes, ISO international standards are the first port of call when available, otherwise European EN standards are used.

If there are no existing ISO and/or EN standards for a given field, other standards are called by the codes.

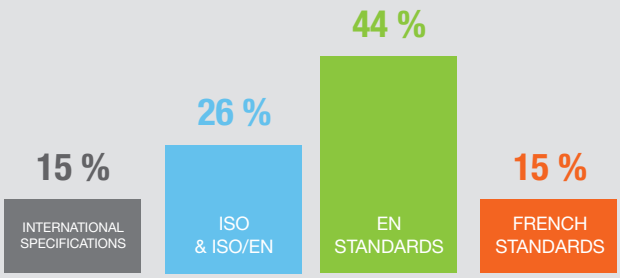
The standards used by a code are specified in one of the code's chapters.

The Subcommittees occasionally analyze the standards to determine whether any revisions have been made in order to ensure that codes are up-to-date.

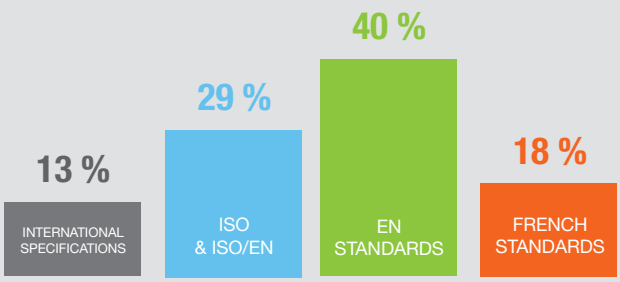
The two diagrams in Figure below illustrate AFCEN's approach for prioritizing the use of international or European standards in the RCC-M 2012 and RCC-CW 2015 codes.

USE OF STANDARDS IN THE RCC-M 2012 AND RCC-CW 2015 CODES

234
STANDARDS AND SPECIFICATIONS
DIRECTLY REFERENCED IN **RCC-M CODE**
70% : ISO, ISO/EN AND EN



227
STANDARDS AND SPECIFICATIONS
DIRECTLY REFERENCED IN **RCC-CW CODE**
69% : ISO, EN/ISO AND EN



3.2 HARMONIZATION AND COOPERATION INITIATIVES

Empowered by its long tradition as a major force in the nuclear codes sector in several countries, and as part of its determination to continually incorporate industry best practice and local regulations for its code users, AFCEN is naturally involved in the harmonization programs either set up by international organizations or created at its own initiative.

For example, AFCEN contributes to the objectives of harmonizing mechanical codes as set forth in the multinational design evaluation program (MDEP) implemented by the Safety Authorities in the main countries using nuclear energy.

Similarly, AFCEN is represented in the “Codes & Standards” task force of the working group (formed by the World Nuclear Association WNA, which includes industry’s main players) on cooperation in reactor design evaluation and licensing (CORDEL).

Furthermore, at the European level, AFCEN has undertaken a workshop within the European Committee for Standardization (CEN) to bring the various European stakeholders together and thereby anticipate needs for codes.

In the same spirit, AFCEN’s members are active in various standardization bodies at European (CEN / CENELEC) and international level (ISO / IEC).

3.2.1 MDEP

AFCEN has taken part in the group of Standards Development Organizations (SDO) ever since it was created by the MDEP (Multinational Design Evaluation Program) Mechanical Codes and Standards Working Group (CSWG) in 2006. With this aim in mind, the “Convergence Board [for nuclear mechanical codes]” was created in 2010 to identify and facilitate the introduction of compatible rules in each of the mechanical codes. Just like ASME, JSME, KEPIC, CSA and NIKIET, AFCEN is a member of the Convergence Board, which is led by ASME ST LLC. The board holds three meetings a year in addition to the ASME Code Week and reports on its work once a year to MDEP/CSWG (November 10, 2016).

The SDO group published a report entitled “Code Comparison Report for Class 1 Nuclear Power Plant Components” in 2011 and a comparison of welding practices in 2016. Proposals have been submitted to compare codes covering the following subject areas: fatigue curves and environmental effects, pipe design rules, and the use of finite element analyses for classifying stresses. These comparative studies are widely based on the work carried out within CORDEL. AFCEN invited the other members to direct their attention towards Fabrication and Quality Control & Assurance, but the topics have yet to be confirmed.

The SDO group has reported the difficulty in “reconciling” the codes due to the fact that different approaches are used to specify requirements (additional requirements expressed outside the remit of the codes, especially for ASME) and due to the specific nature of the nuclear industry compared to conventional sectors (materials and welding). MDEP/CSWG has confirmed its desire to maintain the “Convergence Board” and lend its support to the work headed by CORDEL (see 1.4.2), but points out that it will not impose any position on the Safety Authorities with respect to the work produced by the SDO group.

3.2 HARMONIZATION AND COOPERATION INITIATIVES

3.2.2 CORDEL

WNA (World Nuclear Association) created the CORDEL working group (Cooperation in Reactor Design, Evaluation and Licensing) in 2007 to stimulate dialog between the international nuclear industry and Safety Authorities.

AFCEN's RCC-M Subcommittee is an active participant in the work of the Mechanical Codes & Standards Task Force (CORDEL/MCSTF). In 2015, AFCEN endorsed the publication of a document comparing the qualification of non-destructive testing personnel (Qualifications for NDE Personnel, Harmonization of International Code Requirements). In 2016, WNA/CORDEL published a comparative study on welding practices commissioned by the SDO Convergence Board featuring input from AFCEN's members, who also contributed to the code comparison report on non-linear analysis methodologies while benchmarking based on real cases. A project to compare different design codes on fatigue analysis was launched under AMEC's leadership (meeting on September 8, 2016), and AFCEN will check the elements presented in the RCC-M and RCC-MRx codes.

CORDEL is a useful platform for AFCEN and its members to harmonize coded best practices at the international level.

3.2.3 CEN WORKSHOP 64

AFCEN's determination to rally Europe's nuclear industry to a set of codes geared towards the needs of future nuclear projects in Europe has found a conducive framework for the development of its action with the 2007 creation of the Sustainable Nuclear Energy Technology Platform (SNETP).

A proposal was initially made within CEN to set up a workshop to encourage the different organizations and stakeholders in the ESNII (European Sustainable Nuclear Industrial Initiative affiliated with SNETP and covering Generation IV fast neutron reactors) to help with enhancing the RCC-MRx code draft.

The European Commission has been associated with AFCEN's initiative since day one and has lent its support ever since.

This proposal was accepted by CEN and joined by 14 European organizations.

Workshop 64, named "Design and Construction Code for mechanical components of innovative nuclear installations", was created on February 3, 2011. Its terms of reference were compared to those in force within AFCEN's Subcommittees.

Workshop 64 ran until October 2012 and produced 33 modification proposals for the RCC-MRx code, 20 of which were incorporated into the published edition. Furthermore, 8 of the 13 other proposals, which could not be converted into modification files due to a lack of technical justification, highlighted the need for mid-term changes to the code.

Feedback on the first initiative was considered to be highly satisfactory and rewarding by all stakeholders.

Spurred on by these results, AFCEN took the initiative of continuing this action by fine-tuning objectives according to two focus areas:

. invite short-term project leaders to come and work directly in the Subcommittee in order to enhance the code with the driving force adapted to their requirements,

. prepare the future codes within external prospective groups, where parties potentially using codes for medium and long-term projects can express their technical requirements, discuss which supporting evidence is required, any R&D actions needed and the installations where such actions can be carried out.

As part of the first focus area, AFCEN gained three new European members.

The second focus area prompted AFCEN to propose a second phase for Workshop 64 with a broader scope than for Phase 1; in other words, in addition to mechanical engineering for Gen IV nuclear facilities, Phase 2 includes mechanical components for current reactors (based on the RCC-M code) and civil engineering works (based on the RCC-CW code).

This proposal was again accepted by CEN and has currently been joined by 15 organizations.

Workshop 64 - Phase 2, entitled “Design and Construction Code for mechanical and civil engineering for Gen II to IV nuclear facilities (pilot case for process for evolution of AFCEN codes)”, was created on June 6, 2014 for a three-year term, which may be renewed if necessary according to the participants’ needs and interests.

The workshop comprises three “prospective groups”, each of which covering one of the aforementioned fields (Gen II-III mechanical engineering, Gen IV mechanical engineering and civil engineering works) and led by renowned experts from organizations that are not AFCEN members.

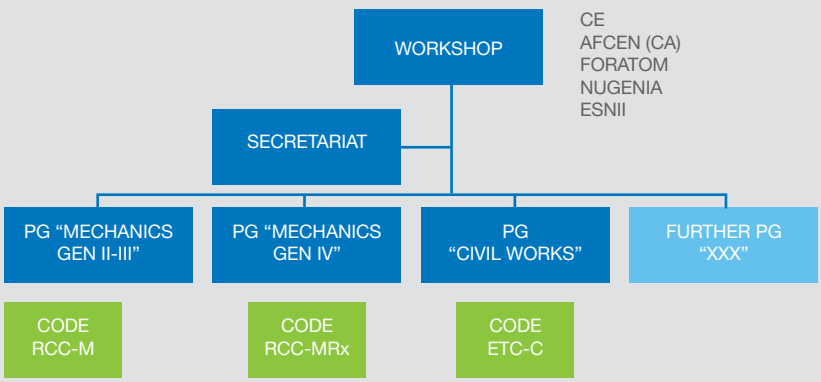
In each group, AFCEN has delegated a representative from the relevant Subcommittee to guide the group’s work and provide information on the codes and the methods for updating the codes.

In 2016, recommendations were issued for each code concerned by the Workshop.

AFCEN has started, but not completely finished, examining the recommendations within its relevant Subcommittees, since the recommendations were submitted later than expected. AFCEN’s feedback on these recommendations will be released early 2017. In addition, the Workshop’s prospective groups are formulating other recommendations, which will require an extension to the timeline stipulated in the initial business plan in order to be addressed by AFCEN. Consequently, during its general meeting in June 2016, the Workshop decided to extend the process by one year.

Based on the performance of this first stage, AFCEN will propose the terms for continuing this initiative.

ILLUSTRATION OF AFCEN’S PARTICIPATION IN CEN



afcen

Shaping the rules for a sustainable nuclear technology

SUPPORT THROUGH TRAINING

4

The Training Committee ensures that certified training is available to users of AFCEN codes.

AFCEN does not personally run training courses, so that its experts can remain focused on drafting codes.

As such, the Training Committee delegates training to external providers and consequently assesses their ability to provide such training.

To do so, the Training Committee relies on the relevant Subcommittees wherever practicable.

It establishes partnership agreements with training organizations and manages all the aforementioned aspects.

Partnership agreements

AFCEN has signed partnership agreements with 12 organizations that are qualified in the field of nuclear pressure equipment: AIB VINCOTTE INTERNATIONAL, APAVE, AREVA UNIVERSITY, BUREAU VERITAS, CETIM, ECOLE DES PONTS PARIS TECH, EFECTIS, INSTITUT DE SOUDURE INDUSTRIE, INSTITUT NATIONAL DES SCIENCES ET TECHNIQUES NUCLEAIRES, INTERNATIONAL NUCLEAR ACADEMY, NUCLEXPERT, SICA NUCLEAIRE, SNPI (CGN Group).

PARTNERSHIP AGREEMENTS SIGNED BY AFCEN AND TRAINING ORGANIZATIONS BY THE END OF 2016

4.1 CERTIFIED TRAINING

Following proposals from the training officers, the Committee has certified the content of 24 training courses to date.

When certifying courses, AFCEN validates the teaching aids and materials, and trainers are first audited and approved by specialists from the field in question.

Organizations that have signed a partnership agreement are authorized to provide trainees with certificates of attendance signed jointly by AFCEN.


afcen

Logo Organisme

ATTESTATION

de suivi de la session de formation

« TITRE DE LA FORMATION »

Titre du Code

Délivré à : M./Mme Prénom Nom

de la société : Société

***Session réalisée* : du** jj **au** jj mmm 20xx **à** lieu **– (durée** XX **heures)**

Domaines techniques couverts par le stage : Contenu de la formation en termes de domaines du code couverts.

Fait à Lieu, le jj mmm 20xx

Pour l'AFCEN
Le Correspondant Formation CODE
Nom, Prénom

Pour l'organisme
Le Responsable de la Formation
XXXXXX

www.afcen.com

www.site organisme

AFCEN CERTIFICATE OF ATTENDANCE

AFCEN TRAINING CATALOG AS OF LATE 2016 (DETAILS IN APPENDIX C).

Code	Type of training	Duration	Language	Partnership
RCC-M	Introduction & further study of the code (two to four days)	2 to 5 days	FR/EN/CH	Seven partner companies
	Structure and application of RCC-M	3 days	FR	One partner
	Procurement and materials according to the code	1 day	FR	One partner
	Quality assurance	1 day	FR	One partner
	Inspection methods	1 day	FR	One partner
	Design and sizing	1 day	FR	One partner
	Fabrication - Welding	1 day	FR	One partner
RSE-M	Introduction to the code	3 days	FR	Two partners
RCC-E	Introduction to the code	1 day	FR/EN	One partner
	Comprehensive code training	4 days	FR	One partner
	Qualification and long-term fabrication of mechanical components qualified under accidental conditions	3 days	FR	One partner
RCC-CW	General introduction	1 day	FR/EN	One partner
	Construction	2 days	FR/EN	One partner
	Design	3 days	FR/EN	One partner
RCC-F	Comprehensive code training	4 days	FR/EN	One partner
RCC-MRx	Introduction to the code	3 days	FR/EN	Three partners

AFCEN makes a point of notifying all training organizations that have signed a partnership agreement of any changes and modifications made to the codes. Teaching sequences for the code in question are updated and defined in mutual agreement with AFCEN.

4.2 TRAINING COURSES DELIVERED IN 2016

In 2016, 51 training sessions1 were held and covered all codes, representing 481 trainees and 1,223 days of training. Training quality was assessed per codes and organizations, with specific attention to ensure that all associated messages related to nuclear safety were effectively delivered.

In 2016, the Training Committee stabilized the training catalog. It launched a brainstorming process to enhance the courses on offer, towards modules transverse to several codes or addressing specific topics (fabrication, materials, etc.). The committee is also looking into the prospect of developing a range of more specific tools, including distance learning (videoconferences and webinars) and e-learning.

4.3 INTERNATIONAL TRAINING

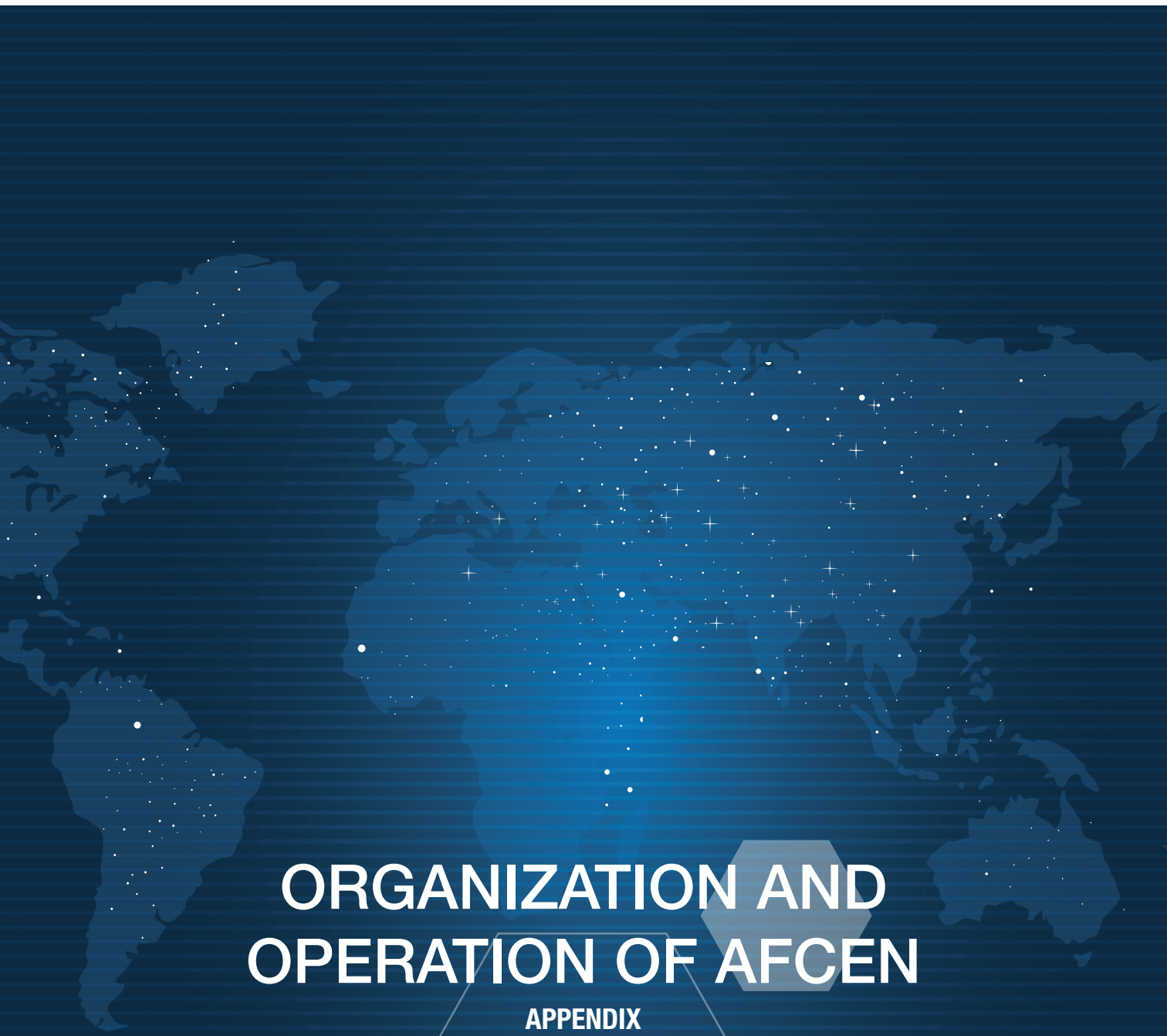
The Training Committee also implemented the appropriate processes to allow AFCEN certified training to be carried out abroad. The courses organized by international training providers that have signed partnership agreements with AFCEN, irrespective of the country or the language used, therefore offer the level of quality expected by the Subcommittees that produce the codes.

In 2015, two courses were held in China, and one in the United Kingdom.

A partnership agreement has been signed in China with SNPI (CGN Group). In 2016, the RCC-M training course provided by this organization was certified, and two Chinese-language sessions were carried out.

afcen

Shaping the rules for a sustainable nuclear technology



ORGANIZATION AND OPERATION OF AFCEN

APPENDIX

A

A.1 AFCEN'S MISSION

AFCEN is an association whose primary purpose is to:

. produce up-to-date codes offering accurate and practical rules for the design, construction and in-service inspection of components for use in industrial or experimental nuclear facilities (RCC codes),

. ensure certified and readily-available training programs enabling code users to achieve a high level of expertise, knowledge and practical skills in using AFCEN codes.

AFCEN codes form a consistent set of rules that:

. encompasses a broad spectrum of technical fields, including mechanical engineering, electricity and I&C systems, nuclear fuel, civil engineering works and fire protection systems,

. has been evolving over the last 35 years to reflect changes in safety requirements, technological progress and international feedback based on users' practices,

. offers an overarching approach to nuclear facility design and construction without specifically targeting a given type of project,

. can adapt to the specific local regulations applicable in different countries,

. helps unify and rally a country's entire nuclear industry around the same reference framework.

Codes are continually updated to incorporate feedback from international industry best practices and changes to regulations, while striving to achieve harmonization with the other nuclear codes used around the world.

This ongoing activity is driven by an organizational and operational structure in response to AFCEN's Quality Management Policy, whose key goals are to:

. prioritize the quality of its publications, which contribute to the safety and economic performance of sustainable nuclear facilities,

. deliver a fast response to users' inquiries,

. encourage members and customers to adopt a safety culture,

. disseminate and promote uptake of the codes, especially through training and information systems.

AFCEN codes are published in English and French.

To improve distribution and uptake by industry in certain countries, editions of AFCEN codes have been translated into Chinese and Russian with AFCEN's consent.

A.2 ORGANIZATION AND OPERATION

A.2.1 General organization

General organization

AFCEN is an international association. Its members are companies from the nuclear or conventional energy sector (when operating in the nuclear sector), whose activities are related to the technical fields covered by AFCEN codes.

AFCEN organizes one General Meeting a year for its members, during which its general strategic directions and budget are approved.

AFCEN is managed by a Board of Directors, which defines and ensures compliance with the association's strategic objectives and provisional budget once adopted by the General Meeting.

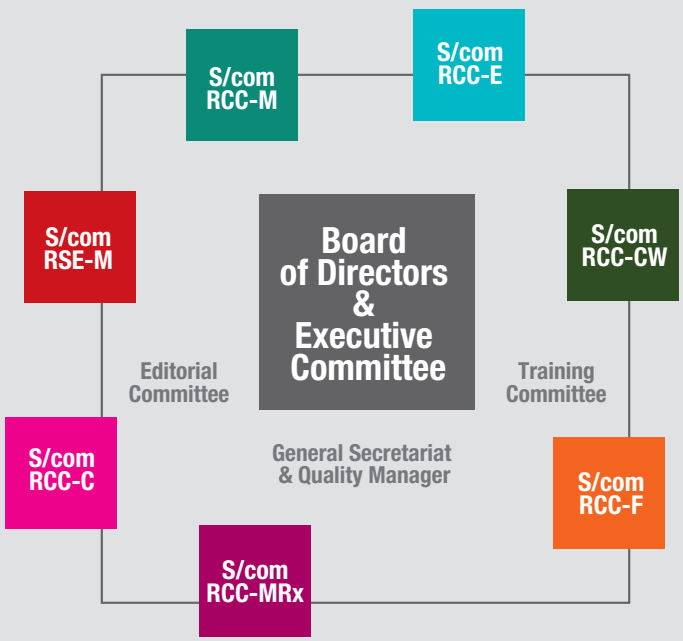
To achieve its work program, the Board is supported by an Executive Committee comprising designated members from the association. The Executive Committee is assisted by a General Secretariat, which is responsible for the general coordination of the association's activities, a Training Committee, an Editorial Committee and Subcommittees, each of the Subcommittees covering a technical field associated with a specific code.

AFCEN does not have any regular employees. Its work is entrusted to experts who have been designated and made available by its members. The organization and operation of AFCEN's different entities reflect this particular situation.

In some countries, such as China and the United Kingdom, AFCEN has set up local structures to help the Subcommittees more easily understand the codes and incorporate national issues into their work.

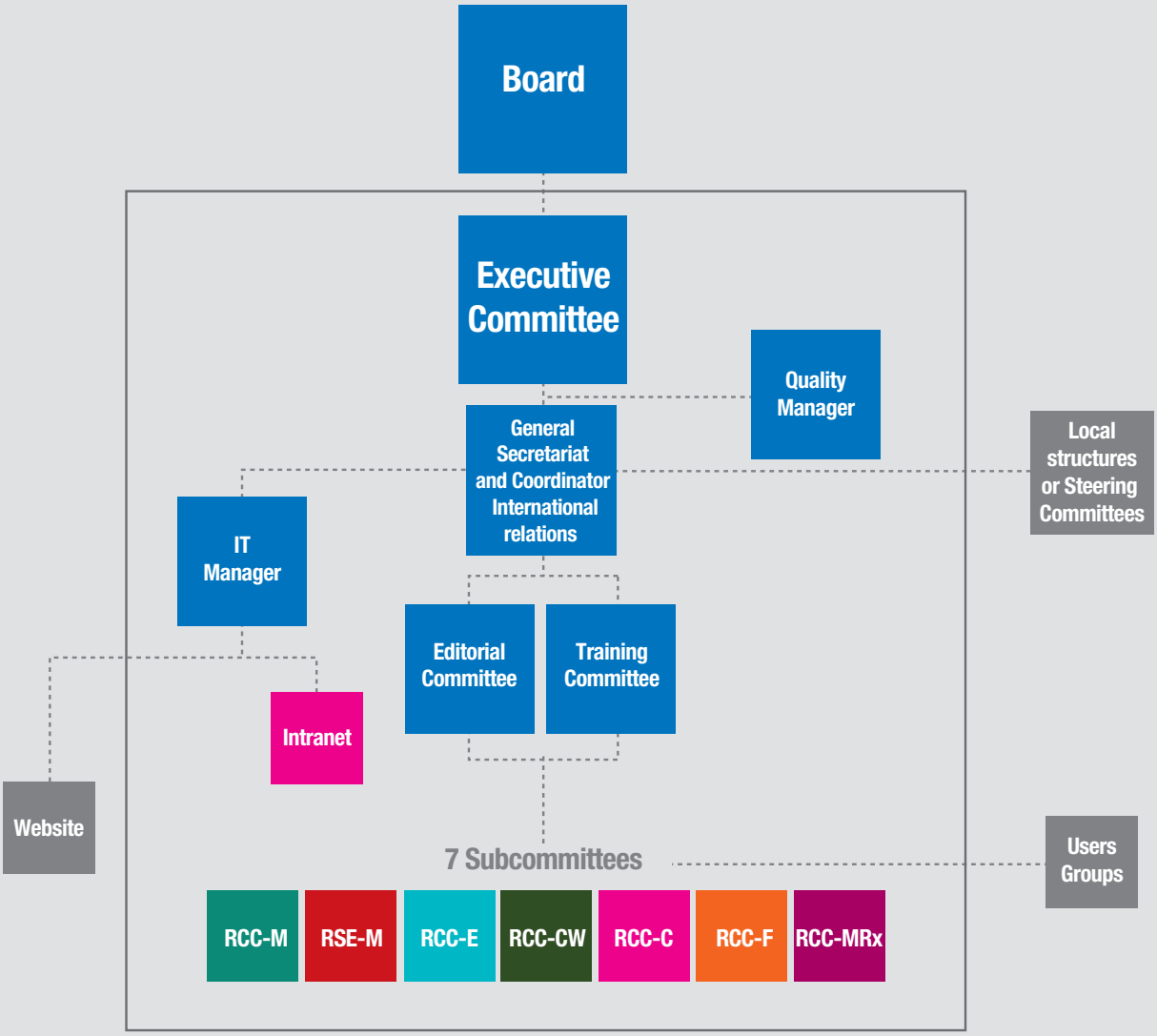
These local structures usually comprise Users Groups, which users are not necessarily AFCEN members. Each Users Group is associated with a code.

Each Users Group is chaired by an AFCEN member as part of an agreement. In cases where a country has several Users Groups, a Steering Committee is created to coordinate their activities.



AFCEN'S ORGANIZATIONAL STRUCTURE

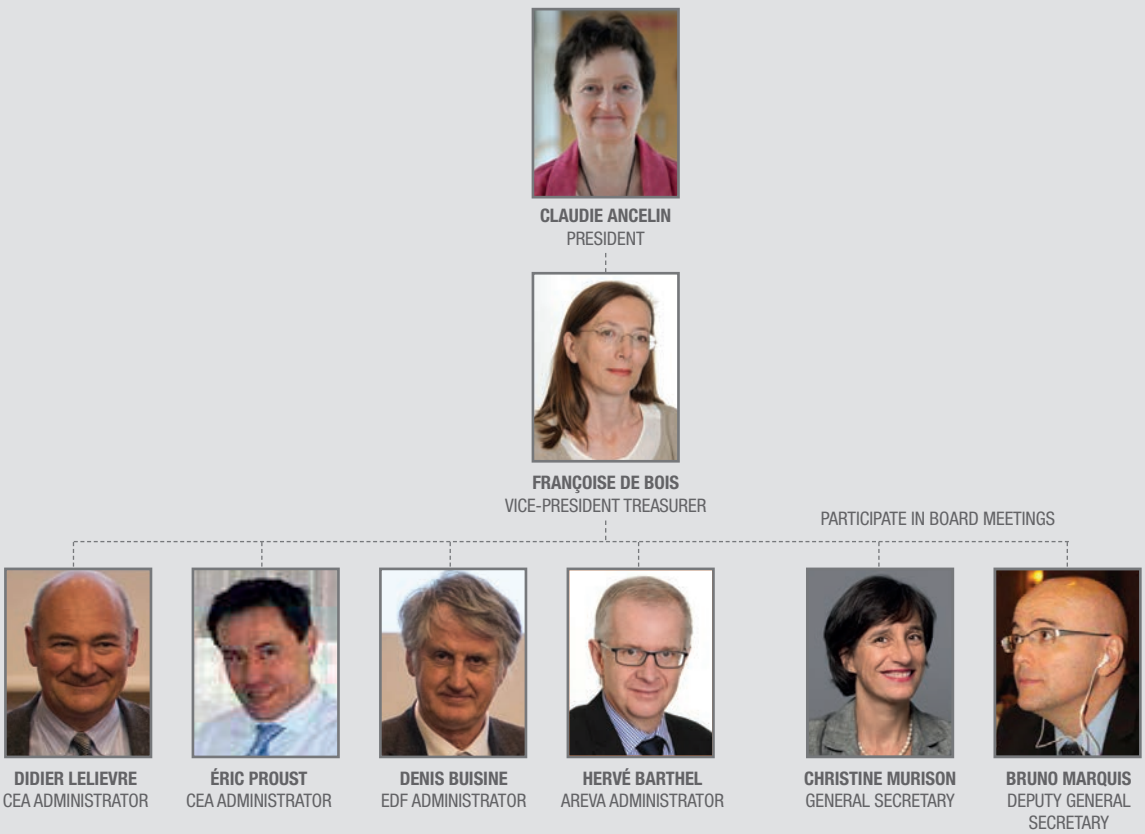
A.2 ORGANIZATION AND OPERATION



GENERAL ORGANIZATION OF AFCEN

A.2.2 General Meeting and Board of Directors

AFCEN is managed by a Board of Directors, whose members are appointed according to its articles of association and which reports to members on its activities during the General Meeting.



AFCEN'S BOARD OF DIRECTORS

A.2 ORGANIZATION AND OPERATION

The general activity of the Board of Directors and the General Meeting in 2016 is summarized in box below.

ACTIVITY OF THE BOARD OF DIRECTORS AND THE GENERAL MEETING IN 2016

The Board of Directors held four meetings, while the Executive Committee held two meetings.

The General Meeting was held on March 24, 2016.

During the 2016 General Meeting, members approved the following:
. continuation of AFCEN's internationalization policy in the United Kingdom, European Union and China, to promote AFCEN codes,
. continued cooperation with NEA in China to develop Chinese standards based on AFCEN codes,
. continuation of the process of updating the mechanical codes and creating guides and national appendices to provide a clearer insight into the requirements of the ESPN Regulation,
. continuation of plans to produce a code on the deconstruction of nuclear facilities, with the aim of creating a Subcommittee by the end of 2016.

In addition, members raised inquiries about the new sales model during the General Meeting. These inquiries were addressed during the year, and an action plan was presented to the Board of Directors on December 14, 2016.

During the Board of Directors meeting on August 31, 2016, members approved the following changes:

1. Nomination of a new AFCEN President, effective as of October 1, 2016.
President: Claudie Ancelin (EDF), taking over from Cécile Laugier (EDF)

2. Change in General Secretariat:
Secretary-General: Christine Murison (AREVA NP), taking over from Morello Sperandio (AREVA)
Deputy Secretary-General: Bruno Marquis (EDF), taking over from Gérard Ithurralde (EDF)

3. Change to the Training Committee:
Chair: Bruno Marquis (EDF), taking over from Morello Sperandio (AREVA)
Deputy Chair: Christine Murison (AREVA NP), taking over from Gérard Ithurralde (EDF)

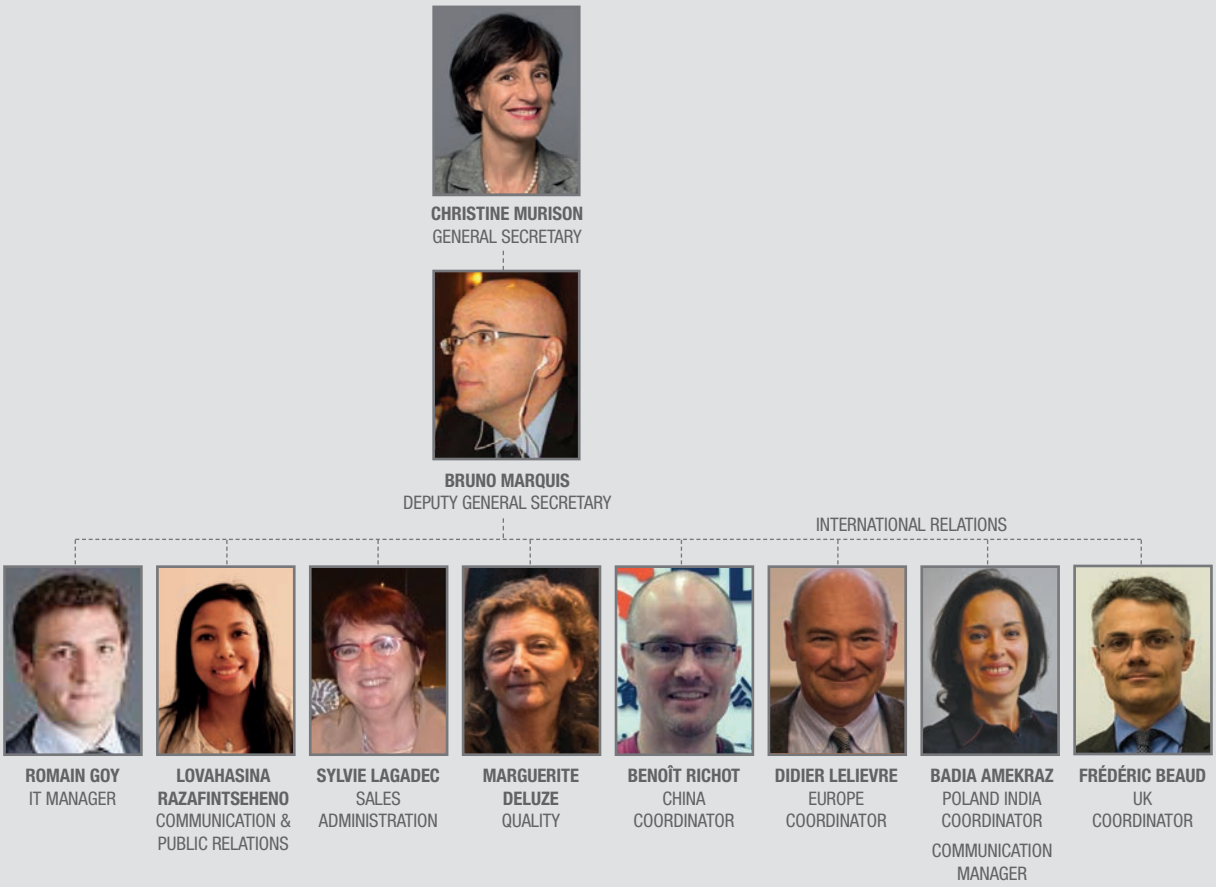
The Board of Directors also approved the following appointments:
. Pierre Champeix (EDF), taking over from Jean Michel Haure (EDF) as Chair of the RCC-E Subcommittee
. Bertrand Robault (EDF), taking over from Luce Lobgeois (EDF) as Chair of the RSE-M Subcommittee
. Pascal Blin (EDF) and Anne de Buttet (AREVA NP) as Deputy Chairs of the RSE-M Subcommittee
. Nicolas de Mathan (EDF) as Deputy Chair of the RCC-M Subcommittee

A.2.4 General Secretariat

The General Secretariat oversees AFCEN's operation, proposes strategic directions to the Board of Directors and implements the actions chosen by the Board. The Secretary-General and Deputy Secretary-General are appointed by the Board of Directors.

It organizes and coordinates all AFCEN activities deployed by the Editorial and Training Committees.

On an international level, the General Secretariat is supported by International Relations Coordinators and local representatives if applicable.



AFCEN'S GENERAL SECRETARIAT

The General Secretariat provides AFCEN's constituent entities and their members with a collaborative work tool called "AFCEN-Core".

This tool simplifies interaction between experts on a national and international level, while providing them with the data required for their work and enabling them to archive their work in accordance with the confidentiality rules associated with the protection of intellectual property.

A.2 ORGANIZATION AND OPERATION

Access to this tool by members and their designated representatives is subject to AFCEN membership and compliance with such confidentiality rules.

For everyday communication with code users and more generally with interested parties, AFCEN offers a website **www.afcen.com** containing information on the codes and their environment, membership forms and the sale of its publications, as well as forms for submitting interpretation and modification requests to AFCEN.

For the routine management of AFCEN's activities, the General Secretariat holds weekly conference calls that are open to the Committee Chairs and Deputy Chairs and the International Relations Coordinators.

A.2.5 Editorial Committee

The Editorial Committee Chair is appointed by the Board of Directors. The Editorial Committee is overseen by a Chair and is attended by the Chairs from each Subcommittee. The Secretary-General and the Deputy Secretary-General are invited to attend Editorial Committee meetings. International stakeholders and the IT Manager are also invited, depending on the meeting agenda.

The Editorial Committee is responsible for authoring and updating the codes published by AFCEN, as well as carrying out the associated technical studies. The committee defines AFCEN's editorial program, monitors and guides the work of the Subcommittees and approves the code editions and modifications prior to publication.

The Editorial Committee oversees the quality of AFCEN's publications. The quality of publications contributes to the safety and availability of nuclear facilities and takes account of the economic aspect of building and operating such facilities by leveraging feedback from international industry best practices.

The editorial program is aimed at responding to the needs of AFCEN's members.

Standard practice is for members to express their needs by means of code Requests for Modification (RM) or Requests for Interpretation (RI). Such needs may also be voiced during general meetings or any events organized by AFCEN. The various international schemes set up by AFCEN are ultimately intended to ascertain potential requirements.

As such, the Editorial Committee guides the work of each Subcommittee and proposes how all cross-functional tasks are to be distributed.

The Editorial Committee is also the preferred means for circulating information to and fro between the executive bodies and the experts.

The general activity of the Editorial Committee in 2016 is summarized in Box below.

DENIS BUISINE
CHAIRMAN OF THE EDITORIAL COMMITTEE

GENERAL SECRETARY
AND DEPUTY GENERAL SECRETARY

CLAUDE DUVAL
DEPUTY

STÉPHANE MARIE
CHAIRMAN
OF THE RCC-M
SUBCOMMITTEE

BERTRAND ROBAULT
CHAIRMAN
OF THE RSE-M
SUBCOMMITTEE

PIERRE CHAMPEIX
CHAIRMAN
OF THE RCC-E
SUBCOMMITTEE

CLAUDE DUVAL
CHAIRMAN
OF THE RCC-CW
SUBCOMMITTEE

MARC TON-THAT
CHAIRMAN
OF THE RCC-C
SUBCOMMITTEE

RICHARD TULINSKI
CHAIRMAN
OF THE RCC-F
SUBCOMMITTEE

CÉCILE PETESCH
CHAIRMAN
OF THE RCC-MRx
SUBCOMMITTEE

AFCEN'S EDITORIAL COMMITTEE

General Activity Of The Editorial Committee In 2016

The Editorial Committee held 4 meetings. The main items addressed during the meetings were as follows:
a. Latest news (conferences, international activities, relations with Safety Authorities, feedback, and so on).
b. Changes in the organization and practices.
c. Cross-functional studies and commissioned studies.
d. Subcommittee reporting.

The Editorial Committee approved the publication of the 2016 editions of RCC-M, RSE-M and RCC-CW.

It launched 17 temporary working groups to demonstrate how the codes meet the essential safety and radiation protection requirements stipulated in European and French regulations (PED Directive / France's Nuclear Pressure Equipment Regulation).

Another cross-functional group was set up to address extreme natural hazards with more realistic assumptions and less stringent criteria than the design basis conditions.

A.2 ORGANIZATION AND OPERATION

A.2.6 Training Committee

The Training Committee ensures that certified training is available in each field for AFCEN code users.

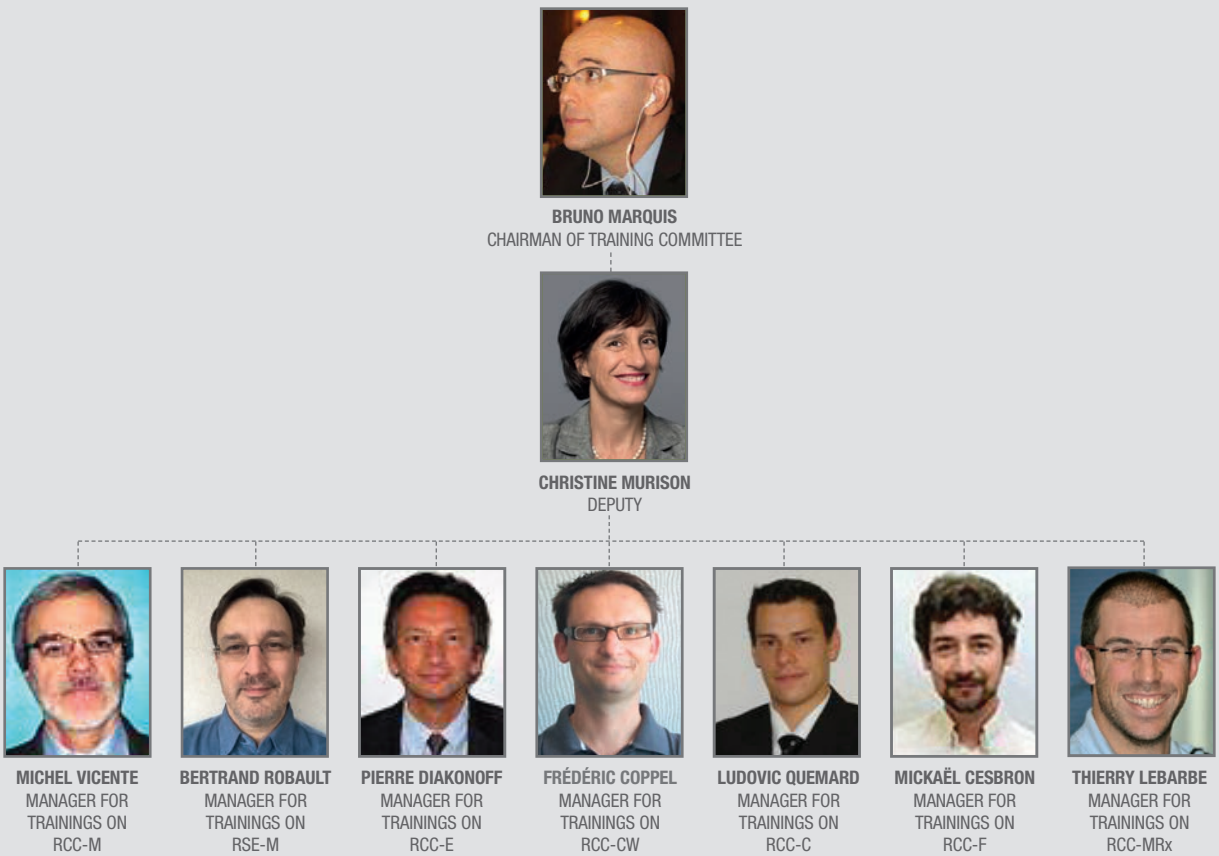
Training programs bearing the AFCEN hallmark guarantee a high level of service quality and thereby allow users to gain a clear insight, knowledge, uptake and proficiency in the requirements and practices for using the codes published by AFCEN.

The Training Committee assesses the ability of prospective providers to implement AFCEN courses and approves the training aids that they consequently need to use.

It establishes partnership agreements with training organizations and manages all the aspects specified in those agreements.

To raise the profile of the range of certified training courses, the Training Committee publishes an AFCEN certified training catalog on the www.afcen.com website. The website also provides detailed information with interactive links on AFCEN's certified training courses, which are delivered by partner training organizations.

The Training Committee makes a specific point of monitoring AFCEN's certified courses over time and updating courses to reflect changes in the codes.



AFCEN'S TRAINING COMMITTEE

The Training Committee Chair is appointed by the Board of Directors.

The Training Committee includes a representative from each Subcommittee, called a "Subcommittee Training Officer".

The general activity of the Training Committee is summarized in the box below:

GENERAL ACTIVITY OF THE TRAINING COMMITTEE IN 2016

In 2016:

The Training Committee held three meetings in February, June and November. These regular meetings enabled members to discuss:

a. General information and latest news (conferences, international activities, organization and quality, etc.).

b. Certified training (review of all agreements signed and certifications pending, number of training sessions delivered, etc.).

c. Subcommittee reporting (certified training strategy, in-class evaluations, feedback from trainees, etc.).

The Training Committee consolidated 24 training courses and issued 481 certificates of attendance for courses on AFCEN codes. It pursued its strategy of developing international courses, particularly in China (a certified Chinese-language course on RCC-M) and the United Kingdom (one course on RCC-M), attended by approximately 150 trainees in all.
It also maintained its focus group to examine the possibility of specialized training modules in response to the needs voiced by AFCEN members during the 2015 Congress. Specialized courses will be available for the RCC-M code.

A.2.7 Subcommittees

The Subcommittees are responsible for carrying out AFCEN's technical activities, with each Subcommittee covering a field associated with a given code.

AFCEN SUBCOMMITTEES IN 2016

In 2016, seven Subcommittees were active:

. **RCC-M:** Design and construction rules for PWR mechanical equipment
. **RSE-M:** In-service inspection rules for mechanical components of PWR nuclear islands
. **RCC-E:** Design and construction rules for electrical and I&C systems and equipment
. **RCC-CW:** Design and construction rules for PWR civil engineering works
. **RCC-C:** Design and construction rules for PWR fuel assemblies
. **RCC-F:** Design and construction rules for PWR fire protection systems
. **RCC-MRx:** Design and construction rules for mechanical components of high-temperature, research and fusion reactors

A.2 ORGANIZATION AND OPERATION

The Subcommittees are responsible for:

. working as part of the Editorial Committee and drafting the rules corresponding to the field covered by the Subcommittee, and continuously updating those rules to reflect feedback from industry best practices and changes to international legislation,

. supporting the Training Committee with certifying training courses and selecting providers to deliver such courses,

. supporting and interfacing with international Users Groups.

Changes to codes are initiated or prompted by Requests for Modification submitted by users.

Each Subcommittee comprises:

. a Subcommittee Assembly

. a Subcommittee Board.

. Working Groups.

The Subcommittee Board represents the Subcommittee's decision-making and arbitration body, and features a Chair, a Vice-Chair and a restricted number of experts appointed by the Subcommittee Chair based on their skills. The Subcommittee Chair designates the working group leaders from the experts in the Subcommittee Board.

Working groups focus on one of the Subcommittee's sub-fields and are responsible for:

. drafting and continually improving the parts of the code corresponding to the sub-fields,

. investigating and responding to Requests for Modification and Interpretation submitted by code users.

Figure below presents the different working groups within each Subcommittee.

Working groups investigate Requests for Modification which, if necessary, are openly discussed during a Subcommittee meeting attended by all representatives appointed by AFCEN members. Decisions are taken by the Subcommittee Board.

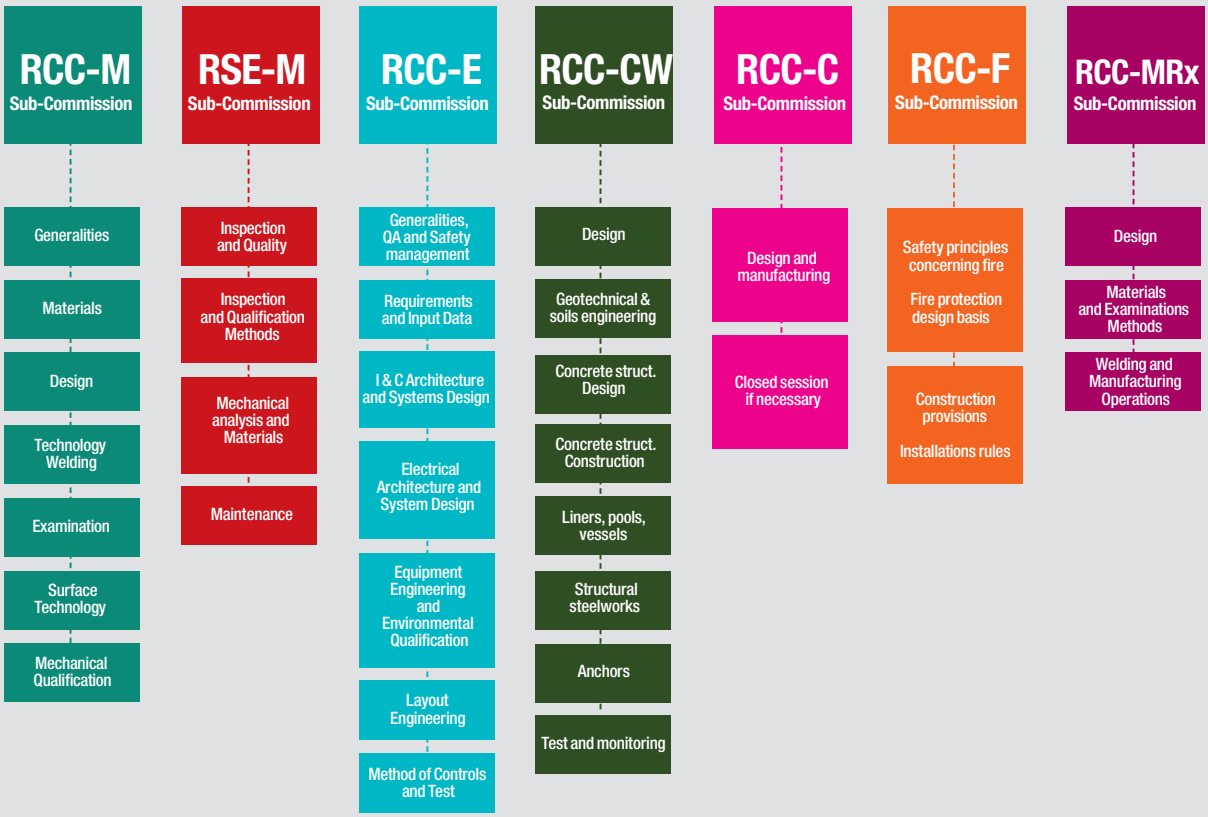
Texts approved by the Subcommittee Board are submitted to the Editorial Committee by the Subcommittee Chair for the prospect of being published by the Secretary-General.

In 2016:

33 permanent working groups were active.

The Subcommittees held between four and ten plenary sessions a year, depending on the Subcommittee.

GENERAL ACTIVITY OF THE SUBCOMMITTEES IN 2016



AFCEN'S SUBCOMMITTEES AND WORKING GROUPS

A.2.8 Users Groups

Users Groups are local structures, at a country scale, that are responsible for coordinating local activities within the scope of the relevant Subcommittee.

Users Groups' missions involve:

. pre-investigating Requests for Modification and Interpretation submitted by local AFCEN code users,

. informing users about the activities of AFCEN's Subcommittees and any changes to the corresponding codes,

. sharing feedback from the country's nuclear industry,

. facilitating adaptation of AFCEN codes to the local context (especially the country's regulations and industry best practices),

. helping to provide training for the AFCEN code users in their country,

. assisting with identifying communication needs (seminars, conferences, etc.) and their implementation in the country,

. helping ensure consistency in the various multi-lingual versions of the codes.

A.2 ORGANIZATION AND OPERATION

In 2016:

The RCC-M Users Group in the United Kingdom held one meeting chaired by member TWI (The Welding Institute) and was attended by over 15 representatives from the UK's nuclear industry.

The RCC-CW Users Group held its preliminary session in November 2016, with work scheduled to start in January 2017.

In China, two sessions of the Chinese Specialized Users Groups (CSUG) each attracted over 150 participants:

. The CSUG for RCC-M (design), RCC-M (fabrication), RSE-M, RCC-MRx, RCC-E, RCC-CW and RCC-C held a meeting in May 2016, chaired by CGN and CNNC.

. A CSUG meeting was organized in October 2016 for RCC-M (design), RCC-M (fabrication), RSE-M, RCC-E and ETC-F.

GENERAL ACTIVITY OF THE AFCEN CODE USERS GROUPS IN 2016

A.2.9 Steering Committees

Steering Committees are local structures that are responsible, at a country level, for coordinating and prioritizing the activities of all Users Groups according to the challenges specific to their country.

Steering Committees are governed by agreements with AFCEN.

At least, Steering Committees comprise:

. One representative from AFCEN's General Secretariat: the designated International Relations Coordinator.

. The Chairs of each Users Group in the country.

In 2016:

The Steering Committees in the United Kingdom and China, chaired by NNB and CGN respectively, each held one meeting during the year. Preliminary meetings between AFCEN and the Steering Committee Chairs or Secretaries were held in the run-up to AFCEN's General Meeting in March 2016. The Steering Committee in China held its meeting on October 25, 2016 in Beijing.

GENERAL ACTIVITY OF THE STEERING COMMITTEES IN 2016

A.3 AFCEN QUALITY MANAGEMENT

AFCEN has implemented a process-based management system covering the main missions that essentially rely on its members' participation in its purpose and which are based on the internal activities supporting those missions.

This process-based organization enables AFCEN to:

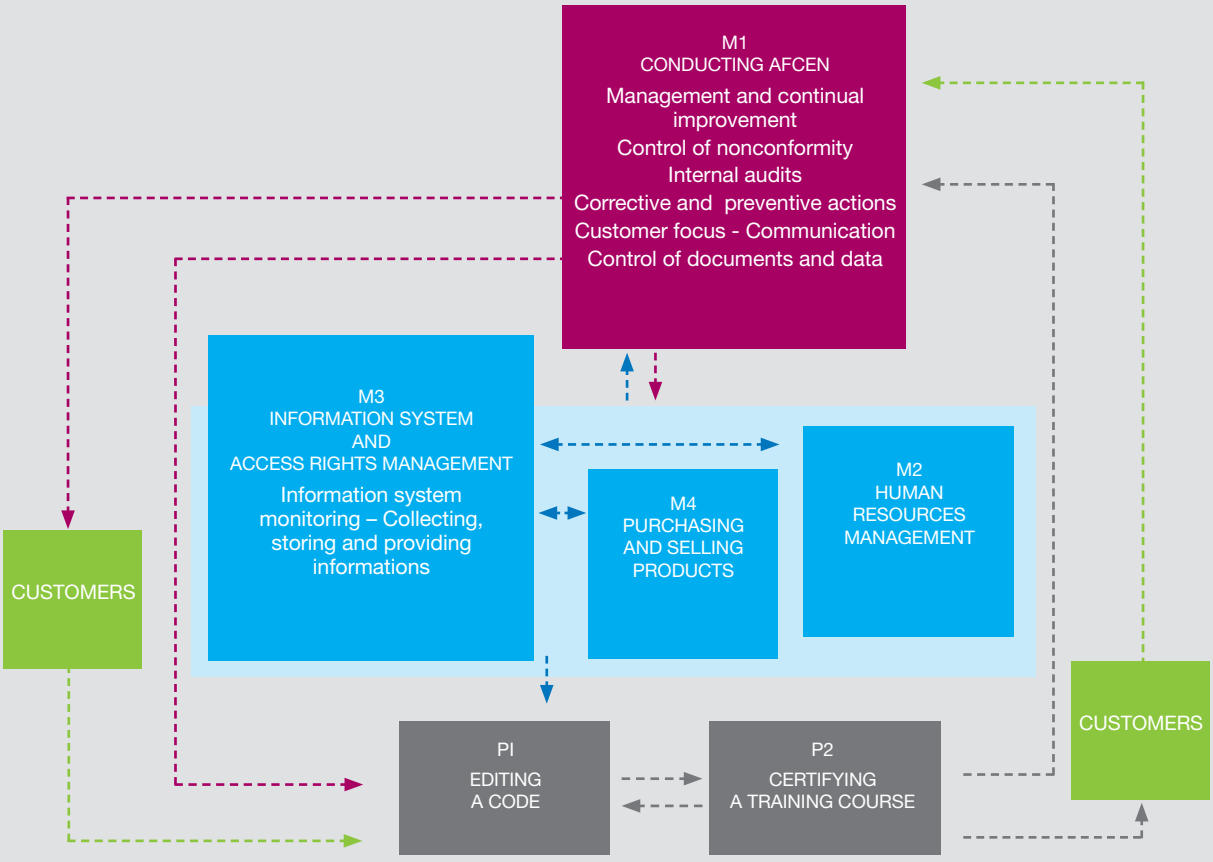
. supervise AFCEN's operation from a cross-functional perspective,

. manage the interfaces and resources,

. clearly define the responsibilities.

This process-driven organization includes coordinating actions on an international level and the goal of providing a framework geared towards the individual context in each country.

AFCEN's management system identifies two production processes and four support processes.



PROCESS MAP

Management of AFCEN is described in process M1.

Production processes P1 and P2 refer to the processes of producing codes and approving / certifying the associated training programs.

The identified support processes concern AFCEN general management (M1), skills management (M2), information system operation and access (M3), the purchase of services by AFCEN and the sale of AFCEN's products (M4).

A.3 AFCEN QUALITY MANAGEMENT

The Quality objectives associated with the processes are subject to periodic reviews to enable AFCEN to achieve its objectives and improve performance.

The Secretary-General acts as AFCEN's Quality Manager.

AFCEN was awarded ISO 9001 certification by Bureau Veritas in January 2014 (audit conducted late October 2013) Certification was renewed following an audit late October 2016.

AFCEN's general quality management activities in 2016 are summarized in the box below.

Two internal audits were conducted in 2016 into the code production process and the operation of the information system.

The AFCEN management review was held on March 30, 2016.

It enabled the association to:
. fine-tune the Quality indicators of the production processes in alignment with the objectives of AFCEN's management policy,
. check the actions taken to resolve any identified nonconformities and implement the associated corrective actions,
. examine the risk assessments for the production processes (P1 and P2) and decide which resources need to be implemented to mitigate such risks,
. check that the customer focus principle is correctly applied when dealing with requests from AFCEN members, and the French and English Safety Authorities.

In response to the customer focus principle, AFCEN agreed to:
. pursue its undertaking towards ASN to align with the ESPN Regulation by producing guides and local appendices specific to France,
. establish and publish criteria for the RCC-M, RSE-M and RCC-CW codes,
. disseminate the safety culture at the international level via the Users Group meetings in China and the United Kingdom,
. attend the WNE event,
. examine the prospect of providing specialized training support.
. ramp up its communication using brochures for each code, the annual report, the website, and so on,
. repeat the European workshop,
. re-examine and enhance its sales model.

Certification renewal audit:

On October 14, 2016, AFCEN passed the certification renewal audit. The audit was conducted in a constructive atmosphere. The effectiveness, maturity and appropriateness of AFCEN's management system were highlighted. The audit findings also emphasized the consistency between the quality policy, objectives and targets. The auditor emphasized how the management system in place is beneficial for managing and demonstrating the product quality assurance activities that are mission-critical in an specialized technical field.

AFCEN'S GENERAL QUALITY MANAGEMENT ACTIVITIES

A.4 RESOURCES (MEMBERS, RESOURCES PER SUBCOMMITTEE)

AFCEN enlists the expertise of its members to realize the activities inherent in the association's purpose.

A.4.1 AFCEN members in 2016

By the end of 2016, AFCEN had 61 members:

1	ADOLF-WUERTH (Germany)	22	EGIS (IOSIS Group)	43	ONET TECHNOLOGIES
2	AIB VINCOTTE (Belgium)	23	EIFFAGE TP	44	OXAND
3	ALSTOM Power Systems	24	EMERSON PM (USA)	45	PETERCEM
4	AMEC (UK)	25	ENDEL GDF SUEZ (Belgium)	46	ROLLS ROYCE FR (UK/FR)
5	APAVE	26	ESS AB (Sweden)	47	ROLLS ROYCE PLC (UK)
6	AREVA NP	27	GEODYNAMIQUE ET STRUCTRES	48	SAMT
7	AREVA TA	28	FLOWSERVE	49	SNCT
8	ASAP	29	GERB SA	50	SCHNEIDER ELECTRIC
9	BOUYGUES TP	30	GIS MIC Nucléaire	51	SCK CEN (Belgium)
10	BUREAU VERITAS	31	HALFEN GmbH (Germany)	52	SITES
11	CEA	32	HILTI (Lichtenstein)	53	SOGETI
12	CETIM	33	INSTITUT LAUE LANGEVIN	54	TRACTEBEL ENGINEERING (Belgium)
13	CLYDE UNION (UK)	34	INTERCONTROLE	55	TWI Ltd (UK)
14	CGN (Chine)	35	ITER	56	UGITECH
15	CNIM	36	JORDHAL (Germany)	57	VALINOX NUCLEAIRE
16	DAHER VANATOME	37	KAERI (South Korea)	58	VATTENFALL / Forsmark (Sweden)
17	DCNS	38	LISEGA (Germany)	59	VELAN
18	DEXTRA MANUFACTURING (Thailand)	39	NFM TECHNOLOGIES (China)	60	VINCI CONSTRUCTION
19	DOOSAN (Korea / UK)	40	NNB (UK)	61	WESTINGHOUSE FR (USA)
20	EDF	41	NUCLEXPERT		
21	EFECTIS France	42	NUVIA PROTECTION (MECATISS)		

AFCEN MEMBERS IN 2016

A.4 RESOURCES (MEMBERS, RESOURCES PER SUBCOMMITTEE)

A.4.2 Member involvement in the Subcommittees

In 2016, AFCEN members were involved in the Subcommittees as shown in Box below.

RCC-M (32 members)

VINCOTTE INTERNATIONAL, AMEC, APAVE, AREVA NP, AREVA TA, ASAP, BUREAU VERITAS, CEA, CETIM, CGN, CNNC, SPX CLYDE UNION, DAHER VANATOME, DCNS, DOOSAN, EDF, EMERSON PROCESS MANAGEMENT, ENDEL, Flowserve Pompes, EDF Energy, GIS-MIC, LISEGA, NUCLEXPERT, ONET, ROLLS ROYCE PLC, SNCT, SOGETI, TWI, UGITECH, VALINOX NUCLEAIRE, VELAN SAS, WESTINGHOUSE France.

RSE-M (17 members)

APAVE, AREVA NP, AREVA TA, ASAP, BUREAU VERITAS, CEA, CETIM, CNNC, DCNS, DOOSAN, EDF, ENDEL ENGIE, INTERCONTROLE, NNB, ONET COMEX, SOFINEL, WESTINGHOUSE France.

RCC-E (20 membres)

ALSTOM - GE, APAVE, AREVA NP, AREVA TA, BUREAU VERITAS, CEA, CGNPC, CNNC, CROUZET, EDF, EMERSON PROCESS MANAGEMENT, ENGIE, HILTI, NNB, PETERCEM, ROLLS-ROYCE CIVIL NUCLEAR, SCHNEIDER ELECTRIC, SGS, SICA Nucléaire, SOFINEL.

RCC-CW (24 members)

ADOLF-WUERTH, AMEC FOSTER WHEELER, AREVA NP, AREVA TA, BOUYGUES TRAVAUX PUBLICS, CEA, CGN, CNNC, DEXTRA MANUFACTURING, EDF, EGIS, EIFFAGE, GEODYNAMIQUE ET STRUCTURE, GERB SA, HALFEN GmbH, HILTI, JORDHAL GmbH, NFM TECHNOLOGIES, OXAND, SAMT, SITES, TRACTEBEL ENGIE, VATTENFALL FORSMARKS, VINCI.

RCC-F (7 members)

AREVA NP, CEA, CGN, CNNC, EDF, EFECTIS France, NUVIA PROTECTION (MECATISS).

RCC-C (7 members)

AREVA NP, CEA, CGN, CNNC, EDF, NNB, WESTINGHOUSE.

RCC-MRx (20 members)

AIB VINCOTTE, APAVE, AREVA NP, AREVA TA, BUREAU VERITAS, CEA, CGN, CNNC, CLYDE UNION, CNIM, EDF, ESS AB, ENDEL, INSTITUT LAUE LANGEVIN, ITER, KAERI, ONET, SCK CEN, TWI, VALINOX NUCLEAIRE.

AFCEN MEMBER INVOLVEMENT IN THE SUBCOMMITTEES IN 2016

A.4.3 Participation of member-appointed experts in AFCEN's work

AFCEN members were actively involved in the work of the Subcommittees (working groups and plenary sessions), as can be seen by the number of experts made available by the members.

In 2016, over 650 experts contributed to AFCEN's work as follows:

RCC-M	RSE-M	RCC-E	RCC-CW	RCC-F	RCC-C	RCC-MRx	COMMANDITES ESPN N1& N2/N3
203	94	88	178	20	20	85	139

EXPERTS' PARTICIPATION IN THE WORK OF AFCEN'S SUBCOMMITTEES AND USERS GROUPS

Note also the participation of foreign experts in the Users Groups.

China: 234 experts - UK: 57 experts

A.4.4 Oversight of AFCEN resources

AFCEN's resources and skills are managed according to processes M1 and M2.

Within each Subcommittee, the experts in the Subcommittee Board are appointed by the Subcommittee Chair based on their skills. Justification for each appointment is compiled in a skills record.

The resources corresponding to AFCEN's senior managers (Committee and Subcommittee Chairs, International Coordinators, etc.) are generally subject to an annual skills review and are continually monitored by the Board of Directors to anticipate any movements and replacements without disrupting AFCEN's operation.

Furthermore, in the event of a difficulty, the Subcommittees' resource requirements are escalated to the Board of Directors by the Chairs of the relevant Committees when such requirements cannot be satisfied by the members participating in the Subcommittees.

A.5 INFORMATION AND SALES SYSTEM

Several years ago, AFCEN implemented a policy to overhaul its internal and external tools in an effort to provide its members and customers with the latest collaborative technologies and services, as well as access to its digital publications. In 2016, AFCEN continued enhancing and upgrading its sales model to best meet users' expectations.

A.5.1 AFCEN-Core collaborative workspace

All AFCEN members have personalized and secure access to the AFCEN-Core collaborative workspace, which hosts all the work of the working group members in AFCEN's Subcommittees and Users Groups. The workspace improves interaction and provides all members with a portal featuring the latest information from their community. New workspaces are created as new working groups and Users Groups are formed.

A.5.2 The AFCEN.com website

AFCEN.com presents AFCEN's organization, activities and latest news.

The website also supports the AFCEN sales model. The e-shop sells AFCEN's publications with access via the online library.

A.5.3 Changes to the sales model for AFCEN's publications

In October 2015, the AFCEN sales model underwent a major upgrade by switching over to an online purchase and access model using the new e-shop platform on AFCEN.com.

In 2016, AFCEN took user feedback on board and made the model even easier to use. The changes are aimed at:

. prioritizing AFCEN's members by offering access to its publications at even more attractive prices,

. driving subscription renewals from one year to the next to give users unlimited access to the latest updates and publications,

. allowing multi-user corporate subscriptions, offering solutions better suited to companies with several AFCEN users.

AFCEN is looking to offer its users greater simplicity and an even broader array of services through its code subscription solutions:

. access to the digital versions of its publications,

. unlimited and anywhere access to its online library,

. access to the most recent versions of the codes upon publication,

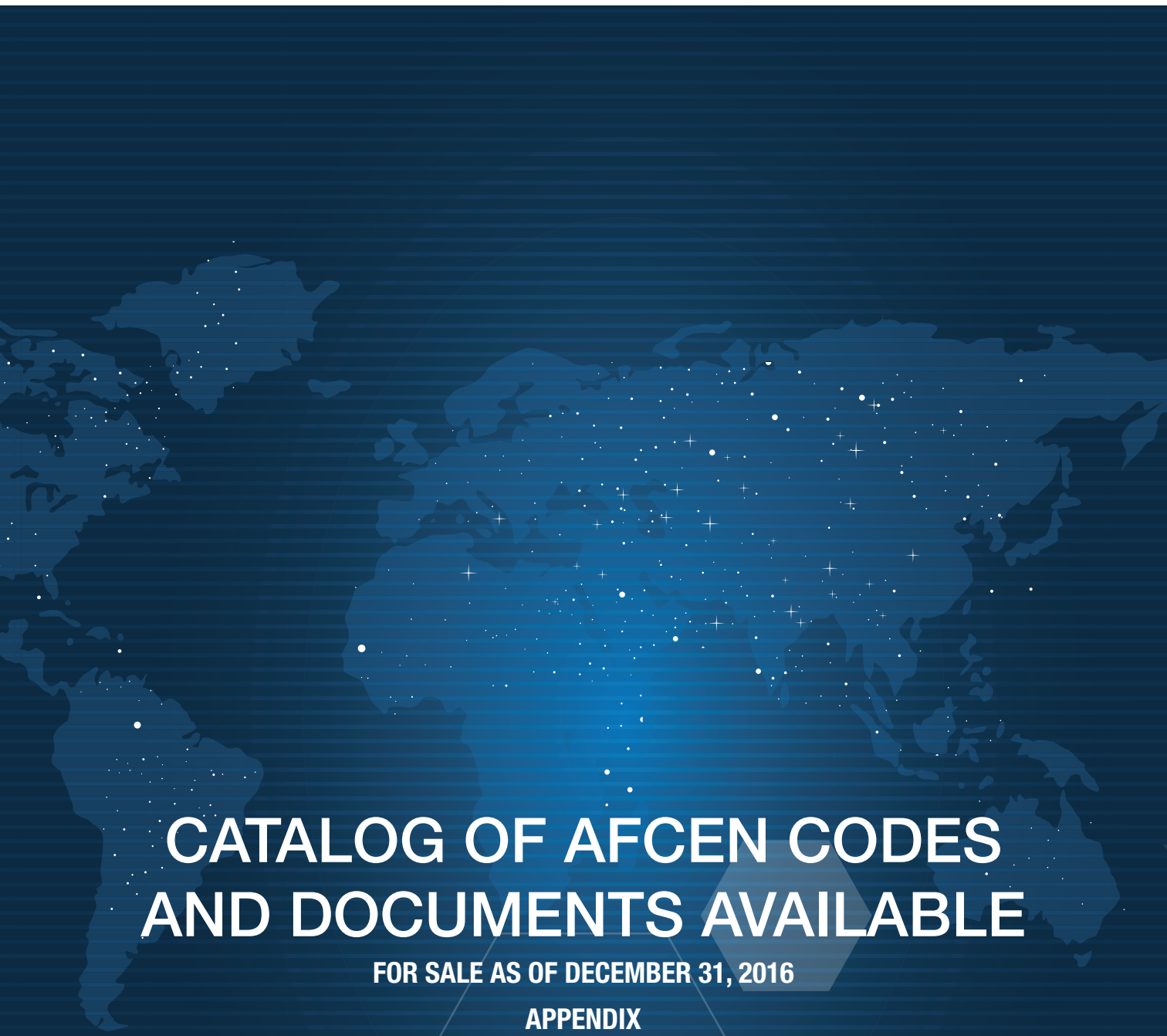
. access to the technical publications and criteria associated with the codes,

. access to the code history and versions in the different languages published.

Visit www.afcen.com to find out more!

afcen

Shaping the rules for a sustainable nuclear technology



CATALOG OF AFCEN CODES AND DOCUMENTS AVAILABLE

FOR SALE AS OF DECEMBER 31, 2016

APPENDIX

B

B PUBLICATIONS PRICES

Publications	Description	Available language	Paper book single purchase (€ excl tax)	PDF single purchase (€ excl tax)	Subscription for 1 year** (€ excl tax)
RCC-M 2016	Design and Construction Rules for Mechanical Components of PWR Nuclear Islands	FR	2950	/	Cf. Subscription
RCC-M 2012 + add 1, 2, 3 add 1, 2, 3 = addendum 2013, 2014, 2015	Design and Construction Rules for Mechanical Components of PWR Nuclear Islands	FR, EN	2820	2470	
RCC-M 2007 + add 1, 2, 3 add 1, 2, 3 = addendum 2008, 2009, 2010	Design and Construction Rules for Mechanical Components of PWR Nuclear Islands	FR, EN	/	1620	
CRITERIA RCC-M 2014	Prevention of damages in mechanical components. Introduction to the design, analysis and construction rules of the RCC-M	FR, EN	1590	1540	
PTAN RCC-M 2015	Radiation protection guide for the design of Nuclear Pressure Equipment for PWR plants in France	FR, EN	35	30	
PTAN RCC-M 2016 - 1	Guide ADR (Analyse de risques) pour ESPN N1	FR	210	200	
PTAN RCC-M 2016 - 2	Guide pour le contenu de la notice d'instructions d'un équipement sous pression nucléaire	FR	70	65	
PTAN RCC-M 2016 - 3	Guide RDE - Référentiel dimensionnel des équipements sous pression nucléaires N1	FR	90	85	
PTAN RCC-M 2016 - 4	KV faibles épaisseurs - Justification de l'exemption d'essai de flexion par choc pour les composants de faible épaisseur en aciers inoxydables austénitiques et les alliages base nickel	FR	75	70	
Subscription RCC-M	Publications included in the subscription: - RCC-M 2016 - RCC-M 2012 + mod 1, 2, 3 - PTAN RCC-M 2015 - Guide de Radioproteciton - PTAN RCC-M 2016 - 1 - Analyse de Risques - PTAN RCC-M 2016 - 2 - Guide Notice d'Instructions - PTAN RCC-M 2016 - 3 - Guide RDE - PTAN RCC-M 2016 - 4 - KV faibles épaisseurs - CRITERIA RCC-M 2014	•	/	/	2600
Subscription RCC-M + RCC-M 2007	Publications included in the subscription: - RCC-M 2016 - RCC-M 2012 + mod 1, 2, 3 - RCC-M 2007 + mod 1, 2, 3 - PTAN RCC-M 2015 - Guide de Radioproteciton - PTAN RCC-M 2016 - 1 - Analyse de Risques - PTAN RCC-M 2016 - 2 - Guide Notice d'Instructions - PTAN RCC-M 2016 - 3 - Guide RDE - PTAN RCC-M 2016 - 4 - KV faibles épaisseurs - CRITERIA RCC-M 2014	•	/	/	3550
RSE-M 2016	In-Service Inspection Rules for Mechanical Components of PWR Nuclear Islands	FR	1760	/	Cf. Subscription
RSE-M 2010 + add 1, 2, 3, 4 add 1, 2, 3, 4 = addendum 2012, 2013, 2014, 2015	In-Service Inspection Rules for Mechanical Components of PWR Nuclear Islands	FR, EN	1760	/	
PTAN RSE-M 2016 - WPS	Principe et justification de la prise en compte du préchargement à chaud dans le critère de résistance à la rupture brutale de la cuve d'un REP	FR	90	85	
Subscription RSE-M	Publications included in the subscription : - RSE-M 2016 - RSE-M 2010 + add 1, 2, 3, 4 - PTAN WPS 2016	•	/	/	1600

Publication	Description	Available language	Paper book single purchase (€ excl tax)	PDF single purchase (€ excl tax)	Subscription for 1 year** (€ excl tax)
RCC-E 2012	Design and construction rules for electrical equipment of nuclear islands	FR, EN	625	600*	Cf. Subscription
Subscription RCC-E	Publications included in the subscription: RCC-E 2012	•	/	/	600
RCC-CW 2016	Rules for design and construction of PWR nuclear civil works	FR, EN	1500	/	Cf. Subscription
RCC-CW 2015	Rules for design and construction of PWR nuclear civil works	FR, EN	1500	/	
ETC-C 2012	EPR Technical Code for Civil Works	FR, EN	1060	1010	
ETC-C 2010	EPR Technical Code for Civil Works	FR, EN	820	780	
PTAN RCC-CW 2015	French Experience and Practice of Seismically Isolated Nuclear Facilities	FR, EN	200	190	
Subscription RCC-CW	Publications included in the subscription: - RCC-CW 2016 - RCC-CW 2015 - PTAN RCC-CW 2015	•	/	/	1430
Subscription RCC-CW + ETC-C	Publications included in the subscription: - RCC-CW 2016 - RCC-CW 2015 - ETC-C 2012 - ETC-C 2010 - PTAN RCC-CW 2015	•	/	/	1720
RCC-C 2015	Design and construction rules for fuel assemblies of PWR nuclear power plants	FR, EN	850	820*	Cf. Subscription
RCC-C 2005 + add 1 add 1 = addendum 2011	Design and construction rules for fuel assemblies of PWR nuclear power plants	FR, EN	725	700	
Subscription RCC-C	Publications included in the subscription: - RCC-C 2015 - RCC-C 2005 + add 1	•	/	/	820
ETC-F 2013	EPR technical code for fire protection	FR, EN	400	380*	Cf. Subscription
ETC-F 2010	EPR technical code for fire protection	FR, EN	275	260	
Subscription RCC-F	Publications included in the subscription: - ETC-F 2013 - ETC-F 2010	•	/	/	380
RCC-MRx 2015	Design and Construction Rules for Mechanical Components of nuclear installations : high-temperature, research and fusion reactors	FR, EN	2940	/	Cf. Subscription
RCC-MRx 2012 + add 1 add 1 = addendum 2013	Design and construction rules for mechanical components of nuclear installations	FR, EN	2880	2620	
RCC-MR 2007	Design and construction rules for mechanical components of nuclear installations	FR, EN	/	2140	
Subscription RCC-MRx	Publications included in the subscription: - RCC-MRx 2015 - RCC-MRx 2012 + add 1	•	/	/	2670
Subscription RCC-MRx + RCC-MR	Publications included in the subscription: - RCC-MRx 2015 - RCC-MRx 2012 + add 1 - RCC-MR 2007	•	/	/	3200

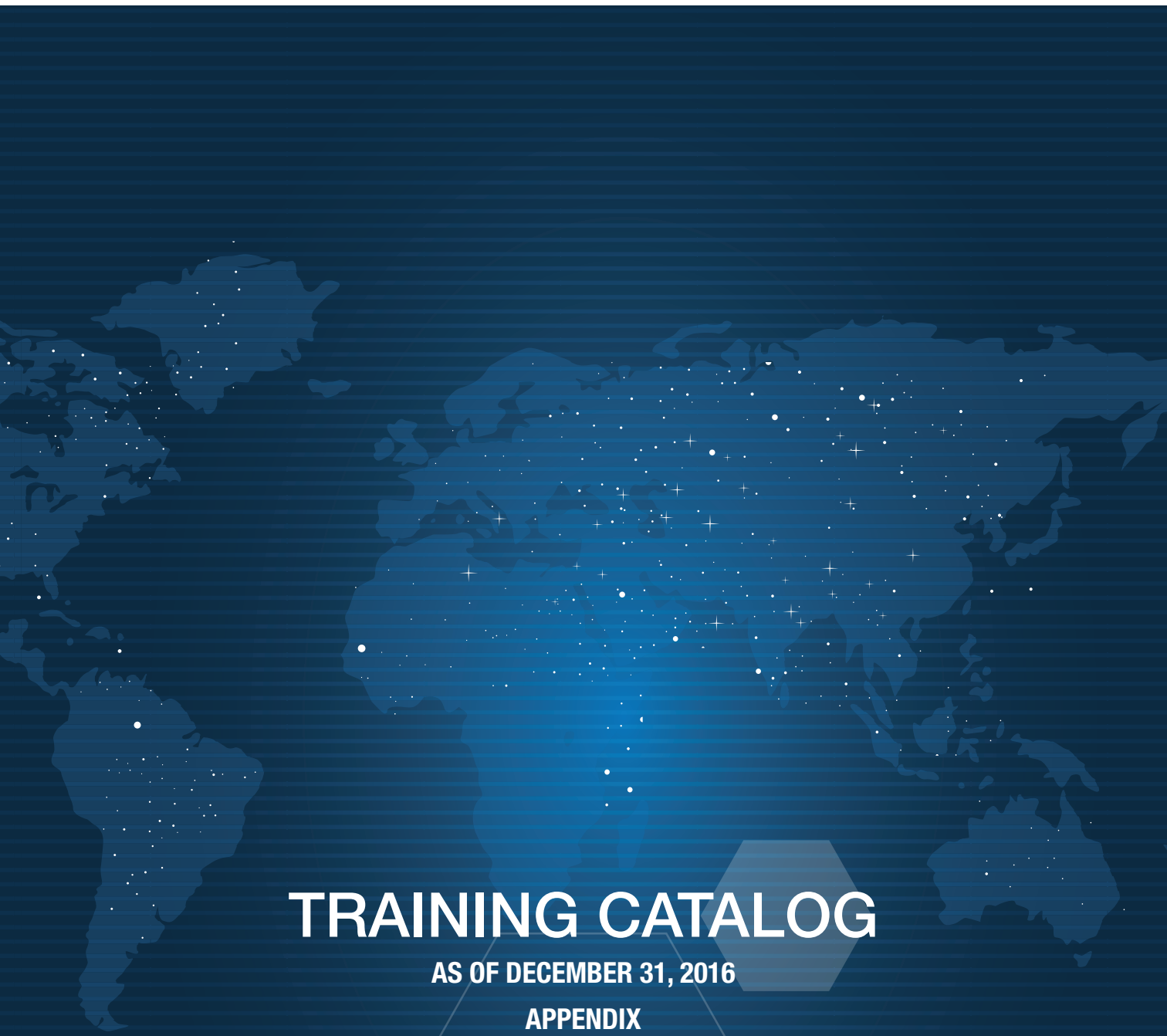
• Access to the publications in all available languages
* For the launch of the new AFCEN sales model, the subscription to the code is at the same price as the pdf single purchase and offers many more benefits.
** The subscription period is one year.

Nota : For clients who already purchased the basic edition and previous addendum :
. The last published addendum are still on sale
. The Add 3 (2015) of RCC-M 2012 and Add 4 (2015) of RSE-M 2010 are available
> To place an addendum order, please write to the following address : publications@afcen.com

Available for sale as of December 31, 2016

afcen

Shaping the rules for a sustainable nuclear technology



TRAINING CATALOG

AS OF DECEMBER 31, 2016

APPENDIX

C

C CATALOG OF CERTIFIED TRAININGS

Domaine	Référence	Code	Title of training	Duration	Language	Organisme
Mechanical field for PWR	M-001	RCC-M	Supply and materials according to RCC-M	1 d	French	APAVE
	M-002		Quality assurance according to RCC-M	1 d	French	APAVE
	M-003		Control methods according to RCC-M	1 d	French	APAVE
	M-005		Introduction to the RCC-M	2 d	French / English	Nuclexpert
	M-006		Understanding of the code RCC-M	2 d	French	APAVE
	M-007		Design of class 2 & 3 equipments	2 d	French	APAVE
	M-008		Fabrication - Welding - Monitoring according to the code RCC-M	2 d	French	APAVE
	M-009		Discovery of the code RCC-M	2 d	French	IS Groupe
	M-010		RCCM - Construction code for nuclear pressure equipment	3 d	French	Bureau Veritas
	M-011		Architecture and application of the code RCC-M	3 d	French	APAVE
	M-012		Nuclear pressure equipments - Discovery of the code RCC-M	3 d	French	VINCOTTE Academy
	M-013		Discovery of the code RCC-M	4 d	French / English	AREVA University
	M-014		RCC-M Code	5 d	Chinese	SNPI (CGN Group)
	EM-001	RSE-M	Introduction to the use of the code RSE-M	3 d	French	CETIM
	EM-002		Training to the code RSE-M	3 d	French	Bureau Veritas
	MRx-001	RCC-MRx	Discovery of the code RCC-MRx	3 d	French / English	AREVA University
	MRx-002		Training to RCC-MRx	3 d	French / English	Bureau Veritas
	MRx-003		Discovery of the code RCC-MRx	3 d	français	INSTN
Civil work	CW-001	RCC-CW	Civil engineering for nuclear (ETC-C and RCC-W): Construction	2 d	French / English	Ponts Formation Conseil
	CW-002		Civil engineering for nuclar (ETC-C and RCC-CW): Design	3 d	French / English	Ponts Formation Conseil
	CW-003		Civil engineering for nuclear (ETC-C and RCC-CW): General introduction	1 d	French / English	Ponts Formation Conseil
Electrical and I&C systems	E-001	RCC-E	Introduction to the code RCC-E (Design and construction rules regarding electric material)	1 d	French / English	AREVA
	E-002		RCC-E 2012 - Qualification and manufacturing of safety classified products RCC-E 2012 - Optional day EDF Monitoring	3 d 1 d	French	SICA Nucléaire
	E-003		Use of the RCC-E	4 d	French	APAVE
Fire protection	F-001	RCC-F	ETC-F : fire protection conception and construction rules	4 d	French / English	EFECTIS

Note:

The trainings certified by AFCEN are delivered by a partner organization. Locations and dates appearing in this catalog were provided from them. The AFCEN does not warrant that these informations include the latest updates.

Find all our trainings on www.afcen.com

afcen

Shaping the rules for a sustainable nuclear technology

AFCEN
1 Place Jean Millier
F-92400 Courbevoie
www.afcen.com