afcen

Shaping the rules for a sustainable nuclear technology

ANNUAL REPORT

2018

CONTENTS

FOREWORD
BY AFCEN'S PRESIDENT

Philippe BORDARIER,
President

"One of my overriding aims during 2018 was to define and implement a strategic plan to steer AFCEN down a clear and robust road for the next four years.

This plan reflects our determination to see our codes continue gaining traction and achieve even greater recognition for their ability to guarantee safety and raise the efficiency bar in industry.

We intend to share this plan and put its guidelines into action with a supporting hand from AFCEN's lifeblood, namely its leaders, members and experts. We are committed to modernizing AFCEN's governance structure, developing our portfolio of codes and publications, building closer ties with our clients and helping industry professionals lead their projects.

To drive our ambitions, we have chosen three values that are deeply in the AFCEN's DNA, namely the expertise that injects the added value into all our work, the collaborative culture that brings success to all our joint projects, and the accountability that should guide everyone's actions if our codes are to bring safety and create a competitive advantage.

We also decided to change the association's name in 2018.

"AFCEN - French Association for the design, construction and in-service inspection rules for electro-nuclear reactors" was simply changed to "AFCEN".

AFCEN is focused on delivering support and guidance to various types of nuclear facilities and has created an international platform for developing nuclear codes.

AFCEN hereby presents its fifth activity report on behalf of its 73 members (operators, manufacturers, equipment suppliers, organizations, consulting firms, training providers, and so on), who represent an accurate cross-section of the stakeholders involved in both the French and international nuclear industry. By subscribing to our association, our members send out a clear message about their commitment to see AFCEN play an instrumental role in their success. I would like to thank them for making such a significant contribution to AFCEN's success stories in 2018.

Dear readers, as you thumb through the pages of this report, you will see a convincing picture emerging of how AFCEN is thriving. That is why I would invite you to promptly join one of our working groups

I look forward to seeing you at AFCEN's next Congress in Paris from March 26 to 28."

MESSAGE
FROM AFCEN'S VICE-PRESIDENT

Françoise DE BOIS,
Vice-President

"During the Conference in Dijon on December 3, Nuclear Valley invited ASN (French Nuclear Safety Authority) to conclude on AFCEN's three-year work program.

Bearing testament to the high quality of its plan and its ability to establish effective dialog, AFCEN scored an unimaginable result in 2015 with ASN acknowledging the solutions proposed in the 2018 edition of the RCC-M code. Even ASN stressed that such approval was "unusual", but that the French nuclear industry needed a construction code like RCC-M.

Within AFCEN and, I believe, in each of the companies that took part, we can be highly proud of the efforts that have been invested in AFCEN's three-year work program."

SIGNIFICANT EVENTS OF 2018

In 2018, AFCEN defined its strategic plan for the next four years

In a bid to guide and shape AFCEN's development over the next four years, its President, Philippe Bordarier, spearheaded a strategic plan in 2018 featuring the support and involvement of all the association's leaders. Staying true to its mission statement, AFCEN is actively pursuing a strong set of ambitions geared towards the requirements and opportunities in the current environment. Driven by three values (expertise, collaboration and accountability), AFCEN is implementing the strategic plan according to the six focus areas defined in the following figure.

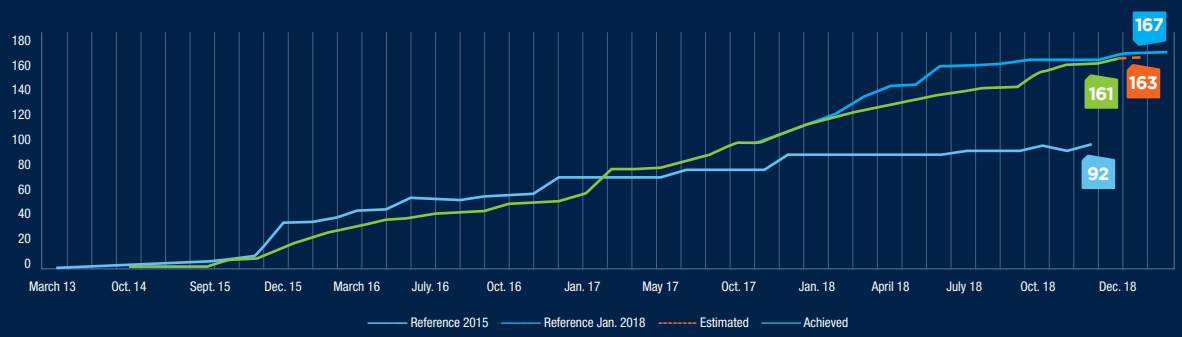
AFCEN'S STRATEGIC PLAN

SIGNIFICANT EVENTS OF 2018

In 2018, AFCEN reached the objectives in the three-year program relating to the ESPN Regulation

The work program, which was aimed at producing a professional technical standard to address the essential safety requirements of France's ESPN Regulation covering the design, manufacture and operation of nuclear pressure components, was completed on time (over 150 deliverables produced), and its conclusions were introduced into the 2018 editions of the RCC-M and RSE-M codes. ASN and GSEN examined and evaluated the entire program.

AFCEN is currently preparing an additional work program to consolidate and future-proof the lessons learned.



PROGRESS CURVE FOR THE DELIVERABLES OF THE THREE-YEAR ESPN PROGRAM

"During the Conference in Dijon on December 3, 2018, Nuclear Valley invited ASN (French Nuclear Safety Authority) to conclude on AFCEN's three-year work program. Julien Collet, Executive Vice-President of ASN, spelt out the facts. In 2015, France was clearly struggling to apply the ESPN Regulation. Everyone had their own ideas on the situation: the nuclear industry (acting through AFCEN) tabled and implemented an ambitious plan to clarify the regulation's requirements along with the corresponding solutions, while ASN defined a transitional period for deferring full and unconditional application of the regulation until late 2018 on its own terms. Bearing testament to the high quality of its plan and its ability to establish effective dialog, AFCEN scored an unimaginable result in 2015 with ASN acknowledging the solutions proposed in the 2018 edition of the RCC-M code. Even ASN stressed that such approval was "unusual", but that the French nuclear industry needed a construction code like RCC-M.

Within AFCEN and, I believe, in each of the companies that took part, we can be highly proud of the efforts that have been invested in AFCEN's three-year work program.

I would like to share two memories with you.

The first is that I joined AFCEN in 2014 as Vice-President, Treasurer and Administrator. Due to my position at Framatome, it was only natural that I took part in defining the three-year work program in 2015. It was a great eye-opener to attend a work meeting where professionals, sometimes competitors or representatives from organizations at both ends of the spectrum, such as equipment manufacturers and conformity assessment bodies, were sitting around the same table and brainstorming ways of building an appropriate solution without wasting any time. I also witnessed how our AFCEN experts freely gave their expert opinions without any fear of betraying their duty towards their respective companies. I discovered the tremendous power wielded by such a professional association as AFCEN!

The second is the Steering Committee meeting in January 2016 with ASN, conformity assessment bodies and leaders of the working groups that had been set up to address the three-year work program. To kick off the meeting, we presented a series of letters from EDF, Framatome, Westinghouse and ONET pledging their commitment to the program. Despite finding this initiative somewhat "unusual", ASN confirmed that it would provide its feedback on topics like risk analysis, dimensional reference standard, instructions manual and inspectability, ahead of the publication of the 2016 edition. By the end of March, we received the precious acknowledgement of the solutions outlined in the work program.

This experience can be seen as a major sign of encouragement that AFCEN should not be afraid about enterprising and persevering."

Françoise De Bois, Vice-President of AFCEN

SIGNIFICANT EVENTS OF 2018

In 2018, AFCEN published three major changes to the RCC-M, RSE-M and RCC-MRx codes, as well as two enhanced editions of the RCC-C and RCC-CW codes

The major 2018 editions of the RCC-M and RSE-M codes incorporate a broad array of addenda to reflect members' work on the three-year ESPN program and other relevant developments. The major 2018 edition of the RCC-MRx code includes the outcome of three years of development and feedback. The 2018 annual editions of the RCC-C and RCC-CW codes have been updated in response to recent changes and developments.

During the year, AFCEN also released 20 technical publications (PTAN).

EDITIONS PUBLISHED IN 2018

In 2018, AFCEN met with nuclear industry professionals at the international WNE exhibition

AFCEN attended the third consecutive WNE exhibition from June 26 to 28, 2018, at the Parc des Expositions venue in Villepinte, France.

The three-day exhibition proved to be a productive networking platform for AFCEN, which ran a series of breakout sessions on training and CEN Workshop 64. The event also included a mini-conference on codes and standards at the EDF pavilion, a visit from a Chinese delegation to the AFCEN stand and especially an interview with AFCEN's President on the association's strategic plan, which was published in the WNE Tribune newspaper. Other highlights included a meeting between AFCEN's administrators and Gerassimos Thomas, Deputy Director-General for Energy at the European Commission.

AFCEN AT THE WNE

SIGNIFICANT EVENTS OF 2018

In 2018, AFCEN stepped up its collaborative ties with Chinese industry

Commissioning of the first unit of the TAISHAN EPR (AFCEN codes underlie the technical standards used as a blueprint for the plant's design) heralded a new success for AFCEN and collaboration between France and China. Their cooperation paved the way for four work sessions of the Users Groups in 2018, as well as the implementation of the NEA-AFCEN memorandum of understanding for codes and standards.

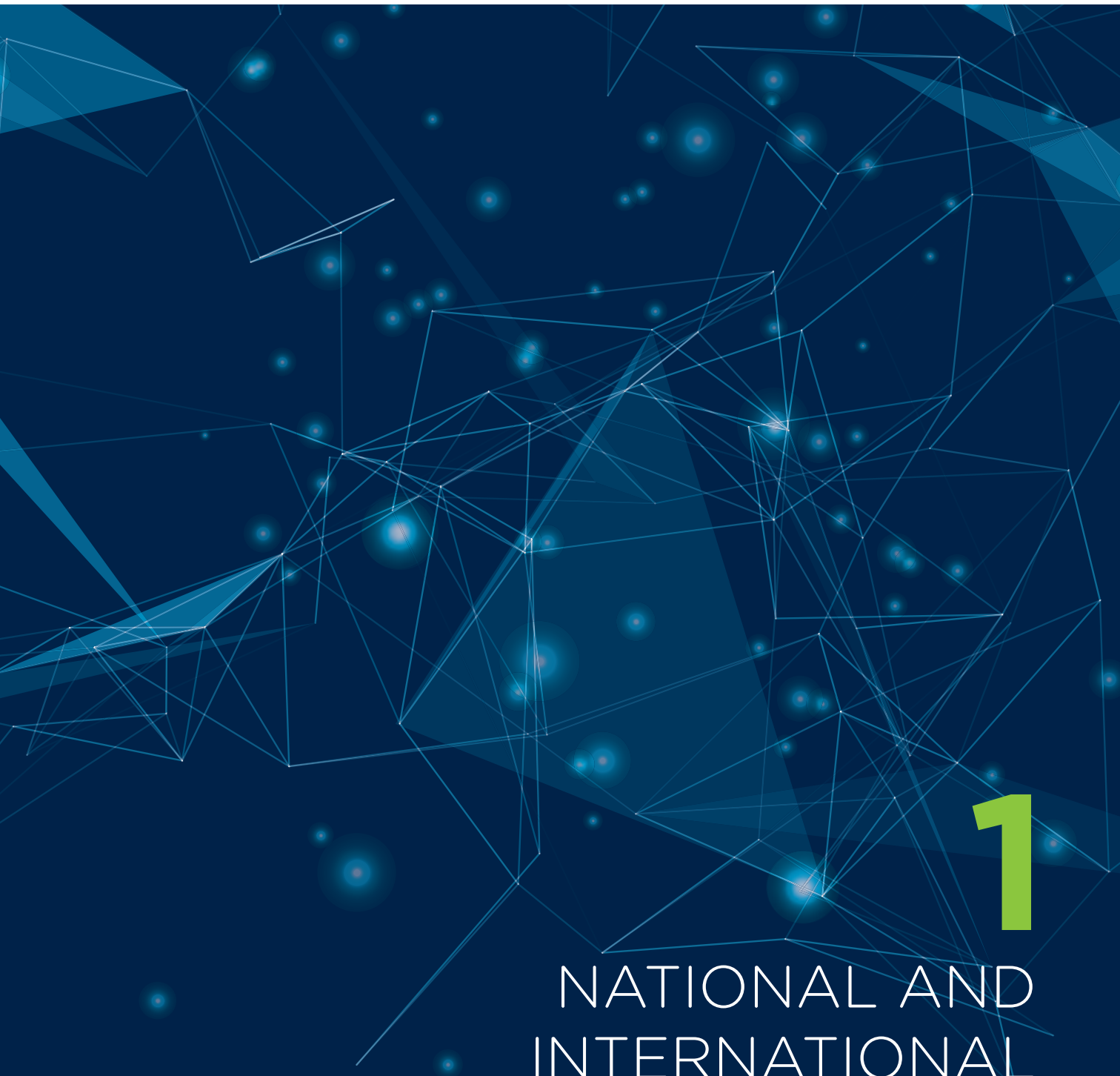
SITE OF THE TAISHAN NUCLEAR POWER PLANT IN CHINA

In 2018, AFCEN improved access to its publications

Leveraging its agreement with standards organization AFNOR, AFCEN took simplicity and user-friendliness to another level by giving users access to an online viewer for its codes.

afcen

Shaping the rules for a sustainable nuclear technology



1

NATIONAL AND INTERNATIONAL CHALLENGES

1.1 USE OF AFCEN CODES AROUND THE WORLD

AFCEN codes are used as a reference for nuclear components and structures in over 100 power plants currently in operation (95), under construction (18) or in planning stages (15) around the world.

Since 1980, AFCEN codes have served as the 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 mechanical components and nuclear civil engineering works in South Africa (Koeberg) and South Korea (Ulchin). These reactors actually represent the first applications of AFCEN's codes. AFCEN codes have subsequently been used to design, build and operate the Daya Bay, Ling Ao power plants and the main reactors in China, as well as different EPRs around the world.

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

Project	Country	States of the reactors			Number of reactors	Number of reactors that are using or have used AFCEN codes		Series of codes used						
		P	C	0		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 power plants	France			58	58	16	58	x	x	x	x	x		
Type CP1	Afrique du Sud			2	2	2		x			x			
	Corée			2	2	2		x			x			
M310	Chine			4	4	4	4	x	x	x	x			
CPR 1000 & ACPR1000	Chine		6	22	28	28	28	x	x	x	x			
CPR 600	Chine			6	6	6	6	x	x	x	x			
EPR	Finlande		1		1	1		x						
	France		1		1	1	1	x	x	x	x	x	x	
	Chine		1	1	2	2	2	x	x	x	x	x	x	
	UK	2	2		4	4	4	x	x	x	x	x	x	
	Inde	6			6	6	6	x	x	x	x	x	x	
HPR1000	Chine	4	4		8	8	8	x	x	x		x	x	
	UK	2			2	2		x				x	x	
PFBR	Inde		1		1	1								x
RJH	France		1		1	1								x
ITER	France		1		1	1								x
ASTRID	France	1			1	1								x
		15	18	95	128	86	117							

SUMMARY OF THE USE OF AFCEN CODES AROUND THE WORLD

Furthermore, AFCEN codes are being used as a reference for the EPR2 project in France. The EPR2 project is currently in the pre-FID stage and is modeled on the EPR design, but builds on the feedback from the design and construction of the Flamanville 3 and Taishan 1-2 projects. The codes used include the most recent editions, including RCC-CW and RCC-F, whose initial versions (ETC-) were used for the previous EPR projects and have since been updated.

In addition to these formal applications of the codes, AFCEN codes also serve for designing many other nuclear facilities and equipment, based on their reputation but 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, European Synchrotron Radiation Facility, European Spallation Source (ESS - under construction in Sweden), Multi-purpose hYbrid Research Reactor for High-tech Applications (MYRRHA - in the planning stages in Belgium).

. 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 for the 1300 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-E and RCC-C codes are used for the operation of all of France's nuclear power plants.

EPR

AFCEN codes are also serving as a reference for certifying the EPR reactor in France (Flamanville 3 project). The RCC-M (2007 edition + 2008 addenda), RSE-M (2010 edition), RCC-E (2005 edition) and RCC-C (2005 edition + 2011 addenda) codes are used. The project's fire protection rules are based on EDF's proprietary specifications and the EPR's specific design requirements (ETC-F Revision G of 2006), which were subsequently included in AFCEN's collections (ETC-F 2010 edition). The project's civil engineering construction rules are based on EDF's proprietary specifications and the EPR's specific design requirements (ETC-C Revision G of 2006), which were subsequently included in AFCEN's collections (ETC-C 2010 edition).

EPR2

The EPR2 project is currently in the pre-FID stage and is modeled on the EPR design, but builds on the feedback from the design and construction of the Flamanville 3 and Taishan 1-2 projects. The codes used are based on recent editions, since the versions used for the previous EPR projects have been updated.

ASTRID

The 2012 edition of the RCC-MRx code has been chosen for France's ASTRID reactor project (Advanced Sodium Technological Reactor for Industrial Demonstration). This code proved to be the obvious choice due to its close links with the RCC-MR code, which France's nuclear industry has used as a reference for its sodium-cooled fast reactors, and also because it incorporates all the feedback and R&D breakthroughs achieved by CEA, Framatome and EDF.

1.1 USE OF AFCEN CODES AROUND THE WORLD

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.

The 2012 edition of the RCC-MRx code is serving as a reference for experimental reactors.

ITER

ITER used the 2007 version of the RCC-MR code as a reference for its vacuum vessel. 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). RCC-MRx is also being used for other components.

OTHER USES OF AFCEN CODES

Nuclear marine propulsion in France:

The construction of nuclear marine propulsion equipment (generally concerning the key equipment for the main primary and secondary systems), which is the responsibility of Naval Group, 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.).

1.1.2 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: National Nuclear Safety Authority) in 2007 (NNSA Decision no. 28).

By the end of 2018, 44 of the 57 units in operation or under construction in China were using AFCEN codes, with 34 in operation and 10 under construction. These units correspond to the M310, CPR-1000, ACPR-1000, HPR-1000, CPR-600 and EPR projects shown in blue font in the table below.

During 2018:

. Taishan #1 was commissioned, the world's first EPR unit to use AFCEN codes.

. In addition to unit 1 of the Taishan EPR, six new reactors were commissioned, one of which designed according to AFCEN codes (Yangjiang 5).

Lastly, note that no new projects were launched in 2018.

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 (5) Fangchenggang (2) Fuqing (4) Fangjiashan (2)**	**Hongyanhe (2) Yangjiang (1) Tianwan phase III (2)**	**28**
HPR 1000		**Fuqing (2) Fangchenggang (2)**	**4**
CPR600	**Qinshan II (4) Changjiang (2)**		**6**
CANDU 6	Qinshan III (2)		2
AP1000	Sanmen (2) Haiyang (2)		4
EPR	**Taishan (1)**	**Taishan (1)**	**2**
AES-91	Tianwan (4)		4
HTR-PM		Shidaowan (1)	1
CFR-600		Xiapu (1)	1
Total number	**45**	**12**	**57**

LIST OF REACTORS CURRENTLY UNDER CONSTRUCTION OR IN OPERATION IN CHINA AS OF LATE 2018
(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 reported to be serving as a baseline for the FBR 1 and 2 projects. Feedback from the construction of the PFBR reactor is being incorporated into the RCC-MRx code, which has replaced RCC-MR.

INDIAN PFBR REACTOR

EPR

In 2017, EDF and NPCIL (Nuclear Power Corporation of India) resumed discussions for the supply of six EPR reactors. The technology supplied to NPCIL is based directly on AFCEN codes.

1.1 USE OF AFCEN CODES AROUND THE WORLD

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 the Hinkley Point C site (HPC) and two other plants at Sizewell C (SZC).

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

. RCC-M 2007 edition + 2008-2009-2010 addenda

. RCC-E 2012 edition

. ETC-C 2010 edition

The project's fire protection rules are based on EDF's proprietary specifications and the EPR's specific design requirements (UK version of ETC-F Revision G of 2007), which were subsequently included in AFCEN's collections (ETC-F 2010 edition).

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 or HPR-1000) is undergoing the GDA process in the UK (Bradwell B site). The design is mainly based on a reactor that is currently being built in China (Fangchenggang 3). AFCEN codes are being used except for the civil engineering works.

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 (German Nuclear Safety Standards). The RCC-M code was chosen as a 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. As for the 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 focused on achieving the following key objectives:

1. Continue developing working platforms for the nuclear industry in each area where its codes are used, mainly the UK 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 by supporting projects in France's nuclear industry.
3. Build on the industrial practice of international users (United Kingdom and China in particular) and the technical instructions for certifying projects that have used AFCEN codes as a reference (General Design Assessment in the UK for example).
4. Listen to the proposed changes to the codes voiced by participants in CEN WS 64, which contains leading players in Europe's nuclear industry looking to improve their expertise in AFCEN's codes.
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

AFCEN pursues an extensive range of rewarding initiatives in France. AFCEN's editorial activities are described in Chapter 2, while training activities are detailed in Chapter 3.

Relationship with France's nuclear Safety Authority

AFCEN's senior management meets the Nuclear Safety Authority's executives every two years. The last meeting was held on January 5, 2017. AFCEN's Board of Directors met with 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).

In addition, AFCEN holds monthly meetings with ASN's Nuclear Pressure Components Division for the purpose of incorporating the requirements of the ESPN Regulation into its codes. This relationship of trust between both organizations is instrumental in the success of the three-year ESPN program, which is covered by the 2018 editions of the RCC-M and RSE-M codes.

AFCEN annual day

On June 25, 2018, AFCEN held a special day for its experts, contributors and members.

During the event, various workshops were held to present the association's work activities, organizational structure and core principles, as well as the strategic plan.

Attendees took great interest in the workshops covering AFCEN's international activities and the presentation of the latest Subcommittee works.

Participation in the WNE exhibition

AFCEN attended the third consecutive WNE exhibition from June 26 to 28, 2018, at the Parc des Expositions venue in Villepinte, France.

1.2 AFCEN'S ACTIVITIES AROUND THE WORLD

The three-day exhibition proved to be a productive networking platform for AFCEN, which ran a series of breakout sessions on training and CEN Workshop 64. The event also included a mini-conference on codes and standards at the EDF pavilion, a visit from a Chinese delegation to the AFCEN stand and especially an interview with AFCEN's President on the association's strategic plan for the next five years, which was published in the WNE Tribune newspaper. Other highlights included a meeting between AFCEN's administrators and Gerassimos Thomas, Deputy Director-General for Energy at the European Commission.

PRESENTATION OF AFCEN'S STRATEGIC PLAN BY PHILIPPE BORDARIER

1.2.2 European Union

In keeping with its international development strategy, AFCEN launched an exercise in "Europeanizing" codes 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/WS 64 workshop was launched in 2014 to investigate the potential needs for creating a code for civil engineering works (see Section 3.2.3) and mechanical works for Gen II to Gen IV reactors. Workshop members submitted several proposed changes to the RCC-M, RCC-MRx and RCC-CW codes to AFCEN, which has responded positively about the prospect of incorporating the majority of the proposals into the codes.

Phase 3 of the workshop is now ready. The kick-off meeting is due to be held in January 2019. The aim of this phase is to invite proposals for code changes from the operators, the authorities' technical support teams and industry professionals who could ultimately be involved in evaluating or taking part in nuclear projects using AFCEN codes. Phase 3 has four key objectives:

. Strengthen synergistic ties between European experts on nuclear codes to minimize fragmented best practices across the nuclear industry and give international rules greater emphasis while promoting and defending European requirements and practices.

. Allow future nuclear project leaders to raise awareness of their project's constraints and suggest changes to the codes.

. Engage operators and manufacturers with a collaborative process for preparing and defining a standard for managing aging facilities, sourcing spare parts and extending the service life of nuclear power plants.

. Raise awareness of AFCEN's codes among entities potentially involved in evaluating nuclear reactors during an invitation to tender for the purpose of developing new nuclear production assets as part of the long-term plan to renew Europe's existing nuclear infrastructure.

In addition to the three codes already involved, Phase 3 also invites electrical experts to take part in the process based on the RCC-E code.

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. Furthermore, AFCEN highlighted the value of this approach when developing the implementation programs during the 2018-2025 period of the European Union's Strategic Energy Technology Plan (SET-Plan). A collaborative process for defining and creating the codes would appear to be a key enabling condition for identifying the potential gains in competitive advantage for European industry and driving research, innovation and demonstration efforts across the EU.

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 MWe 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 into Chinese following authorization from AFCEN between 2008 and 2012, and this initiative was strongly supported by various Chinese governmental organizations (NEA, NNSA, CMIF, etc.).

From 2008 to 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 have strengthened their relationship with their French counterparts since 2015 by holding several technical sessions (Chinese Specialized Users Groups or CSUGs) to discuss the contents and interpretation of the codes. There are currently eight CSUGs covering all of AFCEN's technical fields. By December 2018, 38 CSUG meetings had been held in China, during which experts presented and discussed 450 technical topics.

1.2 AFCEN'S ACTIVITIES AROUND THE WORLD

In 2017, AFCEN and NEA signed a long-term memorandum of understanding relating to nuclear standards and codes, which took AFCEN's codes one step closer to mainstream use in China. The agreement gives Chinese standardization bodies official permission to use AFCEN codes as a reference for drafting the country's future nuclear standards (NB standards), while allowing for their translation into Chinese. The agreement also encourages regular technical discussions between China and France with a view to working together in enhancing the nuclear codes and standards by incorporating the highly dynamic feedback from the nuclear industries in both countries.

Activities in 2018

Taishan 1 enters active service

The world's nuclear industry had its watershed moment in 2018 when the very first EPR unit was commissioned at the Taishan site.

SITE OF THE TAISHAN NUCLEAR POWER PLANT IN CHINA

This success story can be credited to the close working ties between the French and Chinese nuclear industries, especially the TNPJVC joint venture (Taishan Nuclear Power Joint Venture Co.). AFCEN codes (RCC-M, RSE-M, RCC-E, ETC-F and RCC-C) played a role in this achievement by providing a coherent set of key technical standards for ensuring nuclear safety and spanning each phase of the project, from licensing, design and manufacturing through to installation, testing and operation. Training sessions were also organized with AFCEN's support to improve uptake of AFCEN code requirements among local manufacturers.

TNPJVC TEAM – CHINA

Other events

In 2018, AFCEN's main actions relating to activities in China were as follows:

Meetings in China to implement the NEA-AFCEN agreement:

. Further to the MOU that AFCEN signed with NEA in 2017, both parties formally launched the governance structure for Franco-Chinese cooperation on nuclear codes and standards on September 7, 2018, in Beijing. A Steering Committee and Expert Assembly featuring 30 Chinese experts and 30 AFCEN experts were set up to implement the agreement signed on November 30, 2017, which heralds a milestone in AFCEN's development in China.

. In addition to the official event for creating the Steering Committee and Expert Assembly, the first work session for Chinese and French experts on nuclear codes (Expert Assembly meeting) was held on September 6. This half-day session proved to be a hotbed of discussion and allowed participants to identify potential technical subjects of benefit to both parties.

SEPT. 2018
EXPERT ASSEMBLY MEMBERS DURING THEIR FIRST WORKING SESSION
BEIJING, CHINA

Visit from a delegation to Paris during AFCEN Day:

. To coincide with AFCEN Day late June 2018 in Paris, AFCEN received a large Chinese delegation from NEA (National Energy Administration), CGN, CNNC and other industrial groups. In addition to taking part in the AFCEN seminar, delegation members also attended an event to celebrate the MAI's 10th birthday (Materials Ageing Institute) at the EDF Lab Les Renardières and participated in a session illustrating how AFCEN codes continually incorporate the results and findings of EDF's R&D teams.

JUNE 2018
CUG CHAIRMAN T. QIAN (CNNC) WITH AFCEN'S CHINESE DELEGATION AND DIRECTOR OF THE MAI (MATERIALS AGEING INSTITUTE)
MORET-SUR-LOING, FRANCE

1.2 AFCEN'S ACTIVITIES AROUND THE WORLD

Users Groups meetings in China, and AFCEN training courses:

. In April, May, September and subsequently in November 2018, eight further meetings were held between AFCEN's experts and members of the Chinese Specialized User Groups (CSUGs) in Wuhan, Chengdu, Beijing and Suzhou respectively. AFCEN's experts 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.

. The RCC-M CSUG session in Suzhou in November 2018 was also attended by John Wintle, Chairman of the RCC-M UK Users Group. This international meeting featured experts from China, Great Britain and France, and ended with feedback on their use of the RCC-M code in their respective contexts.

. After AFCEN had formally certified the Chinese-language RCC-M training in 2016, which was subject to an agreement between SNPI and AFCEN, two new RCC-M training sessions were held in Suzhou in 2018. AFCEN training completion certificates were issued to the trainees who passed the final exam.

Outlook for AFCEN in China in 2019

In 2019, AFCEN will pursue its policy of developing cooperation on codes and standards, and will continue honoring its commitments towards its Chinese partners. The main milestones and prospects are as follows:

. In the wake of the MOU with NEA, set up a committee to oversee all cooperation actions and define the governance rules and terms of operation for the expert working group.

. Participation of AFCEN's Chinese members in the March 2019 Congress in Paris, including the Subcommittee meetings and technical breakout sessions.

. Organize new 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.

. Extend the agreement with SNPI concerning AFCEN-certified Chinese-language training courses and either develop a new course on a new AFCEN code or adapt the existing courses on a given code according to a new format.

. Adapt AFCEN's IT tools and systems to suit the local context in China.

1.2.4 United Kingdom

EPR projects

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

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

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

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 SZC site based on the same design as the two HPC units.

The reactors' future operator (NNB – Nuclear New Build) is liaising with the regulator. Following completion of the GDA (Generic Design Assessment), ONR approved the use of AFCEN codes for mechanical components (RCC-M 2007 edition + 2008-2010 addenda), electrical equipment (RCC-E 2012 edition), civil engineering works (ETC-C 2010 edition) and fire protection (ETC-F revision G of 2007). An addendum has been created for the ETC-F code to incorporate British fire protection regulations, which AFCEN has subsequently added to the code in the form of a UK-specific appendix. 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 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), which are supervised by an NNB-led Steering Committee, comprise the companies concerned and representatives from NNB and AFCEN. These Users Groups have the following missions:

. facilitate uptake of AFCEN codes among industry and partners by minimizing discrepancies caused by poor interpretation of the codes early into the project,

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

. determine training needs and facilitate appropriate solutions,

. establish effective communication channels with AFCEN's Subcommittees.

The RCC-M Users Group has been coordinated by TWI (The Welding Institute) since 2013. From 2013 to 2016, this group comprised approximately 15 members representing manufacturers, engineering firms, consultants, inspection and training organizations, institutes, and so on. They addressed the following key technical issues with a helping hand from AFCEN's experts: materials sourcing and manufacture, quality requirements, and requirements for nuclear pressure components. The decision to launch the process for sourcing mechanical components for the HPC project in 2018 provided the ideal opportunity to restart the Users Group in a different format and identify new work topics. Group members will reconvene early 2019, with the participation of AFCEN's experts.

The Users Group on civil engineering codes was formed in November 2016 and held two meetings in 2017 (June and December) and one meeting in 2018 (October). Chaired by WOOD, the group includes the main companies involved in the Hinkley Point C project. A meeting held on October 2, 2018, allowed industry's main players to address a wide range of technical subjects, including concrete reinforcement and shrinkage, and coordinate contributions from specific members concerning offshore structures with a view to their ultimate incorporation into RCC-CW. The group proved to be an attractive and profitable venture for taking advantage of the lessons learned from the HPC project and fostering a close-knit community of experts and manufacturers in the UK. The Users Group will pursue its activities in 2019.

1.2 AFCEN'S ACTIVITIES AROUND THE WORLD

The green light was given in 2018 to create an RCC-E Users Group, which is expected to be launched in 2019.

The Steering Committee for the UK Users Groups held a meeting on April 26, 2018.

HPR-1000 project

The project to build a PWR reactor featuring Chinese technology (UK Hualong or HPR-1000) is undergoing the GDA (Generic Design Assessment) process in the UK in anticipation of installing two units at the Bradwell B site. The GDA is being coordinated by an EDF-CGN joint venture (GNS). The blueprint for this project is mainly based on a reactor that is currently being built in China (Fangchenggang 3) and significantly inspired by AFCEN codes. The GDA for this reactor will take advantage of the lessons learned from the EPR project incorporated into the chosen AFCEN codes.

1.2.5 India

After participating in the international India Nuclear Energy show in Mumbai in 2016 and several events involving Indian suppliers in 2017, AFCEN has continued its policy of developing cooperative ties with India, especially in terms of training on the RCC-M code.

On March 10, 2018, EDF, AFCEN, Bureau Veritas and Larsen & Toubro signed a memorandum of understanding (MOU) to provide training services for the RCC codes in India. This concerted effort to provide training will be instrumental in developing the necessary skills among the wide range of local vendors willing to supply their components and equipment for the Jaitapur project. Larsen & Toubro (L&T) is one of the main companies in India with heavy forging facilities and experience in using AFCEN codes.

Two training sessions on the RCC-M code were held in 2018, each of which attracting close to 30 trainees (see Chapter 4).

These initiatives are aimed at reinforcing collaborative ties between France and India ahead of the JNPP project (Jaitapur Nuclear Power Project).

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 2019, AFCEN is determined to pursue its policy of building cooperation with India while supporting the proposal for six EPR units as part of the Jaitapur project.

afcen

Shaping the rules for a sustainable nuclear technology

2

EDITORIAL ACTIVITY REVIEW

2.1 CODES AND OTHER EDITORIAL PRODUCTS

AFCEN's editorial activities involve authoring and approving the publication of codes and other associated technical works. AFCEN keeps a close eye on these different publications and updates them as necessary.

The technical works associated with the codes are as follows:

. studies to complement and develop certain topics in relation the codes,

. criteria, which present the reasons for the rules in the codes,

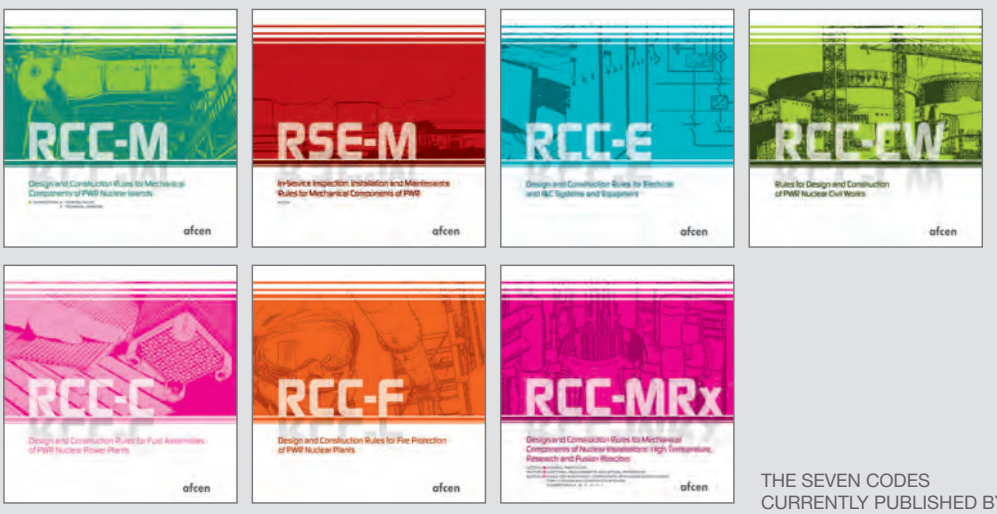
. guides to accompany the use of the codes.

2.1.1 AFCEN codes

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

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

In some cases (civil engineering and fire), RCC- codes were preceded by EPR design specifications (ETC-) developed and used by EDF.



THE SEVEN CODES
CURRENTLY PUBLISHED BY AFCEN

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,

Examples include an update to the 2018 edition of RCC-MRx to incorporate feedback from current projects, such as the Jules Horowitz Reactor (RJH) and the ASTRID project, and a wide variety of topics, like the inspection and welding processes for aluminum alloys.

New developments, scientific breakthroughs and R&D work

These also represent major reasons for updating the codes.

Examples include the inclusion of new materials in the mechanical codes (STR reference technical specifications in RCC-M, and Eurofer low activation martensic stainless steel in RCC-MRx) or improved rules for calculating the minimum reinforcement rate for reinforced concrete (RCC-CW code).

Regulatory changes

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

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

For example, developments associated with the need to prove compliance with the essential requirements of the European Pressure Equipment Directive (PED) and France's Nuclear Pressure Equipment Regulation (ESPN) have been integrated into the 2018 editions of the RCC-M and RSE-M codes, particularly Appendices ZY and ZZ.

Another example is RCC-F, which includes appendices focusing specifically on the requirements of fire protection regulations in France and the UK.

Changes in standards

AFCEN codes are updated to reflect changes to the standards on which they are based. International standards are the first to be called when available, followed by EN standards.

AFCEN regularly analyzes the standards to determine whether any revisions have been made and updates the codes accordingly.

For example, the RCC-CW code was revised to ensure alignment with the construction rules for concrete structures defined in EN 13670. Further to the need to prove compliance with the essential requirements of the European Pressure Equipment Directive, the rules in the RCC-M code were compared against European standards on piping and vessels (EN 13480 and EN 13445), and the code was amended accordingly.

Extensions of the scope of application

AFCEN codes may be revised by extending its scope of application.

One example is the inclusion of a new chapter in the RCC-M code (RPP no. 4 - Probationary Phase Rules, 2017 edition) to cover the qualification of active mechanical components requiring qualification under accidental conditions, as well as chapters addressing N1 and N2/N3 assemblies (RPP no. 5 and 6, 2018 edition).

2.1.2 AFCEN's technical publications (PTAN)

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 concern common requirements (such as quality) or technical interfaces between codes (anchoring systems and penetrations).

Criteria

AFCEN is determined to explain 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 Appendices 5.4 and 5.5 of the RSE-M code.

2.1 CODES AND OTHER EDITORIAL PRODUCTS

Guides

Guides may be aimed at publishing recommendations or explaining how the code can be used to comply with regulatory requirements.

For example, a guide was released in 2018 as a series of recommendations to clarify the provisions of the RCC-MRx code relating to the seismic design rules for components.

The 2018 editions of the RCC-M and RSE-M codes are supported by a complete set of guides that explain how the codes can be used to fulfill the essential safety requirements of the ESPN Regulation.

2.1.3 AFCEN's editorial situation

From an editorial perspective, 2018 proved to be a busy year for AFCEN and was marked by the publication of the 2018 editions of the following codes: RCC-M, RSE-M, RCC-CW, RCC-C and RCC-MRx.

The rate at which new editions are published depends on the editorial program for each code and therefore may vary according to internal developments (R&D work, scientific and technical breakthroughs, and new scopes in application), external changes (regulations and standards), feedback on the facilities designed using AFCEN's codes, and users' needs and project requirements.

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

The table lists AFCEN's technical publications.

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

AFCEN'S EDITORIAL SITUATION AND EDITORIAL PROGRAM

CODE		EDITIONS AVAILABLE	EDITORIAL OBJECTIVES (work topics)
RCC-M	Construction of PWR mechanical components	. 2000 and 2007 editions, with addenda . 2012 edition, with addenda in 2013, 2014 and 2015 . 2016, 2017 and 2018 editions . Next edition: 2020	. Incorporation of the requirements of France's nuclear pressure equipment regulation (ESPN): feedback from the application of the 2018 edition, additional rules . Non-linear mechanical analyses: ratcheting . Flanged connection design . Seismic design of pipelines . Feedback from the EPR projects and the nuclear industry
RSE-M	In-service inspection for PWR mechanical components	. 2010 edition, with addenda in 2012, 2013, 2014 and 2015 . 2016, 2017 and 2018 editions . Next edition: 2020	. Initiation factors . Incorporation of the requirements of France's nuclear pressure equipment regulation (ESPN): feedback from the application of the 2018 edition, additional rules . Integration of requirements for non-pressurized equipment important to safety . Views on the prospect of adopting a requirements engineering format for the code . Integration of the EPR inspection program . Internationalization (UK) . Mechanical analysis methods and associated material data: initiation factors . NDT qualification
RCC-E	Electrical and I&C systems and equipment	. 2012 edition . 2016 edition . Next edition: 2019	. Feedback from the application of RCC-E 2016 . Design extension situations . IT security
RCC-CW	Civil engineering	. ETC-C editions 2010 and 2012 . RCC-CW editions 2015, 2016, 2017 and 2018 . Next edition: 2019	. Composite steel and concrete structures . Pile foundations . Improved reinforcement rates . Maintenance . Marine structures

RCC-C	Fuel	. 2005 edition, with addenda in 2011 . 2015, 2017 and 2018 editions . Next edition: 2019	. Changes in manufacturing and inspection processes . Fuel performance criteria . Situations outside the nuclear steam supply system before and after irradiation . Cleanliness requirements
RCC-F	Fire	. 2010 edition, then 2013 (ETC-F) . RCC-F 2017 edition . Next edition: 2020	. Methods for analyzing fire risks . Risks associated with fire protection equipment . External fires . Comparison with international codes (WENRA, IAEA, etc.)
RCC-MRx	Mechanical components in fast neutron, experimental and fusion reactors	. 2012 edition, with addenda in 2013 . 2015 edition . 2018 edition . Next edition: 2021	. Feedback from the RJH project for manufacturing and 6061-T6 aluminum alloy . Clarification of the design approach . Update to the process for analyzing progressive deformation (efficiency diagram method) and fast fracture resistance . Lessons learned from the CEN/WS 64 workshop for innovative coolant reactors

TECHNICAL PUBLICATIONS AVAILABLE FOR SALE

CODE	TECHNICAL PUBLICATIONS
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 2018: RCC-M editions 2007 and 2012 and their addenda – Responses to Interpretation Requests (IR) (French) . PTAN RCC-M 2016: Hazard analysis guide for N1 nuclear pressure equipment - Replacement steam generators (French) . PTAN RCC-M 2016: Application of the ESPN order - Guide for the contents of the operating instructions for nuclear pressure equipment (French and English) . PTAN RCC-M 2016: Application of the ESPN order - Dimensional reference standard of N1 nuclear pressure equipments (French and English) . PTAN RCC-M 2016 (Criteria): Justification for exemption from Charpy impact testing for low-thickness components made from austenitic stainless steel and nickel-based alloys (French) . PTAN RCC-M 2017: Application of the ESPN order - Inspectability guide for the design of N1 nuclear pressure equipment in PWR plants in France (French) . PTAN RCC-M 2018: Radiation protection guide for the design of nuclear pressure components in PWR plants in France (French) . PTAN RCC-M 2018: Application of the ESPN order - Guide on N1 allowable limits (French) . PTAN RCC-M 2018: Application of the ESPN order - Guide on N2-N3 allowable limits (French) . PTAN RCC-M 2018: Application of the ESPN order - Guide on the provisions for carrying out visual inspections during the final examination (French) . PTAN RCC-M 2018: Application of the ESPN order - Guide for visual examinations during fabrication following the hazard analysis (French) . PTAN RCC-M 2018: Application of the ESPN order - - Dimensional reference standard of N1*, N2 or N3 nuclear pressure components (French) . PTAN RCC-M 2018: Application of the ESPN order - Guide for the contents of the operating instructions for nuclear pressure equipment (French) . PTAN RCC-M 2018: Thermal aging of austenitic and duplex stainless steels (French) . PTAN RCC-M 2018: Corrosion of austenitic and duplex stainless steels (French) . PTAN RCC-M 2018: Application of the ESPN order - Hazard analysis guide for N1 nuclear pressure equipment (French) . PTAN RCC-M 2018: Application of the ESPN order - Methodological guide for carrying out hazard analyses for N2 nuclear pressure equipment manufactured according to RCC-M (French) . PTAN RCC-M 2018: Application of the ESPN order - Guide for designing SRMCRs installed at PWR plants to protect N2 or N3 nuclear pressure equipment (French) . PTAN RCC-M 2018: Application of the ESPN order - Inspectability guide for the design of N1 nuclear pressure equipment in PWR plants in France (French) . PTAN RCC-M 2018: Application of the ESPN order - Inspectability guide for the design of N2-N3 nuclear pressure equipment in PWR plants in France (French) . PTAN RCC-M 2018: Application of the ESPN order - Storage of material resulting from the manufacture of components for N1 nuclear pressure equipment (French)

2.1 CODES AND OTHER EDITORIAL PRODUCTS

RSE-M	. CRITERIA RSE-M 2016: Principle and justification for including warm pre-stressing (WPS) in the criterion for the fast fracture resistance of a PWR vessel (French and English) . CRITERIA RSE-M 2017: Appendix 5.4 of RSE-M - Principles and background to the formulation of the analytical methods for calculating stress intensity factors and the J integral for a planar defect (French) . CRITERIA RSE-M 2018: 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 with a planar defect during operation (French) . PTAN RS 16-007 revision E: Guide for periodic requalification of N2 or N3 ESPN piping (French and English) . PTAN RS 16-009 revision B: Professional guide for repairing and modifying nuclear pressure equipment subject to articles 1 to 4 in Appendix V of the French Nuclear Pressure Equipment Regulation of December 30, 2015 as amended (French) . PTAN RS 16-010 revision E: Professional guide for the significant repair/modification dossier for nuclear pressure equipment subject to articles 1 to 4 in Appendix V of the French Nuclear Pressure Equipment Regulation of December 30, 2015 as amended (French) . PTAN RS 17-022 revision B: Professional guide for designing and fabricating main pressure parts for nuclear pressure equipment in main primary or secondary systems (French) . PTAN RS 18-003 revision A: Professional guide on conformity assessment requirements and procedures for a permanent installation assembly for nuclear pressure equipment subject to article 4.1.a in Appendix V of the French Nuclear Pressure Equipment Regulation of December 30, 2015 as amended (French) . PTAN RS 18-004 revision C: Professional guide on the protection methodology for the installation of nuclear pressure equipment (French) . PTAN RS 18-005 revision A: Professional guide on the installation provisions for nuclear pressure equipment subject to article 5 in Appendix V of the French Nuclear Pressure Equipment Regulation of December 30, 2015 as amended (French) . PTAN RS 18-006 revision A: Professional guide on the requirements applicable to repairs and modifications of nuclear pressure equipment subject to articles 1 to 4 in Appendix V of the French Nuclear Pressure Equipment Regulation of December 30, 2015 as amended, and the procurement of the parts required for such repairs and modifications (French) . PTAN RS 18-007 revision A: Professional guide for operations on nuclear pressure equipment in main primary and secondary systems (French)
RCC-MRx	. PTAN RCC-MRx 2017: Guide for introducing a new material in RCC-MRx – Requirements and recommendations for acquiring and gathering the necessary data for establishing all the characteristics for the materials in Appendix A3 of RCC-MRx (French and English) . PTAN RCC-MRX 2018: Supplements to the guide for seismic analysis of components - Recommendations for the seismic design of equipment according to Annex A1 of RCC-MRx (French and English)
RCC-CW	. PTAN RCC-CW 2015: French experience and practice of seismically isolated nuclear facilities (French and English)
RCC-C	. PTAN RCC-C: Qualification of scientific computing tools for first barrier safety demonstrations (French)

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 rating,

. 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 South 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 (South 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.

The new information incorporated into the 2016 edition includes the first series of modifications resulting from the commissioned studies into the ESPN Regulation (see Section 2.2.5).

The 2017 edition introduced the Q subsection as Probationary Phase Rules to cover the qualification of active mechanical components (pumps and valves) and the new non-mandatory Appendix Z C to guide users in carrying out non-linear finite element analyses.

2.2.3 Edition available as of early 2019

The 2018 edition is the most recent version of the code. It integrates 176 modification files, mainly relating to the commissioned studies into the ESPN Regulation. This edition is supplemented by the different guides released as PTAN publications and addresses the essential safety requirements of the ESPN Regulation of December 30, 2015, as amended by the Regulation of September 3, 2018. AFCEN has provided an extensive set of documentation to justify how the requirements in the RCC-M code are compliant for N1, N2 and N3 nuclear pressure equipment. Despite being unable to finish examining the safety factors and uncertainties during AFCEN's demonstrations, ASN and GSEN nevertheless endorsed this edition.

More specifically, the changes implemented in the 2018 edition relate to the following provisions:

. Incorporation of the work involved in testing the code for conformity with the essential requirements of French regulations (Annex I of Directive 2014/68/EU and Appendices I to IV of the French Nuclear Pressure Equipment Regulation of December 30, 2015, as amended by the "ESPN" Regulation of September 3, 2018), including an update to Appendices ZY and ZZ relating to the French and European regulations respectively, which contain all the work from the commissioned studies:

- The technical qualification methodology and applicable requirements for materials used in the pressure parts of N1 equipment.
- The "unacceptable defects" methodology relating to Section 3.4 (Essential Safety Requirements) in Appendix I of the ESPN Regulation (an application guide is available in ZY 360).
- References to AFCEN's different technical publications (PTAN), which provide support in the form of solutions for achieving the objectives laid down in the regulation.

. Introduction of two new Probationary Phase Rules (RPP no. 5 and 6) concerning N1 and N2/N3 assemblies respectively.

. Introduction of a new appendix to Section III describing the procedure for preparing an equivalence report as defined in MC 2900, which describes the methodology for advanced ultrasound inspections.

. Lowering of the evaluation threshold for ultrasound inspections of Class 1 and 2 welds to -12 dB.

. Introduction of eddy current examinations for steam generator tubes after bending.

. Introduction of reduction factors for effective fatigue resistance for welded joints in N2 or N3 equipment.

. Clarification of the thicknesses to be used for analysis dossiers.

. Revision of the terms for carrying out tensile testing.

. Introduction of two new STRs:

- M 1161 N1, N2 and N3 bars made from rolled non-alloy steel
- M 2331 Valve forged from steel with a nickel, chrome and molybdenum alloy for primary pumps in pressurized water reactors

. Alignment of Chapters B C D 6000 with 4126 and 764-7.

. Update to Chapter A 5000 introducing the 2015 edition of the ISO 9001 Quality standard.

CONTENTS OF THE 2018 EDITION OF THE RCC-M CODE

2.2 MECHANICAL FIELD FOR PWR RCC-M

2.2.4 Next edition

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

In addition to pursuing its activities relating to the ESPN Regulation, AFCEN is also producing an editorial program for the RCC-M Subcommittee to cover the 2019-2022 period and define the key improvements that need to be made to the RCC-M code to reflect project requirements and industrial practices.

The next edition of RCC-M is scheduled for 2020 to leverage initial feedback on the use of the 2018 edition. This edition will incorporate the modifications relating to the follow-up work on the ESPN Regulation.

The new 2020 edition of the code will also incorporate the feedback on the code's use in current projects (EPR UK, TSN, FA3, replacement steam generators, etc.) and on the results of the development or assessment work carried out in AFCEN's working groups (France, China Users Groups, UK, etc.) by ASN or in international groups (Europe and MDEP).

2.2.5 RCC-M technical publications

Publication of interpretation requests

In 2018, the RCC-M Subcommittee published the interpretation requests relating to the 2007 and 2012 editions of the RCC-M code and its addenda. This publication is presented as a compilation of anonymous interpretation requests arranged by edition and topic.

This document can be downloaded free of charge from the AFCEN website.

The scope of this publication will be extended in 2019.

Guides

In 2015, AFCEN published a radiation protection guide for the design of nuclear pressure components in PWR plants in France. In 2018, the guide was updated to take account of the latest feedback.

Commissioned studies into the ESPN Regulation led to a series of guides, some of which were published in 2016 and 2017, and subsequently updated and supplemented in 2018 (see table in Section 2.1.3).

RCC-M criteria

The RCC-M code criteria 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. 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.

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

The Editorial Committee has launched 19 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 for N1, N2 and N3 equipment.

These groups have the following missions:

. hazard analyses,

. Inspectability.

. 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 for fabrication,

. definition of a component's admissible limits,

. instructions manuals,

. fabrication of assemblies,

. developments in technologies and practices,

. safety devices and pressure accessories,

. technical qualification,

. SRMCR systems,

The groups' findings were published in 2016 as:

. generic modifications introduced into the body of the code,

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

. technical publications in the form of guides and criteria.

The working groups produced 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 ("three-year program").

The results of the group's work on N1 equipment were submitted to ASN. The results of the group's work on N2 and N3 equipment were submitted to GSEN (Group for Nuclear Equipment Safety). Aside from the commissioned study on Safety Factors and Uncertainties, whose results will be assessed in 2019, ASN and GSEN examined the proof of compliance submitted by AFCEN and subsequently endorsed the 2018 edition as fulfilling the essential safety requirements of the ESPN Regulation.

2.2 MECHANICAL FIELD FOR PWR RCC-M

In 2018, new commissioned studies were launched to address other regulatory requirements that are not considered to be essential safety requirements:

. A material storage guide aimed at specifying the rules for identifying and reserving the materials that will be supplied to the operator in accordance with Section 8.1 in the Regulation of December 30, 2015 as amended.

. A methodological guide for overseeing the fabrication of components that are not subject to specific technical qualification. This guide aims to provide guarantees relating to the conditions for manufacturing certain components that are not subject to specific technical qualification. The main objective is to ensure that suppliers consistently enforce the provisions stipulated by the STR.

. Work focusing on testing in response to Section 8.2 of the Regulation of December 30, 2015 as amended.

. A definition of what constitutes “situations” and “loads”.

In addition to the three-year program, AFCEN is also looking into the prospect of:

. creating an oversight group to update the standard following changes to the regulation over time and thereby maintain official endorsement; as such, AFCEN proposed a new work program to ASN and GSEN for 2019-2022,

. ensuring that the standard is sufficiently stable for implementation in projects; Section 6 of the amended ESPN Regulation gives manufacturers the possibility of submitting a safety options dossier for N1 equipment to ASN for review and subsequent advisory; the principle for this facility will be extended to N2/N3 equipment.

2.2.7 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 2018:

. AFCEN Day was held on June 25, 2018, under the headline “AFCEN present and future”, which enabled the association to provide members with a review of its RCC-M activities. This event took place ahead of the World Nuclear Exhibition, which AFCEN also attended. To coincide with both events, AFCEN also received a delegation from China. Delegation members were treated to an overview of the Subcommittee’s activities, including detailed presentations on the major updates to the 2017 edition of the RCC-M code.

. Experts from the RCC-M Subcommittee traveled to China in May (three experts) and November 2018 (four experts) to answer questions from the Chinese Specialized Users Groups (CSUGs). The two-day meetings each attracted over 70 Chinese members from various local companies and allowed the experts to answer several dozens of questions which, where applicable, resulted in code interpretation or modification requests.

In 2018, the RCC-M Subcommittee also took part in several international working groups and participated in the associated events:

. RCC-M experts play an active role in the Convergence Board of Mechanical Standards Developing Organizations (SDO Convergence Board) during the ASME Code Week. Members are currently taking an in-depth look at several topics for harmonization.

. At the European level, the organizations taking part in the GEN II/III Prospective Group (PG1) of CEN Workshop WS 64 - Phase 2 issued several modification requests for the RCC-M code. Phase 2 ended in 2018. Phase 3 will be launched in 2019 (refer to the dedicated paragraph in Section 1.2.2).

In 2018, there are plans to maintain international initiatives:

. focusing on international comparisons by publishing the studies launched by CORDEL and the SDO Convergence Board in line with the expectations of the other SDOs,

. furthering the aims of OECD/NEA by continuing relevant work on equivalent codes and regulations alongside the Safety Authorities in the CSWG,

. by leading AFCEN's Chinese and UK Users Groups, and the corresponding international training courses.

. at the European level as part of the CEN/WS 64 workshop.

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 safety mechanical components.

2.3.2 Use and background

Use

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

To date:

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

. Operation of 34 commissioned units in China's nuclear infrastructure, corresponding to the M310, CPR-1000, ACPR-1000, CPR600 and EPR2 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.

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

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).

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.

The 2017 edition builds on the technological, legislative and international developments that occurred in 2016. The changes made to this new edition mainly involve the following points:

. further clarification regarding the limits of main secondary systems,

. creation of a chapter on the extended shutdown of equipment in the main secondary system (especially steam generators), including the chemical specifications for extended shutdowns,

. alignment of the paragraphs in B 4000 that describe a manual penetrant testing technique for defence-in-depth examinations (hypothetical defects) with MC 4000 in RCC-M,

. creation of two chapters: B 4800 (inspection of piping in the main primary and secondary systems) and B 4900 (global inspection of the main primary system) to ensure consistency with current practices,

. creation of a specific chapter on pre-service inspections, which is neither a periodic requalification nor a periodic inspection, and an update to the text,

. clarification of the existing definition for an essential parameter: removal of the reference to the primary parameter and addition of further information to improve on-site monitoring of these parameters,

2.3 IN-SERVICE INSPECTION RSE-M

. complete update to Chapters II and III in Appendix 4.4 relating to the eddy current examination of steam generator tubes to take account of the new transversal rotating probes and offer a clearer description of the operating modes and the examination by acoustic emission method,

. creation of a new section to introduce Appendix 5 (Appendix 5.0) and provide a detailed explanation of how Appendices 5.1 to 5.8 link together,

. alignment of Appendices 5.3 and 5.4 for calculating Keq according to the cumulative theta method, clarification when $|KII| < 0.02 |KI|$,

. integration of the kth2 method in RCC-MRx 2016 (for aligning Appendix 5.4 of RSE-M with Appendix A16 of RCC-MRx),

. update of the inspection tables (complete, partial and EPR pre-service inspection) with references to the examination methods for alignment with new sections B4800 and B4900.

2.3.3 Edition available as of early 2019

The 2018 edition is the most recent version of the RSE-M code.

It builds on the technological and legislative developments that occurred in 2017. The changes made to this new edition mainly involve:

. 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,

. introduction of an appendix with a safety rating for the modification files in RCC-M and an explanation about its use,

. inclusion of changes to the conventional qualification of NDT tests,

. 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 studies on the following topics:

. guide to classifying repairs / modifications / installations on nuclear pressure equipment (not including Class 1 equipment),

. guide to the documentation associated with repaired / modified N2/3 nuclear pressure equipment,

. guide to the methodology for verifying the measures taken to protect against admissible limits being exceeded for circuits manufactured according to the old regulations,

. guide to the procurement of the main pressure parts for main primary / secondary systems,

. guide to the methodology for the periodic requalification of N2 or N3 piping,

. guide for equipment not subject to in-service inspections,

. modifications to the code for the constitution of nuclear facilities.

CONTENTS OF THE 2018 EDITION OF THE RSE-M CODE

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 NC COMPONENTS

VOLUME II - APPENDICES 1 to 8
APPENDICES 1.0 to 1.8: Supporting appendices for the general requirements
APPENDIX 2.1: Appendix associated with § B2000 Requalifications and Hydraulic Tests
APPENDICES 4.1 to 4.4: Appendices associated with § 4000 Examination techniques
APPENDICES 5.0 to 5.8 and RPP2: Appendices associated with § 5000 Indication processing
APPENDIX 7.1: Appendix associated with installation, integration and implementation operations for constituting a new basic nuclear facility
APPENDICES 8.1 and 8.3: Appendices associated with § 8000 Maintenance Operations

VOLUME III - APPENDIX 3
APPENDIX 3.1 - VISIT TABLES
APPENDIX 3.2 - INSPECTION PLANS FOR COMPONENTS NOT ASSIGNED TO ANY PARTICULAR RSE-M CLASS

2.3.4 Outlook and next edition

2020 edition

The 2020 edition has the objective to consolidate and build on technological, legislative and international developments. With this aim in mind, special attention will be paid to the following points:

. extension of the scope to encompass all basic nuclear facility equipment (not only pressure equipment),

. monitoring of changes to the French Regulation of November 10, 1999 (in-service inspection of main primary and secondary systems) and incorporation of those changes into the code,

. inclusion of feedback on the ESPN guides,

. examination of the prospect of creating an RSE-M PTAN containing a thesaurus and definitions,

. use of a requirements engineering process to define the tests, which will be detailed in a section in 2019,

. safety devices and pressure accessories: work on the requirements in Section B: alignment with nuclear industry practices, consistency/level of requirements with those in Sections C and D,

. inclusion of the specific characteristics of the FA3 EPR (N1 not including main primary and secondary systems) + inclusion of the Taishan / FA3 ERP inspection plan,

. Appendix 3.1.1: inspection programs for the main primary and secondary systems, as adapted to EPR projects (if available in 2019),

. Appendix 3.1.2: N2 and N3 inspection programs, as adapted to EPR projects (if available in 2019),

. clarify the concepts of rating threshold, characterization threshold and significant variation threshold in terms of measuring thicknesses,

. Appendix 4.3: review and updating of the methodologies for the general and specific qualification of NDTs,

. Section A4700 - Qualification and certification of testing personnel: to be aligned with Appendix 4.3 – IX,

2.3 IN-SERVICE INSPECTION RSE-M

. clarify the case of examinations that should not be considered to be NDTs: metrological examinations, cleanliness Video examination, etc.

. clarification of the terms for performing pre-service inspections of components at the factory (case of replacement steam generators),

. Appendix 5.4: update to the KCP method in Appendix 5.4,

. Appendix 5.2: standardization between RCC-M and RSE-M in terms of priming factors,

. Appendix 5.2: cleansing in the priming and propagation methods (aggregated transients),

2.3.5 Other RSE-M technical publications

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

The purpose of the 2016 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.

"Appendix 5.4" criteria

These criteria were published in 2017.

AFCEN's members have made major changes to the mechanical fracture methods specified in the appendix. As part of the Hinkley Point C EPR project in the United Kingdom, an Independent Expert Working Group (IEWG) carried out a thorough review and decided that the methods were suitable for use.

"Appendix 5.5" criteria

These criteria were finalized in 2018 and published in the first quarter of 2019.

The criteria for analyzing the impact of planar defects are explained.

PTANs due for release in 2019

Other AFCEN technical publications (PTAN) are being prepared:

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

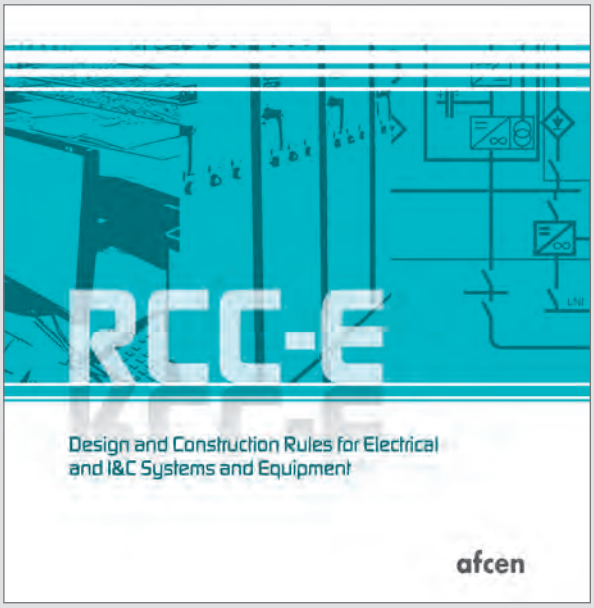
. PTAN "Methodological guide for defining NDT qualifications with ultrasonic processes",

2.3.6 Discussions with NNB

With respect to the use of the RSE-M code for the Hinkley Point C project, a series of meetings was held in 2018 to produce a UK-specific appendix tailored to UK regulations and the operator's constraints.

To simplify the process of making the code accessible to a global audience, the Subcommittee analyzed the sections of the code that could be modified by a foreign operator and the parts that are applicable irrespective of the country. NNB will work with this aim in mind while focusing on in-service inspections.

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 and other nuclear projects.

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,

. equipment engineering and environmental qualification for normal and accidental conditions including seismic events,

. 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

The RCC-E code has been used for designing the following power plants:

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

. 2 CP1 reactors in South Korea (2),

. 44 M310 (4), CPR1000 (28), CPR600 (6), HPR1000 (4) and EPR (2) reactors in service or undergoing construction in China,

. 1 EPR reactor in France.

The RCC-E code is used for maintenance operations in French power plants (58 units) and Chinese M310 and CPR1000 power plants.

RCC-E has been chosen for the construction of the two EPR units in Hinkley Point C (UK).

Users include:

. equipment suppliers,

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

. control and inspection organizations,

. Nuclear 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, 2012 and 2016 editions concern Generation II and III reactors. As from the 2005 edition, a specific book of project data must be written to supplement and implement the rules defined in the RCC-E code in order to allow the code to be used for each 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 early 2019

The RCC-E 2016 edition is the most recent version. French and English versions of the code have been available since early 2017.

The following sources are used when revising the RCC-E codes:

. feedback from facilities under construction and in operation,

. the Nuclear Safety Authorities' investigation process,

. user inquiries,

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

. changes in industry's maturity.

The 2016 edition:

. represents an overhaul of the previous editions, which have tended to be updates,

. 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 of the I&C systems applicable standards.

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 Authority's investigation into the UK's EPR as part of the generic design assessment into the electrical and I&C systems,

. feedback following Fukushima accident.

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.

CONTENTS OF THE 2016 EDITION OF THE RCC-E CODE

VOLUME 1 - GENERAL AND QUALITY ASSURANCE
VOLUME 2 - SPECIFICATION OF NEEDS
VOLUME 3 - AUTOMATION AND CONTROL SYSTEMS
VOLUME 4 - ELECTRICAL SYSTEMS
VOLUME 5 - EQUIPMENT ENGINEERING
VOLUME 6 - LAYOUT OF ELECTRICAL AND INSTRUMENTATION AND CONTROL SYSTEMS
VOLUME 7 - INSPECTION AND TEST METHODS

2.4.4 Technical publications of the RCC-E Subcommittee

Contribution to the ESPN program

In 2018, the RCC-E Subcommittee took part in producing a "Guide to designing SRMCRs installed at PWR plants to protect N2 or N3 nuclear pressure equipment".

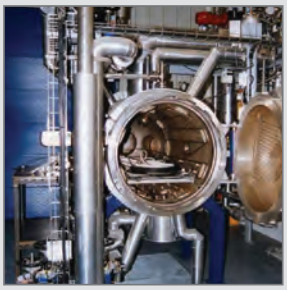
2.4 ELECTRICAL AND I&C SYSTEMS RCC-E

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”,

. a document that compares the 2016 and 2012 editions of the code entitled “Nuclear Codes & Standards: RCC-E 2016 Gap analysis with the RCC-E 2012”.




2.4.5 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,

. cybersecurity.

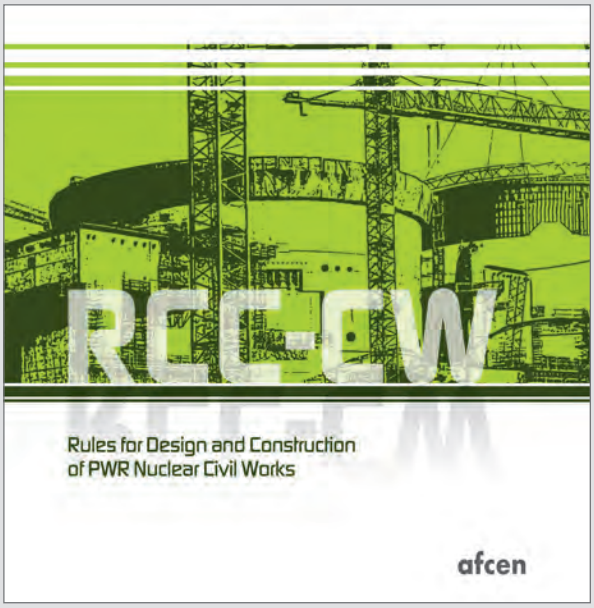
2.4.6 International activities

The RCC-E Subcommittee took part in meetings with the CSUG (Chinese Specialized Users Group). The Chinese working group comprises approximately 30 members. Every year, a meeting is organized in China to improve interaction and help address the interpretation and/or modification requests issued by the CSUG.

Two meetings were held in 2018: one in France during the AFCEN Day event in June and the other in September in Beijing. A similar meeting has been scheduled for 2019 and for the following years.

AFCEN is planning to create a Users Group in the United Kingdom in 2019 to address the specific characteristics of the British projects currently undergoing construction (Hinkley Point, Sizewell and Bradwell).

2.5 CIVIL WORKS RCC-CW



THE RCC-CW CODE

2.5.1 Purpose and scope

The RCC-CW code 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 designing and building 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:

. load cases and combinations,

. geotechnical aspects,

. reinforced concrete structures and galleries,

. prestressed containments with metal liners,

. metal containment and pool liners,

. metal frames,

. anchors,

. concrete cylinder pipes,

. paints and coatings,

. 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 of RCC-CW

AFCEN published the first civil engineering code 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 South 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 EDF document acted as a blueprint for a civil engineering code that AFCEN produced in 2010 as part of the RCC-CW Subcommittee, which led to:

. initially, the publication of two specific editions for EPR projects: a 2010 edition followed by a 2012 edition,

. subsequently, the publication of a generic civil engineering code that is not specific to any given project. Two successive annual editions of RCC-CW have been published since 2015.

The 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.

SUCCESSIVE VERSIONS OF RCC-CW

Release	Description	Key applications
1988	AFCEN document including French PWR fleet experience (RCC-G 1988)	French 1300, 1450 Mwe
2006	Draft for further AFCEN releases (EDF document)	Flamanville 3, Taishan 1&2
2010 - 2012	Prepared for UK GDA process in 2010. Revised in 2012	UK EPR Hinkley Point
2015 - 2016 2017 - 2018	Renewed edition: . post-Fukushima level & methods . improvements & updates . extensions of scope	Updated editions to be used as reference for New Build Projects

2.5.3 Edition available as of early 2019

In 2015, AFCEN prepared and published the first edition of a generic civil engineering code that does not relate to any specific project. The RCC-CW code no longer adheres to the EPR project and can be used for PWR reactors featuring a prestressed containment with a metal liner. This code is being used for the NM EPR project in France.

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

. technical discussions concerning the investigation 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.

It also takes account of the latest changes in European standards and 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 2016 edition of the RCC-CW code implements the following changes:

. correction of various editorial mistakes,

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

The 2017 edition of the RCC-CW code implements the following changes:

. rules for anchor channels and active channels have been worked into the DANCH and CANCH chapters,

. the CCONC chapter has been completely revised to ensure a better fit with EN 13670 and has been based on the latest version of EN 206,

. a new CCOAT chapter has been created for paints and coatings,

. the actions to be considered in design extension hazards have been amended (DGENR chapter),

. requirements for seismic soil column calculations have been included (Appendix DA).

The 2018 edition of the RCC-CW code includes the following improvements:

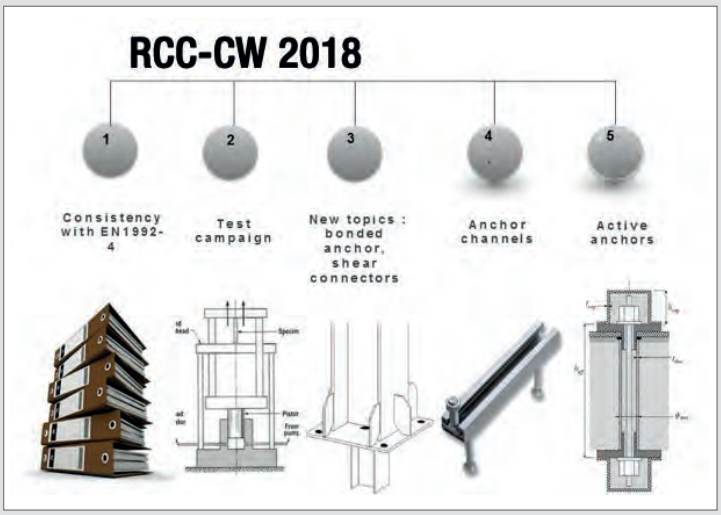
. improved requirements related to the minimum reinforcement rate:

. introduction of requirements for post-installed anchors and recently updated standards,

. changes to the contents for reinforcements (CREIN) in alignment with EN 13670,

. general revision of the requirements relating to tolerances (CA).

RCC-CW 2018 COVERS ANCHOR-RELATED TOPICS



2.5 CIVIL WORKS RCC-CW

CONTENTS OF THE 2018 EDITION OF THE RCC-CW CODE

PART G - GENERAL
GUSER - NOTE TO THE USER
GTABL - ORGANIZATION OF RCC-CW
GREFD - STANDARDS AND DOCUMENTS REFERRED TO IN RCC-CW
GDEFN - DEFINITIONS, NOTATIONS AND ABBREVIATIONS
GGENP - GENERAL PROVISIONS
GA - APPENDICES

PART D - DESIGN
DGENR - GENERAL DESIGN GENERAL REQUIREMENTS
DGEOT - GENERAL RULES FOR GEOTECHNICAL DESIGN
DCONC - GENERAL RULES FOR CONCRETE STRUCTURES
DCLIN - METAL PARTS INVOLVED IN THE LEAKTIGHTNESS OF THE CONTAINMENT
DPLIN - METAL PARTS INVOLVED IN THE WATERTIGHTNESS OF THE POOLS AND TANKS
DSTLW - GENERAL RULES FOR STRUCTURAL STEELWORK
DANCH - DESIGN REQUIREMENTS FOR ANCHORS SYSTEMS IN CONCRETE
DA to DN - APPENDICES

PART C - CONSTRUCTION
CGEOT - EARTHWORKS AND SOIL TREATMENTS
CCONC - CONCRETE
CREIN - REINFORCEMENT FOR REINFORCED CONCRETE
CPTSS - POST-TENSIONING SYSTEM
CPREF - PREFABRICATED CONCRETE ELEMENTS AND REINFORCEMENT CAGES
CCLIN - LEAKTIGHT METAL PARTS ON CONTAINMENTS
CPLIN - POOLS AND TANKS
CSTLW - STRUCTURAL STEELWORK
CANCH - CONSTRUCTION REQUIREMENTS FOR ANCHOR SYSTEMS IN CONCRETE
CBURP - REINFORCED CONCRETE PIPELINES
CJOIN - JOINT SEALING
CCOAT - COATINGS AND PAINTS
CTOLR - SURVEY NETWORKS, TOLERANCES AND MONITORING SYSTEMS
CA to CI - APPENDICES

PART M - MAINTENANCE AND MONITORING
MCONT - LEAK RESISTANCE TEST AND CONTAINMENT MONITORING
MA to MC - APPENDICES

2.5.4 Outlook

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,

. 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:

. composite steel and concrete structures,

. deep foundations,

. improved reinforcement rates,

. maintenance,

2.5.5 Technical publications on seismic isolation and dissipation

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.).

A new technical publication entitled “PTAN – Study report on Seismic Dissipative Devices” will be released early 2019. This PTAN compiles the collective experience of AFCEN’s corporate members on seismic dissipative devices.

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 examines all requests to update the code.

Chinese Users Group (CSUG)

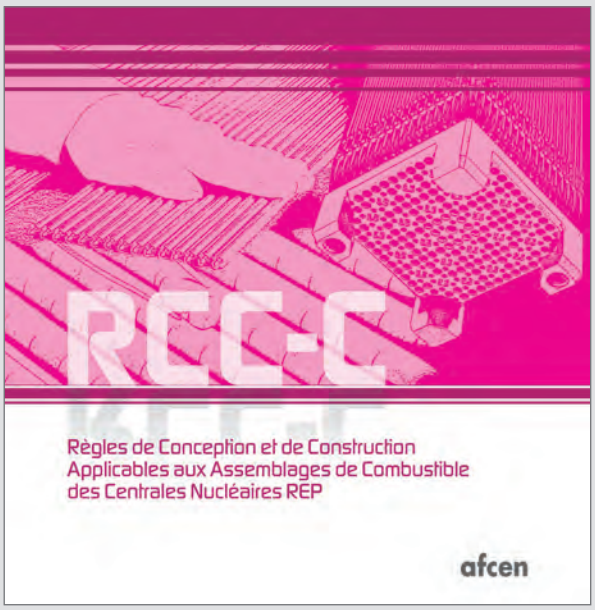
The RCC-CW codes are being shared within the Chinese Users Group, which has held meetings every year since 2015 and is attended by 20 to 30 Chinese experts.

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

UK Users Group

The UK Users Group on civil engineering codes includes the main companies involved in the Hinkley Point C project. The Users Group was officially launched during the AFCEN 2017 Congress. The group held two meetings in 2017 and one meeting in 2018.

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 elements (core components),

. the characteristics to be checked for products and parts,

. fabrication methods and 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.

Between 2013 and 2015, the RCC-C Subcommittee was 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. The Subcommittee's work culminated in the 2015 French edition, which was translated into English the following year.

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	1 - General provisions 2 - Description of the fuel 3 - Design 4 - Manufacturing 5 - Handling and storage

Since the overhaul in 2015, work on modifying the code has mainly focused on reflecting the changes that suppliers have made to the manufacturing aspects, as well as taking account of new products. The code may also be amended as and when requests are issued by ASN following the Permanent Working Groups on fuel, especially product design.

2.6.3 Edition available as of early 2019

The RCC-C 2018 edition is the most recent version.

The main changes between the 2017 and 2018 versions are as follows:

In terms of design:

No changes have been made to the design chapter, insofar as ASN reviewed the fuel performance criteria in the summer of 2017 (Permanent Working Group).

The RCC-C code will be modified in 2019 to take account of any changes requested by ASN in the follow-up letter from the Permanent Working Group on fuel performance criteria.

In terms of manufacturing:

The modifications examined by the working group are as follows:

. Modification to the procedure for inspecting grid welds. Addition of a reinforced inspection during qualification and removal of the need to carry out an inspection during manufacture.

. Consideration of the specific features of resistance welding in terms of inspecting the joint between the guide tube and thimble plug.

. Clarification of the inspection methods and frequency for UO2 Gd2O3 and MOX pellets.

. Clarification of certain formulations relating to the obligation whether or not to specify values in the technical documentation.

. Correction of the unregistered™ / registered® trademark symbols depending on the alloy's commercial name. Addition of a notice on legal protection.

2.6 NUCLEAR FUEL RCC-C

. Update to the paragraph concerning metallurgical inspections of alloy 718 by taking account of the specific features of a partially recrystallized product. Clarification of the provisions for the sampling stages. Further details about the metallurgical state of the material on which inspections are performed.

. Alignment of the paragraph specifying the conditions for chrome-plating using an electrolyte bath (current density and temperature) with industry practices. The requirements in RCC-C whereby the current density and mean temperature parameters must be continuously monitored have been removed, since they do not accurately represent the local conditions of the electrolyte bath, which could affect the quality of the plating. Therefore, manufacturers carry out a full inspection of the plating (thickness and adherence), which provides the necessary and adequate guarantees about the product's quality.

. Alignment of the provisions relating to radiographic examinations with the provisions in the 2005 edition of the RCC-C code, which specified the stages in the inspection process that did not require a certified inspector (e.g. development of the film). Change to the list of unconventional NDT methods, with the addition of an automatic ultrasonic inspection for tubes.

. Harmonization of the provisions for the qualification testing of guide tube expansion with the latest manufacturing processes. The penetrant-based health inspection and metallographic inspection at a sufficiently high magnification are considered to be equivalent in terms of their effectiveness at detecting defects.

. Clarification of the terms for inspecting the equivalent hydrogen content of fuel rod pellets.

. Correction of a typographical error in the specified pressure value during the autoclave corrosion test without any impact on the user.

. Harmonization with industrial processes for welding fuel rod end plugs by introducing the specific characteristics of non-fusion welding processes (RPW and USW).

. Alignment of the provisions for determining the ferrite content in castings with ASTM A800 and ISO 13520.

. Harmonization of the tables of inspection requirements with certain types of industrial processes to allow for an in-line coplanar verification of the guide tubes during rigging, which obviates the need for a later sample-based inspection.

. Alignment of the provisions for pressurizing core component rods with designs for core components requiring an internal pressure greater than atmospheric pressure.

. Incorporation of core components to reduce fluence (hafnium core components) in RCC-C as a new product.

. Clarification of the provisions for radiographic examinations of fuel rod welds in the tables of inspection requirements. Harmonization of the provisions for the radiographic inspection of seal weld holes with industry practices.

CONTENTS OF THE 2018 EDITION OF THE RCC-C CODE

Next edition

The next edition (in French and English) is scheduled for 2019.

2.6.4 Outlook

The code will be updated in alignment with the requirements of ISO 9001:2015.

The RCC-C Subcommittee's work on adapting the design requirements will focus on incorporating the conclusions of the French 2017 Permanent Working Group on fuel performance criteria once ASN has issued its follow-up letter.

Manufacturing process requirements will be modified according to the proposals and feedback from Subcommittee members. There are also plans to clarify how heat treatment requirements apply to factories.

2.6 NUCLEAR FUEL RCC-C

Chapter 5 (situations outside the nuclear steam supply system) will be revised to clarify the rules and scope of requirements.

The cleanliness requirements in RCC-C will be analyzed and amended if necessary.

The table of inspection requirements for manufacturing will be analyzed for the purpose of defining writing recommendations aimed to gradually standardize content. This process will not lead to modifications in the 2019 edition.

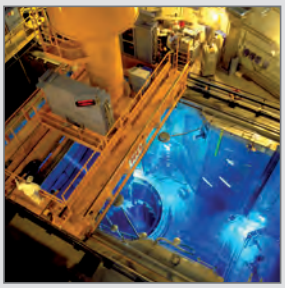
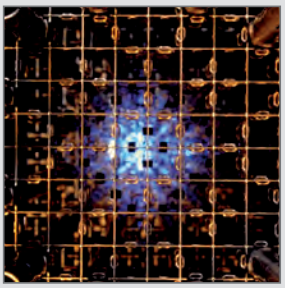
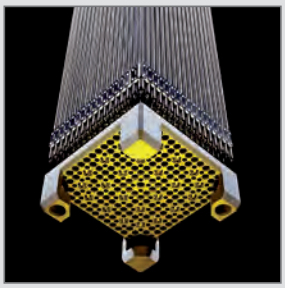
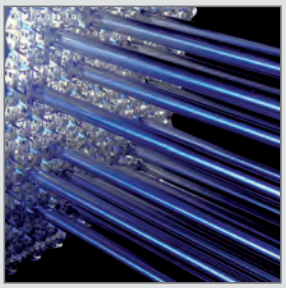
2.6.5 PTAN guide on the qualification of scientific computing tools for first barrier safety demonstrations

In the wake of ASN Guide 28 on the qualification of scientific computing tools for first barrier safety demonstrations (published on July 25, 2017), AFCEN has responded to calls from EDF, Framatome and CEA by preparing a professional guide (AFCEN Technical Publication) on the same subject matter.

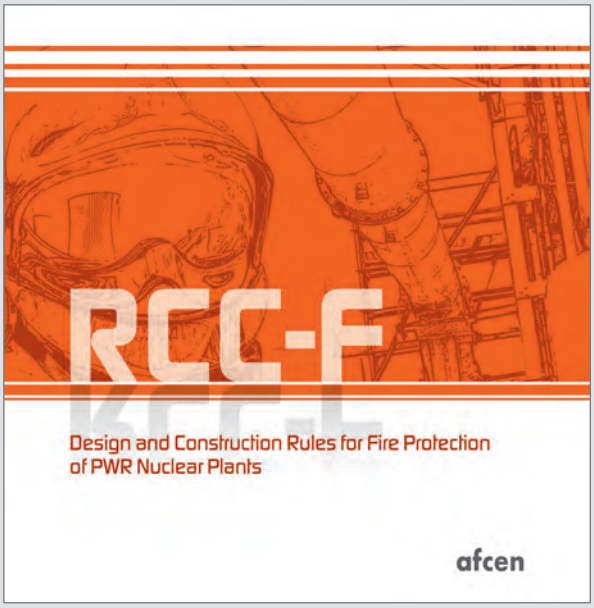
This PTAN guide aims to help industry meet ASN's stricter set of requirements by presenting best practices and implementation examples with the focus on achieving qualification.

A preliminary version of the PTAN was available early 2018 and presented to ASN and IRSN during a meeting on March 12, 2018. Participants confirmed the overall level of consistency between Guide 28 and the PTAN, which is exactly the objective that its authors had been striving to reach in order to simplify work for future users.

As the meeting was brought to a close, industry professionals announced their intention to improve the PTAN by incorporating the feedback and observations made by ASN and IRSN. Modifications were completed late 2018 and a finalized version was sent to ASN for final comments. This PTAN is due to be published in 2019.

2.7 FIRE PROTECTION RCC-F



THE RCC-F 2017 CODE

2.7.1 Purpose and scope

The RCC-F code defines the rules for designing, building and installing systems in a PWR nuclear plant for managing the risk of a fire outbreak inside the facility in light of the nuclear hazards involved and control the fundamental nuclear functions. The code also defines the rules for analyzing and justifying the means used to create the safety demonstration.

This code's target readership is therefore:

. engineering firms responsible for designing, building and installing the buildings constituting a PWR,

. engineering firms responsible for analyzing fire hazards and establishing the safety demonstration from a fire hazard perspective,

. engineering firms responsible for designing the means to prevent and protect against fires and mitigate the effects of a fire outbreak,

. suppliers of fire protection equipment,

. laboratories carrying out qualification testing of fire protection equipment,

. Nuclear Safety Authorities responsible for approving the safety demonstration.

The code defines the rules for designing and analyzing safety demonstrations within a finite scope of service buildings in a light water nuclear power plant.

Design studies can be used to satisfy the code's requirements.

The code provides recommendations for guaranteeing that fire hazards are under control from a safety perspective during the design phase, while incorporating aspects relating to:

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

. personnel safety,

. the environment.

2.7 FIRE PROTECTION RCC-F

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 generally suited to light-water reactors, such as PWRs, as well as EPRs.

2.7.2 Use and background

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

This document acted as a starting point 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 similar to the EPR code,

. subsequently, the drafting of the 2013 edition, which gave less focus to the specifics of EPR projects but which still addresses the safety principles in alignment with existing EPR projects; UK regulations were incorporated into this version of the code,

. finally, the publication of the RCC-F 2017 code, which is generally suited to light-water reactors, such as PWRs.

2.7.3 Edition available as of early 2019

The RCC-F 2017 edition is the most recent version.

The English reference version of RCC-F 2017 was published in February 2018, while the French version was released in December 2018.

Amendments have been made based on the ETC-F 2013 edition and concern the following key topics:

1. Removal of the code's adherence to the safety principles for EPR projects

Safety principles (aggravating events, fire combined with thermal-hydraulic transients, combined stresses, fire outbreaks following an earthquake, and so on) are generally specified for each project according to the national and international context. In a code that covers fire hazards such as RCC-F, a concerted effort must be made to define an approach for adapting fire protection measures according to these principles. However, if the principles used for this purpose correspond to updated best practices, they are mentioned for guidance only and their implementation may be suited to other options by a project applying the code. The code contains practical principles with this goal in mind.

2. Improved traceability of requirements

Various improvements have been made to this subject area to satisfy users' need to easily identify the source of the requirements that led to the rules defined within the code.

3. Improved identification of the code's scope

The code's scope is defined in the introductory chapters with a clear distinction between the parts of the installation where the code is fully applicable and the parts where national practices and regulations may take precedence.

4. Update to the appendix on French regulations

Appendix A incorporates the specific changes to French and English regulations. The French appendix has undergone a significant review to incorporate the latest major changes (regulation on basic nuclear facilities and the ASN decision on the applicable rules for basic nuclear facilities). One of the consequences is that the body of the text in the code now features the new presentation of defence-in-depth vs. fire hazards in accordance with WENRA safety levels.

Finally, the 2017 edition overhauls the RCC-F code to ensure suitability for a wider range of light-water reactors, such as PWRs, while building on feedback from EPR reactors.

CONTENTS OF THE 2017 EDITION OF THE RCC-F CODE

2.7.4 International activities

The RCC-F Subcommittee held a joint meeting with the CSUG (Chinese Specialized Users Group) in Beijing on September 5, 2018. The Chinese working group comprises 19 permanent members and was created during the first meeting in March 2015. Every year, a meeting is organized in China to improve interaction and help address the interpretation and/or modification requests issued by the CSUG.

2.7 FIRE PROTECTION RCC-F

The CSUG was represented during AFCEN Day on June 25, 2018.

The RCC-F Subcommittee was present at the AFCEN stand during the WNE 2018 exhibition (June 26-28, 2018).

In addition, RCC-F was represented during the AFCEN/NEA “Codes and Standards” seminar in Beijing on September 6 and 7.

Two publications on the RCC-F code were released in 2018: one at ICONE 26 (July 2018 in London) and the other at TINCE 2018 (August 2018 in Saclay).

2.7.5 Outlook and preparation of the RCC-F 2020 edition

Outlook

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

. integrate state of the art and 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 may 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 2020 edition

The next edition of RCC-F is scheduled for 2020. The general spirit behind these changes is to strengthen the sections that detail the code’s application and provide the most extensive coverage possible, including methods, technical solutions and links with operations.

In France, further changes may be requested during examination of the RCC-F code as part of the EPR2 project and following China’s activities associated with the AFCEN/NEA memorandum of understanding or the GDA for UK Hualong.

The first set of priority topics was launched in 2018:

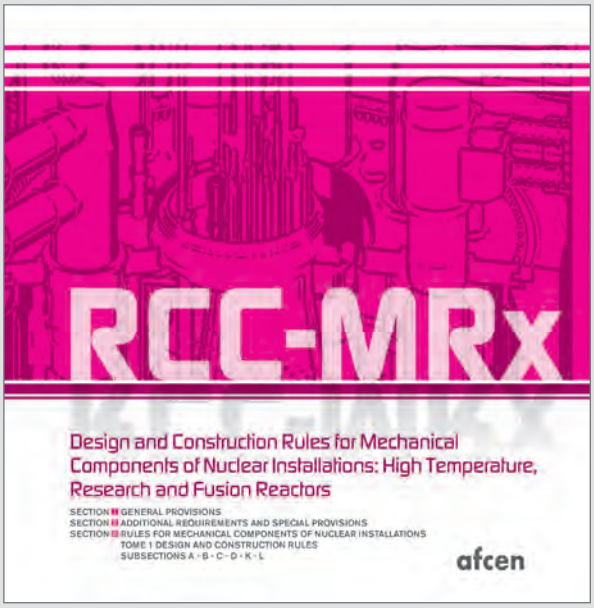
. methods for analyzing fire risks

. risks associated with fire protection equipment

. external fires

. comparison with international codes (WENRA, IAEA, etc.).

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).

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, Eurofer, etc.), 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-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 standard, drafted by the RCC-MX Approval Committee formed on March 31, 1998 by the Commissariat à l'Energie Atomique, AREVA-TA (now TechnicAtome) and AREVA-NP (now Framatome) for the specific needs of the RJH project (Jules Horowitz reactor). This standard 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. The RCC-Mx standard is being used in the current construction of the RJH experimental reactor (Jules Horowitz reactor).

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

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-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 early 2019

CONTENTS OF THE 2018 EDITION OF THE RCC-MRx CODE

SECTION I - General provisions

SECTION II - Additional requirements and special provisions

SECTION III - Rules for nuclear installation mechanical components

VOLUME I: Design and construction rules
. Volume A (RA): General provisions and entrance keys
. Volume B (RB): Class 1 components and supports
. Volume C (RC): Class 2 components and supports
. Volume D (RD): Class 3 components and supports
. Volume K (RK): Examination, handling or drive mechanisms
. Volume L (RL): Irradiation devices
. Volume Z (Ai): Technical appendices

VOLUME II: Materials

VOLUME III: Examination methods

VOLUME IV: Welding

VOLUME V: Manufacturing operations

VOLUME VI: Probationary phase rules

The 2018 edition is the most recent version.

This edition reflects feedback on the use of the previous editions of the code, 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), with special focus on the rules for preventing progressive deformation.

The 2018 edition also proved to be the ideal opportunity to clarify how to use the code, which involved modifying the code’s structure and incorporating flowcharts to explain how the rules are organized. This initiative was implemented for the design process, the rules for analyzing fast fracture resistance, and the rules for designing bolted assemblies.

Integration of the Eurofer material used by the fusion community was finalized in the 2018 edition.

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 (such as incorporation of ISO 3834) and regulations (e.g. updated versions of France's nuclear regulations).

Lastly, the 2018 edition began factoring in feedback from CEN/WS 64 by integrating the workshop's initial modification that identifies the applicable procedure for using the code in case of an innovative coolant.

2.8.4 Outlook

Between 2019 and 2021, efforts will be dedicated at preparing the next edition of the code, which is due to be published in 2021. The aims for the new edition of RCC-MRx are to improve the code's modularity and clarity, so that it can be adapted to the many projects that are likely to use it as a reference. Specific volumes, such as Volume K (examination, handling or drive mechanisms) and Volume L (irradiation devices) will be updated, while a general discussion will be launched on the topic of small components.

Another key objective is pursuing and contributing to the success of Phase 3 of CEN/WS 64.

2.8.5 Technological commissioned studies

In 2016, work was finalized on the commissioned study entitled "Terms for introducing a new material into RCC-MRx". This study led to the publication of a methodological guide (AFCEN/RX.17.004 "Guide for introducing a new material in RCC-MRx"), which explains, when introducing a non-coded material into RCC-MRx, the definition of the methods for obtaining the characteristics in Appendix A3 (expected / possible tests, meaning of the data).

The RCC-MRx Subcommittee launched three commissioned studies in 2017:

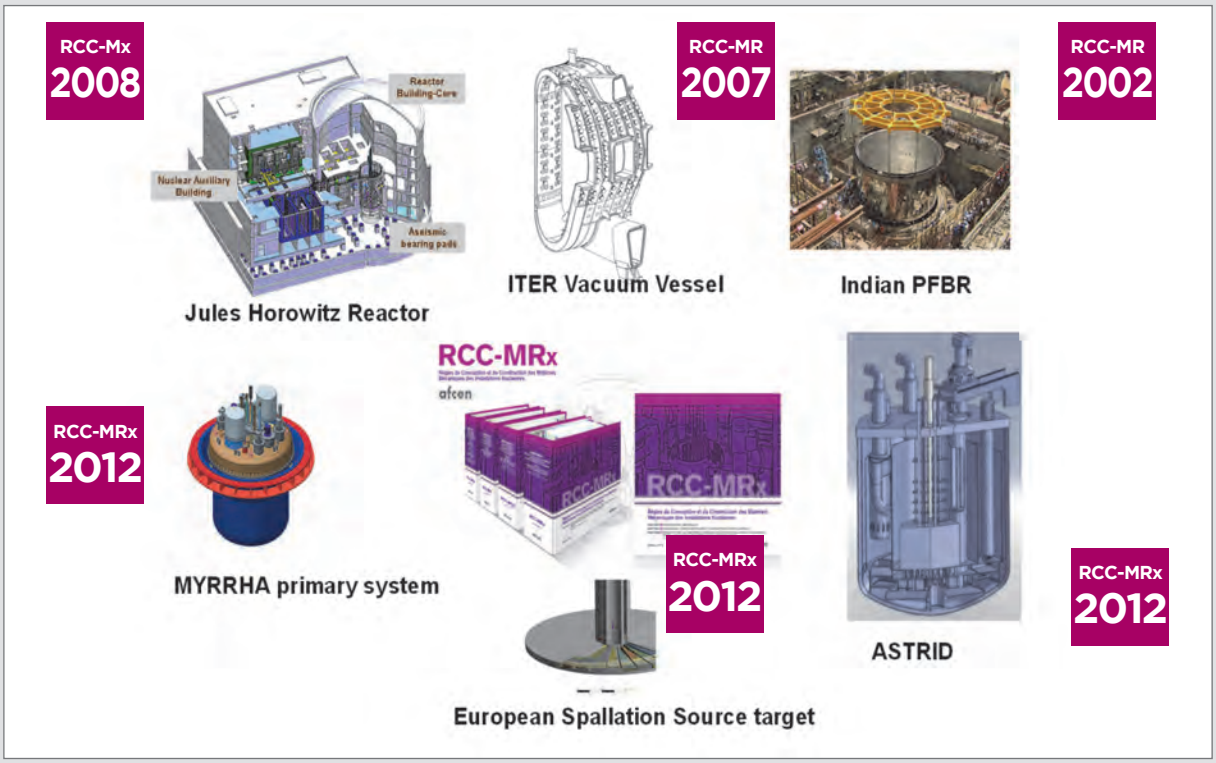
. Fast fracture analysis: this commissioned study also involves the RCC-M code. The aim is to standardize practices between the RCC-M and RCC-MRx codes and clarify the approach for identifying areas where fast fracture analyses must be performed. This commissioned study will continue in 2019.

. Update of RCC-MRx – Section II – Part REC 3000 (Special instructions for equipment subject to regulations): the purpose of this commissioned study is to update the sections on French regulations in line with the work carried out for RCC-M. This commissioned study will be continued in 2019.

. Preparation of a document describing the sources and key reasons underlying Appendix A1 (guide for the seismic analysis of equipment): the aim of this commissioned study is to publish the criteria for Appendix A1 in a PTAN. This commissioned study was finalized in 2018, following which these criteria were published.

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

USE OF THE RCC-MRx CODE IN HIGH-TEMPERATURE, EXPERIMENTAL AND FUSION REACTORS



afcen

Shaping the rules for a sustainable nuclear technology

3

HARMONIZATION AND COOPERATION

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, the codes use other standards as their reference.

The list of standards used by a code is grouped in one of the code's chapters.

The Subcommittees regularly analyze the standards to determine whether any revisions have been made in order to ensure that codes are up-to-date. In addition, AFCEN makes a point of determining how many of its expert members take part in the standardization bureaus that produce standards with a potentially significant impact on its codes (ISO, IEC and CEN/CENELEC at the European level) and subsequently takes steps to increase their presence if necessary. Their participation is instrumental in promoting harmonized practices on an international scale.

3.2 HARMONIZATION AND COOPERATION INITIATIVES

AFCEN is a major player in the nuclear codes sector around the world. Driven by its determination to continually incorporate industry best practice and local regulations, AFCEN is naturally involved in the harmonization programs either set up by international organizations or created on its own initiative.

For example, AFCEN contributes to the objectives of harmonizing mechanical codes launched by the multinational design evaluation program (MDEP, CSWG working group on “Codes and Standards”) set up by the Safety Authorities in the main countries using nuclear energy under the authority of the OECD/NEA.

3.2.1 SDO Convergence Board

AFCEN is an active contributor to the international group of standards developing organizations (SDO Convergence Board), which was founded in 2010 to facilitate the introduction of compatible rules in the various mechanical codes. The SDO Board holds four meetings a year in addition to the ASME Code Week and reports on its work once a year to MDEP/CSWG. The SDO Board also draws inspiration from the work performed by WNA/CORDEL/MCSTF.

AFCEN is a member of the Convergence Board, just like ASME, JSME, KEPIC, CSA and NIKIET. AFCEN voices its development objectives and contributes to convergence opportunities on the topics examined by the group. In 2018, AFCEN presented its strategy for addressing the following topics: carbon segregation (topic raised by MDEP/CSWG), residual welding stress and hydraulic tests.

3.2.2 WNA/CORDEL

AFCEN is an observer in the MCSTF Task Force (Mechanical Codes & Standards) of the CORDEL working group (Cooperation in Reactor Design Evaluation and Licensing). The World Nuclear Association (WNA) created CORDEL in 2007 to stimulate dialog between international nuclear industry professionals. In 2018, AFCEN officially confirmed its role as an observer within MCSTF by appointing Cécile Pétesch (Chair of RCC-MRx) as its representative in CORDEL/MCSTF.

CORDEL/MCSTF compares the rules between different mechanical codes on various subjects, such as non-linear analyses and fatigue, and organizes practical case studies (benchmarks). In 2018, CORDEL consulted AFCEN on the draft benchmark report on fatigue analysis rules.

3.2 HARMONIZATION AND COOPERATION INITIATIVES

3.2.3 CEN WORKSHOP 64

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 (WS 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. The workshop 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 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. Since the workshop's participants experienced difficulties in assimilating the codes, which in turn put the workshop's production phase behind schedule, members formally agreed during the plenary meeting on June 8, 2017 to extend Phase 2 by one year. This extension enabled participants to fully implement the process for ensuring continuous coordination with AFCEN, such as stipulated in the business plan.

Phase 2 of 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.

Early 2017, AFCEN sent its response to the workshop concerning the 13 proposals issued in 2016. AFCEN agreed to incorporate ten of the proposals without any changes, while agreeing in principle to two other proposals subject to having the necessary time to give the proposals due consideration. However, AFCEN saw no merit in accepting the workshop's proposal of supplementing the codes with requirements relating to independent inspection organizations and explained its reasons accordingly.

Based on the performance of this first stage, AFCEN has proposed continuing this initiative with Phase 3. The kick-off meeting for Phase 3 will be held in January 2019. Phase 3 has four key objectives:

. Strengthen synergistic ties between European experts on nuclear codes to minimize fragmented best practices across the nuclear industry and give international rules greater emphasis while promoting European requirements and practices.

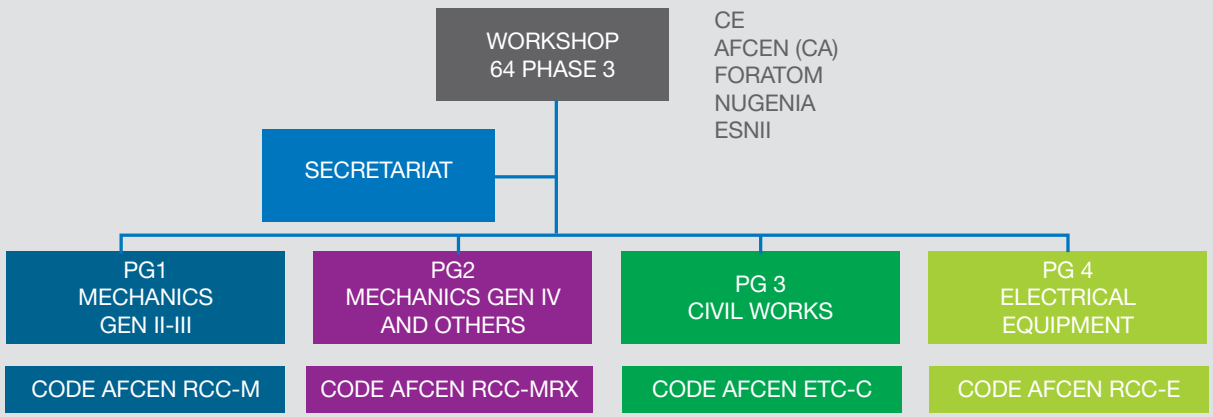
. Allow future nuclear project leaders to raise awareness of their project's constraints and suggest changes to the codes.

. Engage operators and manufacturers with a collaborative process for preparing and defining a standard for managing aging facilities, sourcing spare parts and extending the service life of nuclear power plants.

. Raise awareness of AFCEN's codes among entities potentially involved in evaluating nuclear reactors during an invitation to tender for the purpose of developing new nuclear production assets as part of the long-term plan to renew Europe's existing nuclear infrastructure.

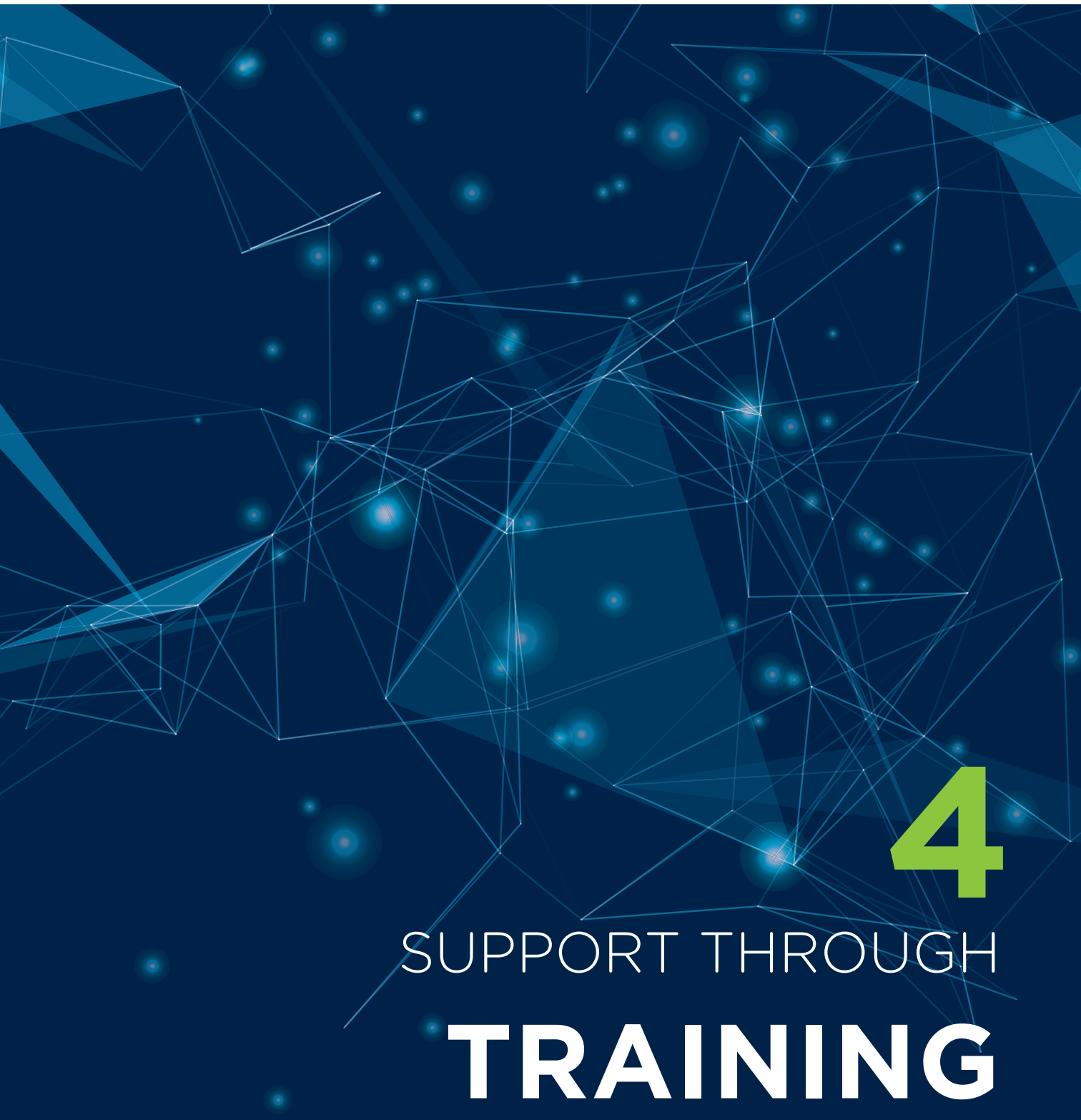
This phase will cover the three codes previously involved in Phase 2 (RCC-M, RCC-MRx and RCC-CW) and will also encompass the RCC-E electrical code if there are enough participants.

ILLUSTRATION OF AFCEN'S PARTICIPATION IN CEN



afcen

Shaping the rules for a sustainable nuclear technology



4

SUPPORT THROUGH TRAINING

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.

By delegating training to external providers, the Training Committee is responsible for assessing 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

In 2018, AFCEN renewed its trust in four partners (Framatome, SICA Nucléaire, SNPI and BUREAU VERITAS) and began a partnership with CEF Ingénierie. In all, the 12 organizations that have signed a partnership agreement with AFCEN to deliver technical training are as follows: VINCOTTE Academy, APAVE, Framatome, BUREAU VERITAS, PONT FORMATION CONSEIL, EFECTIS, INSTITUT DE SOUDURE GROUP, INSTN, NUCLEXPERT, SICA NUCLEAIRE, SNPI (CGN Group) and CEF Ingénierie.

PARTNERSHIP AGREEMENTS SIGNED BY AFCEN AND TRAINING ORGANIZATIONS BY THE END OF 2018

4.1 CERTIFIED TRAINING

Following proposals from the training officers, the Committee has certified the content of 26 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

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.sigo-organisme

AFCEN CERTIFICATE OF ATTENDANCE

AFCEN TRAINING CATALOG AS OF LATE 2018 (DETAILS IN APPENDIX C)

Code	Type of training	Duration	Language	Partnership
RCC-M	Introduction & further study of the code	2 to 5 days	FR / EN / CH	Seven partners
	Structure and application of the code	3 days	FR	One partner
	Procurement of materials according to the code	1 day	FR	One partner
	Quality assurance	1 day	FR	One partner
	Examination methods	2 days	FR	One partner
	Design and sizing	2 days	FR	One partner
	Fabrication - Welding	2 days	FR	One partner
RSE-M	Introduction to the code	2 days	FR	One partner
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-C	Introduction and use of the RCC-C code	2 days	FR	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 agreement with AFCEN.

4.2 TRAINING COURSES DELIVERED IN 2018

In 2018, 51 training sessions were held and covered all codes, representing 660 trainees and 1864 days of training. Training quality was assessed per code and organization, with specific attention to ensure that all associated messages related to nuclear safety were effectively delivered.

By the end of 2018, the certified training catalog was stable. Course content was updated to reflect the technical changes made to the new editions of the codes. To support the three-year program relating to the ESPN Regulation, AFCEN and its partners are developing courses focusing on the ESPN documentation (guides, changes to the RCC-M code), which will be available in 2019.

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 2018, courses were delivered in Germany, India, the Netherlands and the United Kingdom.

A partnership agreement was renewed for China with SNPI (CGN Group) in 2018. The RCC-M training course provided by this organization was certified in 2016. In 2018, 372 trainees completed the RCC-M course.

In India, a partnership was set up by AFCEN, EDF, BUREAU VERITAS and LARSEN & TOUBRO to facilitate the provision of certified training in the country and thereby accompany the projects currently being spearheaded by the French nuclear industry. In 2018, close to 60 trainees completed the RCC-M course.

afcen

Shaping the rules for a sustainable nuclear technology

APPENDIX A

ORGANIZATION AND OPERATION OF AFCEN

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- and RSE- 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 inquiries made by users and interested parties,

. 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

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, who approve its general strategic directions and budget.

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

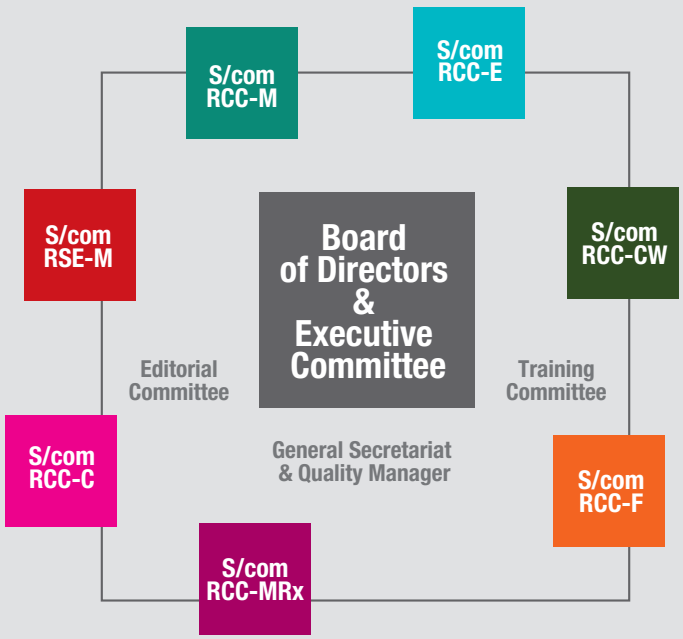
The Board designates an Executive Committee, which is tasked with achieving its work program. The Executive Committee is assisted by a General Secretariat, which is responsible for the general coordination of the association's activities, a Training Committee, an Editorial Committee and seven Subcommittees (one for each code).

AFCEN does not have any regular employees. Its work is performed by experts who have been designated by the Board of Directors and Committees, and who are made available by its members.

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, while capitalizing on user feedback.

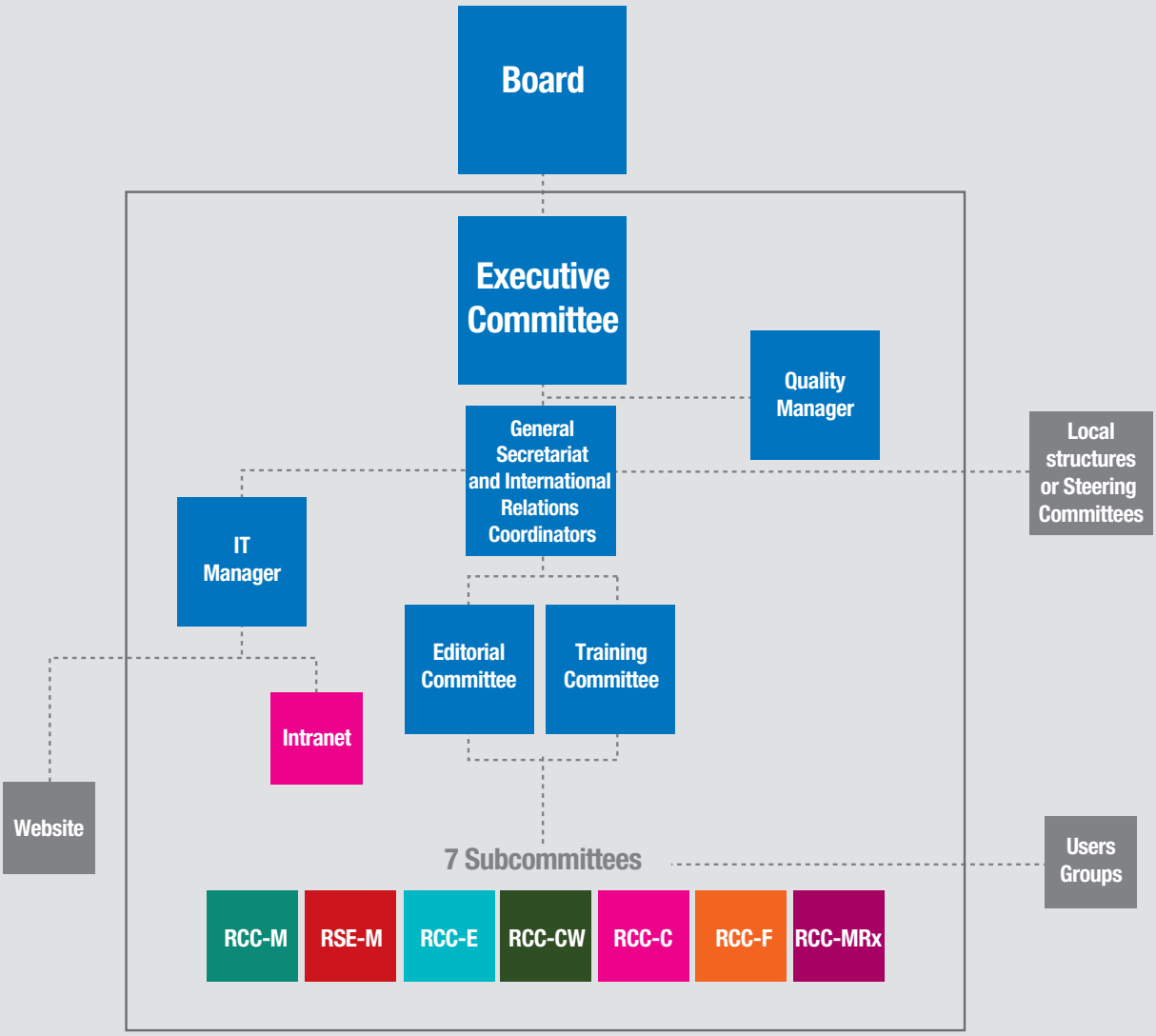
These local structures usually comprise Users Groups, which are not necessarily AFCEN members. In principle, each Users Group is associated with a code.

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.

PHILIPPE BORDARIER
PRESIDENT, EDF ADMINISTRATOR

FRANÇOISE DE BOIS
VICE-PRESIDENT TREASURER,
Framatome ADMINISTRATOR

PARTICIPATE IN BOARD MEETINGS

LUCIEN ALLAIS
CEA ADMINISTRATOR

ÉRIC PROUST
CEA ALTERNATE
ADMINISTRATOR

MANUEL CARRASCO
EDF ALTERNATE
ADMINISTRATOR

HERVÉ BARTHEL
AREVA ALTERNATE
ADMINISTRATOR

CHRISTINE MURISON
GENERAL SECRETARY

BRUNO MARQUIS
DEPUTY GENERAL
SECRETARY

AFCEN'S BOARD OF DIRECTORS

A.2 ORGANIZATION AND OPERATION

The activity of the Board of Directors and the General Meeting in 2018 is summarized in the box below.

ACTIVITY OF THE BOARD OF DIRECTORS AND THE GENERAL MEETING IN 2018

The Board of Directors held two meetings in 2018, while the Executive Committee held seven meetings.

Members held their General Meeting on June 25, 2018, and approved AFCEN's strategic directions for 2018:

. define AFCEN's strategy for supporting an overhaul of the nuclear industry both in France and at the international level,

. fulfill its commitment of aligning the mechanical codes with the requirements of France's Nuclear Pressure Equipment Regulation (France only),

. support EDF France's PWR solutions for major projects,

. reinforce AFCEN's international standing (oversee work on defining codes in China and extend the efforts of the European Working Group),

. pursue the policy of inviting new members to join the association and strengthen their participation in technical issues,

. reinforce and adapt AFCEN's certified training courses to suit industry's needs,

. maintain AFCEN's financial and organizational performance.

Spurred on by AFCEN's President, Philippe Bordarier, the Executive Committee defined its road map in response to the association's strategic plan. The preliminary version of AFCEN's strategic plan for 2018 - 2022 was presented to members on June 25, 2018.

The General Meeting approved the move to change the association's name in the Articles of Association to AFCEN.

In 2018, EDF appointed a new administrator on AFCEN's Board of Directors: Manuel Carrasco from the EDF Technical Operations Division and acting as a substitute for Phillipe Bordarier.

The Board of Directors approved the following appointments in 2018:

. Gautier Cossart was appointed Head of the ESPN Program and Deputy Chair of the Editorial Committee on December 1, 2018, taking over from Cédric Couffignal.

. Bernard Gautier was appointed Chair of the RCC-F Subcommittee on December 1, 2018.

. Benedict Willey was appointed Deputy Chair of the RCC-E Subcommittee and International Supervisor.

. Jimmy Lorange was appointed Deputy Chair of the RCC-E Subcommittee and Technical Supervisor.

. Cécile Pétesch has been appointed AFCEN representative for WNA/CORDEL

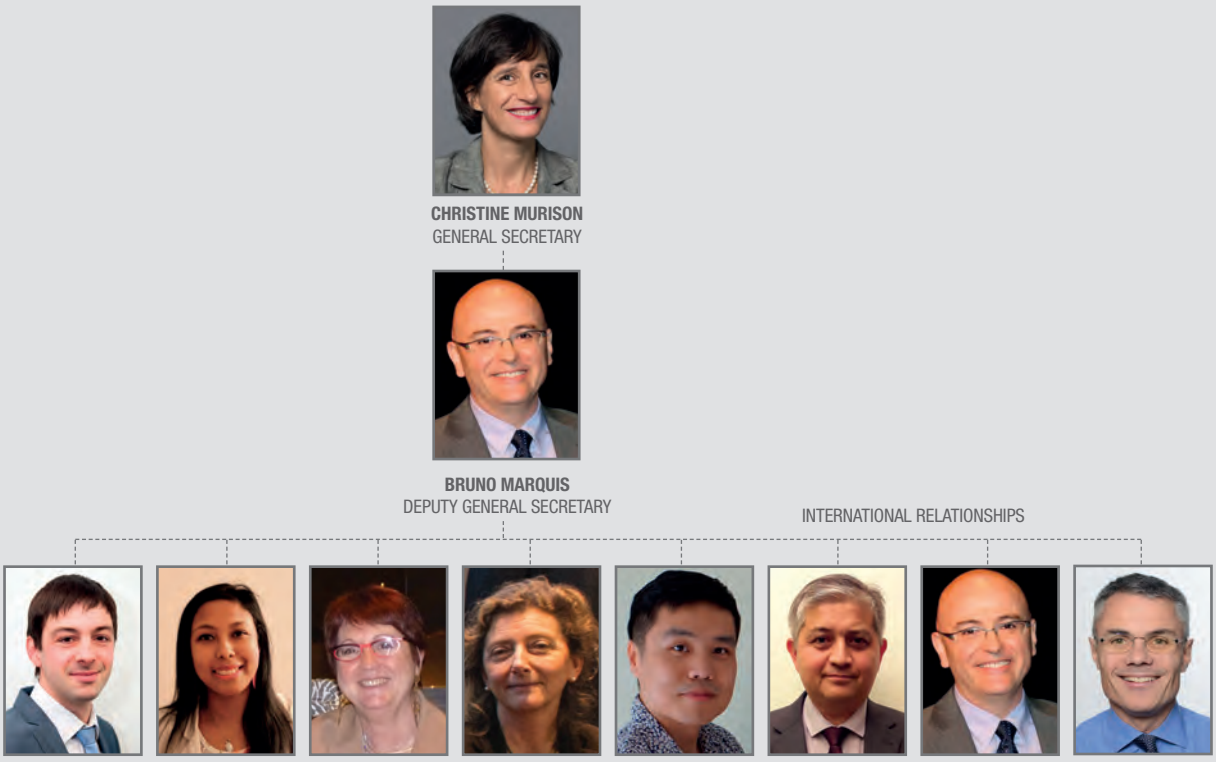
. In addition, AFCEN appointed representatives for CLAP and COLEN: Manuela Triay, leader of the RCC-M Design Drafting Group, was designated to be AFCEN's representative at the CLAP plenary session (Pressure Device Liaison Committee), and Francis Lascroux was designated to be AFCEN's representative at the COLEN plenary session.

A.2.3 General Secretariat

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

The General Secretariat organizes and leads meetings of the Executive Committee, the body responsible for taking the association's operational decisions. It organizes the process of producing and distributing codes, and supports all AFCEN activities deployed by the Editorial and Training Committees. The General Secretariat interfaces with the association's members, clients and interested parties.

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 Committees, Subcommittees and their expert 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 confidentiality and intellectual property rules.

A.2 ORGANIZATION AND OPERATION

Access to this tool by members and their designated representatives is subject to AFCEN membership and compliance with the 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.2.4 Editorial Committee

The Editorial Committee Chair and the Deputy Chairs are appointed by the Board of Directors. In addition to the Chair and two Deputy Chairs, the Editorial Committee is attended by the Chairs from each Subcommittee. The Secretary-General and the Deputy Secretary-General, as well as the International Coordinators, Quality Manager and Information System Manager, are invited to attend Editorial Committee meetings. Depending on the order of business, working group leaders are also invited to report on the progress of specific work programs covering multiple subject areas.

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 allow to include other potential sources of evolutions.

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 2018 is summarized in the box below.

FRÉDÉRIC BEAUD
CHAIRMAN OF THE EDITORIAL COMMITTEE

CLAUDE DUVAL
DEPUTY

GAUTIER COSSART
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

BERNARD GAUTIER
CHAIRMAN
OF THE RCC-F
SUBCOMMITTEE

CÉCILE PETESCH
CHAIRMAN
OF THE RCC-MRx
SUBCOMMITTEE

AFCEN'S EDITORIAL COMMITTEE

A.2 ORGANIZATION AND OPERATION

General activity of the Editorial Committee in 2018:

The Editorial Committee held four meetings. The main items addressed during the meetings were as follows:

a. AFCEN's general information (events, meetings, organization, information system, etc.)

b. International news and projects

c. Operation of the Editorial Committee (organization, quality, etc.)

d. Oversight of the editorial program (codes, overarching studies, ESPN program, etc.) with subject presentations

d. Subcommittee reporting

The Editorial Committee approved the publication of five editions in 2018: RCC-M, RSE-M, RCC-CW, RCC-C and RCC-MRx.

The three-year ESPN program (2016-2018) produced a professional technical standard to address the essential safety requirements of the ESPN Regulation of December 30, 2015, as amended, which governs the construction, manufacture and installation of nuclear pressure components in France. This standard is modeled on modification of the RCC-M and RSE-M and on a set of guides (AFCEN technical publications) targeting the topics covered by the ESPN Regulation. The 2018 editions of the RCC-M and RSE-M codes include all work to date. For most of the subject areas covered, ASN (for N1 equipment) and GSEN (for N2 and N3 equipment) officially endorsed the solutions featured in the 2018 editions.

In addition to amending the codes in the permanent working groups within each Subcommittee, dedicated working groups were regularly set up to develop specific technical subject areas. These groups may operate within a given Subcommittee or focus on several codes at the request of the Editorial Committee.

For example, the work programs completed in 2018 included anchor systems (RCC-CW/RCC-M/RCC-E), qualification of scientific computing tools for fuel core studies (RCC-C guide) and non-destructive testing and inspections (RCC-M/RSE-M). Other work programs were launched or continued in 2018 on such topics as the design of mechanical and electrical equipment to withstand extreme natural hazards, fast fracture methodology (RCC-M/RCC-MRx), quality management requirements (all codes), cybersecurity (RCC-E) and aging concrete structures (RCC-CW).

A.2.5 Training Committee

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

Training programs certified by AFCEN 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.

BRUNO MARQUIS
CHAIRMAN OF TRAINING COMMITTEE

CHRISTINE MURISON
DEPUTY

ANDREW WAZYLYK
MANAGER FOR TRAININGS ON RCC-M

PASCAL BLIN
MANAGER FOR TRAININGS ON RSE-M

THOMAS RIOU
MANAGER FOR TRAININGS ON RCC-E

MALIK RIZOU
MANAGER FOR TRAININGS ON RCC-CW

LUDOVIC QUEMARD
MANAGER FOR TRAININGS ON RCC-C

MICKAËL CESBRON
MANAGER FOR TRAININGS ON RCC-F

THIERRY LEBARBE
MANAGER FOR TRAININGS ON RCC-MRx

AFCEN'S TRAINING COMMITTEE

A.2 ORGANIZATION AND OPERATION

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 2018

General activity of the Editorial Committee in 2018:

The Training Committee held four meetings in March, June, September and December. 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 34 training courses and issued 660 certificates of attendance for courses on AFCEN codes. A new course entitled "Introduction and use of the RCC code" was certified in 2018, and the first session was held in November.

The Training Committee pursued its strategy of developing international courses, particularly in China with a certified Chinese-language course on RCC-M and also in India (two courses on RCC-M).

Specialized courses are available for the RCC-M code. The committee has also pursued work on creating a training program on the documentation associated with the ESPN Regulation, which will be available in 2019 to accompany the publication of the 2018 editions of the RCC-M and RSE-M codes.

A.2.6 Subcommittees

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

AFCEN SUBCOMMITTEES IN 2018

In 2018, seven Subcommittees were active:

. **RCC-M:** Design and construction rules for mechanical components in PWR nuclear islands
. **RSE-M:** Installation, in-service inspection and maintenance rules for PWR mechanical components
. **RCC-E:** Design and construction rules for electrical and I&C systems and equipment
. **RCC-CW:** Rules for Design and Construction of PWR Nuclear Civil 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

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.

Each Subcommittee comprises:

. a Subcommittee General Assembly,

. a Subcommittee Board,

. permanent working groups,

. dedicated 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 nominates the working group leaders from the experts in the Subcommittee Board.

The dedicated working groups spend a finite amount of time investigating specific technical subjects commissioned by the Subcommittee. They produce studies that may give rise to publications following approval from the Subcommittee or issue modification requests that are examined by the permanent working groups.

Permanent 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-field concerned,

. examining and responding to modification and interpretation requests.

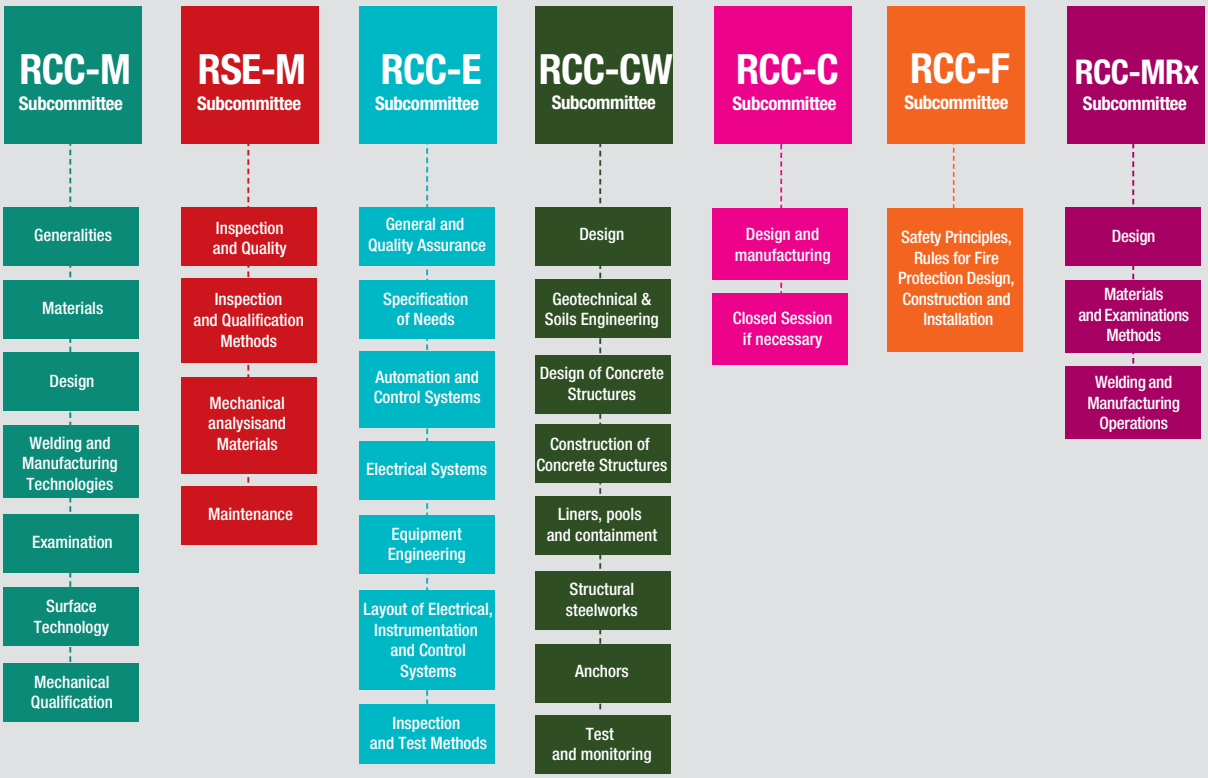
Permanent working groups investigate modification requests which, if necessary, are openly discussed during a Subcommittee meeting attended by all representatives appointed by AFCEN members. Decisions are taken by the Subcommittee Board.

Texts approved by the Subcommittee Board are submitted to the Editorial Committee and Secretary-General by the Subcommittee Chair to obtain approval for publication.

In 2018:
32 permanent working groups were active.
The Subcommittees held between four and twelve plenary sessions (RCC-M: 8; RSE-M: 8; RCC-F: 4; RCC-C: 12; RCC-MRx: 5; RCC-CW: 4; RCC-E: 4)

GENERAL ACTIVITY OF THE SUBCOMMITTEES IN 2018

A.2 ORGANIZATION AND OPERATION



AFCEN'S SUBCOMMITTEES AND WORKING GROUPS

A.2.7 Users Groups

Users Groups are local structures dedicated to a specific country, that are responsible for coordinating local activities within the scope of the relevant Subcommittees. Their missions involve:

. pre-investigating modification and interpretation requests 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 dedicated Steering Committee coordinates the activities of all the Users Groups in a given country. This Steering Committee is governed by an agreement with AFCEN and at the very least comprises a representative from AFCEN's General Secretariat (a designated international coordinator for the country), members from the relevant Subcommittees (international stakeholders) and the Chair of each Users Group in the country.

In 2018 in the UK:

The RCC-M Users Group, which is coordinated by TWI (The Welding Institute), did not have the opportunity to convene after the round of meetings between 2014 and 2016, which were attended by approximately 15 representatives from the UK's nuclear industry. 2018 offered the ideal opportunity to restart the Users Group in a different format and identify new work topics. Group members will reconvene early 2019, with the participation of AFCEN's experts.

The Users Group for civil engineering codes was launched late 2016 under WOOD's supervision. Members continued their activities in 2018 and held a meeting on October 2 attended by industry's main players. The group proved to be an attractive and profitable venture for taking advantage of the lessons learned from the HPC project and fostering a close-knit community of experts and manufacturers in the UK.

The green light was given in 2018 to create an RCC-E Users Group, which is expected to be launched in 2019.

The Steering Committee for the UK Users Groups, which is chaired by NNB, held a meeting on April 26, 2018.

In 2018 in China:

Users Groups have been set up for each code. They held at least one meeting in 2018. The Steering Committee held a meeting on September 6, 2018, in addition to the seminar between AFCEN and NEA (National Energy Administration), featuring a review of each Users Group and open discussions.

GENERAL ACTIVITY OF THE AFCEN CODE USERS GROUPS IN 2018

A.3 AFCEN QUALITY MANAGEMENT

AFCEN has set up a process-based management system to perform its missions, namely produce and disseminate reference publications and codes for building, operating and using nuclear facilities.

This process-based organization enables AFCEN to:

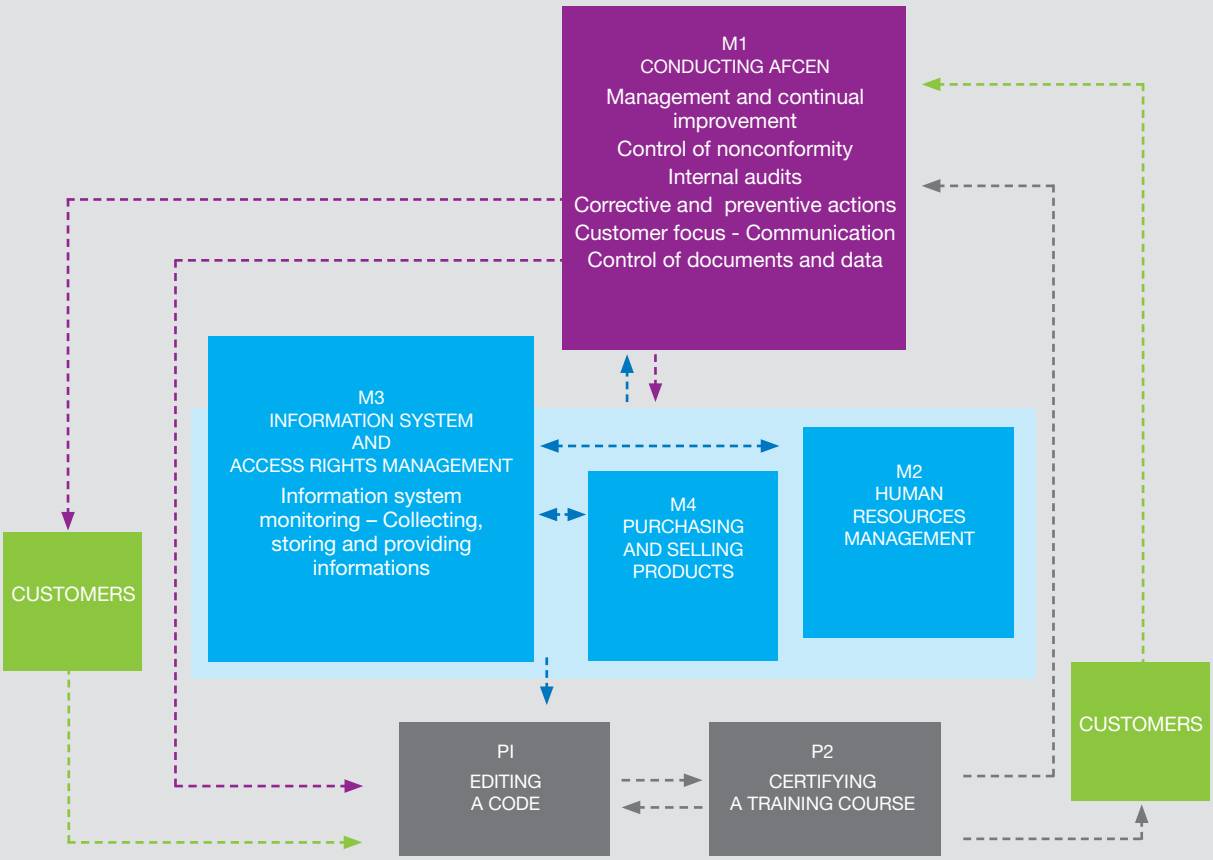
. supervise AFCEN's operation from a cross-functional perspective,

. 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) required to distribute the codes.

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 has been ISO 9001-certified since January 2014. In 2017, AFCEN migrated its quality management system to the 2015 version of ISO 9001. In 2018, the follow-up audit concluded that AFCEN's quality management system was sufficiently robust and effective.

AFCEN's general quality management activities in 2018 are summarized in the box below.

An internal audit was carried out in 2018 on AFCEN's information system management procedures and the access rights to the system.

Two process reviews were performed on training certification and the sale / purchase of AFCEN products respectively.
The AFCEN management review was held on February 1, 2018. 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,
. identify the interested parties and assess their expectations,
. examine the risk assessments for the six processes and decide which actions need to be implemented to mitigate such risks, while considering the opportunities for improving process performance,
. gather and analyze feedback from the General Meeting in 2017,
. incorporate feedback from the European workshop on AFCEN codes,
. 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,
. disseminate the safety culture at the international level via the Users Group meetings in China and the United Kingdom,
. support training on the RCC-M code in China and India,
. encourage partner organizations to develop training courses to support the ESPN Regulation,
. ramp up its communication using the website, presentations at conferences, participation in the ASME Code Week, and so on,
. repeat the European workshop,
. expand its code dissemination platform in partnership with AFNOR.

Certification follow-up audit:

On November 8, 2018, AFCEN passed the certification follow-up audit on its quality management system (ISO 9001: 2015). The auditor highlighted a number of strengths, including consistency between the policy, risks, opportunities, objectives and targets. He described this particular point as the most important progress driver throughout the certification cycle (three years). He also noted how deputy chairs had been designated to reinforce the Subcommittees, the high standards of the document management system and the clearly defined strategy in the Management Manual, which can be credited to a structured debate aimed at opening up a long-term work prospects. The AFNOR Webport/sagaweb platform used to distribute codes was also mentioned in the audit report.

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 2018

By the end of 2018, AFCEN had 73 members:

1	APAVE	FR	27	HALFEN GMBH	ALL	52	SNCT	FR
2	ASAP	FR	28	HILTI France	FR	53	SNPI (Groupe CGN)	CHINE
3	BOUYGUES TP	FR	29	INSTITUT LAUE LANGEVIN	FR	54	SPXFLOW	FR
4	BUREAU VERITAS	FR	30	INTERCONTROLE	FR	55	TECHNICATOME	FR
5	CEA	FR	31	ITER	FR	56	TRACTEBEL Engineering	FR
6	CETIM	FR	32	JIULI (ZHEJIANG JIULI HI-TECH METALS CO LTD)	CHINE	57	TUV UK Ltd	UK
7	CNIM	FR				58	TWI LTD	UK
8	CNNC	CHINE	33	JORDAHL	ALL	59	UGITECH	FR
9	DAHER VALVES	FR	34	KAERI	COREE	60	VALINOX NUCLEAIRE	FR
10	DEXTRA MANUFACTURING	THAI	35	LISEGA SAS	FR	61	VATTENFALL	SUEDE
11	DOOSAN	FR	36	NAVAL GROUP SA	FR	62	VELAN SAS	FR
12	EDF	FR	37	NFM SYSTEMS	FR	63	VINCOTTE SA	BELG
13	EFECTIS France	FR	38	NNB	UK	64	VINCI CONSTRUCTION	FR
14	EGIS INDUSTRIES	FR	39	NUCLEXPERT	FR	65	WEIR POWER & INDUSTRIAL France	FR
15	EIFFAGE GC	FR	40	NUVIA PROTECTION	FR			
16	EMERSON PROCESS MANAGEMENT	FR	41	ONET TECHNOLOGIES	FR	66	WESTINGHOUSE FR	FR
17	ENDEL	FR	42	ORANO	FR	67	WOOD	UK
18	ENSA (EQUIPOS NUCLEARES S.A, SME)	ESP	43	OXAND	FR	68	WUERTH	ALL
19	ESI GROUP	FR	44	PETERCEM	FR	**NEW MEMBERS in 2018**		
20	ESS ERIC	SUEDE	45	ROLLS ROYCE CN SAS	FR	69	ARCADIS ESG	FR
21	FLOWSERVE	FR	46	SAMT	FR	70	BERNARD CONTROLS	FR
22	Framatome	FR	47	SCHNEIDER ELECTRIC	FR	71	CSTB	FR
23	FUSION FOR ENERGY	ESP	48	SCK CEN	BELG	72	MANGIAROTTI SPA	ITA
24	GENERAL ELECTRIC	FR	49	SICA NUCLEAIRE	FR	73	ORTEC	FR
25	GEODYNAMIQUE ET STRUCTURE	FR	50	SIGEDI	FR			
26	GIS MIC NUCLEAIRE	FR	51	SITES	FR			

AFCEN MEMBERS IN 2018

A.4.2 Member involvement in the Subcommittees

In 2018, AFCEN members were involved in the Subcommittees as described in the box below.

RCC-M (36 members)
APAVE, Framatome, ASAP, BUREAU VERITAS, CEA, CETIM, CNNC, DAHER VALVES, DOOSAN, EDF, EMERSON PROCESS MANAGEMENT, ENDEL, ENSA, ESI GROUP, FLOWSERVE SAS, GIS MIC NUCLEAIRE, JIULI, LISEGA SAS, MANGIAROTTI, NAVAL GROUP, NNB, NUCLEXPERT, ONET TECHNOLOGIES, ORANO, ORTEC, SIGEDI, SNCT, SNPI (CGN Group) SPXFLOW, TECHNICATOME, TUV UK Ltd, TWI LTD, VALINOX NUCLEAIRE, VELAN SAS, VINCOTTE SA, WESTINGHOUSE FR

RSE-M (21 members)
APAVE, Framatome, ASAP, BUREAU VERITAS, CEA, CNNC, DOOSAN, EDF, ENDEL, INTERCONTROLE, MANGIAROTTI, NAVAL GROUP, NNB, ONET TECHNOLOGIES, ORANO, ORTEC, SNPI (CGN Group), TECHNICATOME, TWI LTD, WESTINGHOUSE FR, ESI GROUP, WEIR POWER & INDUSTRIAL France

RCC-E (16 members)
APAVE, Framatome, Bernard Controls, CEA, CNNC, EDF, EMERSON PROCESS MANAGEMENT, GENERAL ELECTRIC, NNB, PETERCEM, ROLLS ROYCE CN SAS, SCHNEIDER ELECTRIC, SNPI (CGN Group), TECHNICATOME, WESTINGHOUSE FR, SICA NUCLEAIRE

RCC-CW (29 members)
ADOLF-WUERTH GmbH & Co.KG, AMEC, ARCADIS, Framatome, BOUYGUES TP, CEA, CNNC, CSTB, DEXTRA MANUFACTURING, EDF, EGIS INDUSTRIES, EIFFAGE GC, GEODYNAMIQUE ET STRUCTURE, HALFEN GMBH, HILTI France, JORDAHL, NFM TECHNOLOGIES, NNB, ORANO, OXAND, SAMT, SITES, SNPI (CGN Group), TECHNICATOME, TRACTEBEL Engineering, UGITECH, VATTENFALL FORSMARKS, VINCI CONSTRUCTION, FUSION FOR ENERGY

RCC-C (6 members)
Framatome, CEA, CNNC, EDF, SNPI (CGN Group), WESTINGHOUSE FR

RCC-F (7 members)
Framatome, CEA, CNNC, EDF, EFECTIS France, NUVIA PROTECTION (formerly MECATISS), SNPI (CGN Group)

RCC-MRx (21 members)
APAVE, Framatome, BUREAU VERITAS, CEA, CNIM, CNNC, EDF, ESS ERIC, INSTITUT LAUE LANGEVIN, ITER, KAERI, MANGIAROTTI, ONET TECHNOLOGIES, ORANO, SCK CEN, SPXFLOW, TECHNICATOME, VALINOX NUCLEAIRE, VINCOTTE SA, ENSA, FUSION FOR ENERGY

AFCEN MEMBER INVOLVEMENT IN THE SUBCOMMITTEES IN 2018

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 (this number was up on 2017).

In 2018, over 830 experts contributed to AFCEN's work as follows:

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

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

China: 316 experts - UK: 56 experts

A.4 RESOURCES (MEMBERS, RESOURCES PER SUBCOMMITTEE)

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

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.

In 2018, AFCEN upgraded the collaborative tool available to its expert members. Over 1000 users have registered. The focus in 2018 was improving security and thereby guaranteeing the availability, integrity and confidentiality of the capitalized data. In addition, a shared calendar featuring the main events is now operational.

A.5.2 The AFCEN.com website

AFCEN.com presents AFCEN's organization, activities and latest news. The website acts as an interface with the public, interested parties and users.

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

In 2018, AFCEN upgraded the online sales platform by adding a module allowing users to register for AFCEN's events.

AFCEN implemented the provisions required by the General Data Protection Regulation (GDPR), which became effective on May 25, 2018, for information exchanges. At the same time, AFCEN defined its data privacy policy and updated its terms and conditions of sale on the **www.afcen.com** website to ensure complete transparency.

A.5.3 Sales model for AFCEN's publications

In October 2015, AFCEN switched over to an online purchase and access model using the new e-shop platform on AFCEN.com.

AFCEN continues taking user feedback on board to make 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,

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.

To provide industry players operating across several sites with easier access to the codes, AFCEN has implemented an "unlimited subscription" service with an attractive pricing policy for each code. When clients sign up for the three-year subscription plan, they receive a 60 % discount for the first year of their subscription. The price per code is summarized in Appendix B of the price list.

A.5.4 Distribution agreement with AFNOR

In October 2017 and subsequently in August 2018, AFCEN and AFNOR signed two non-exclusive agreements to distribute AFCEN's codes using AFNOR's "WEBPORT" and "SAGAWEB" web solutions.

These solutions are aimed at both large industrial organizations and small businesses / industries, and are designed to provide users at one or more sites with access to all the codes. These platforms are intended to centralize purchases instead of the AFCEN e-shop, which is more suited to low-volume purchases.

Visit **www.afcen.com** to find out more!

afcen

Shaping the rules for a sustainable nuclear technology

APPENDIX B

CATALOG

OF AFCEN CODES AND DOCUMENTS AVAILABLE FOR SALE

B PUBLICATIONS PRICES

Codes and publications	Description	Available lang.	Paper book format (€ excl tax)	PDF single format (€ excl tax)	Subscription format* (€ HT)
Subscription RCC-M + RCC-M 2007	RCC-M 2018 / RCC-M 2017 / RCC-M 2016 / RCC-M 2012 + add 1, 2, 3 / RCC-M 2007 + add 1, 2, 3 / RCC-M 2000 + add 1 / 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 / PTAN RCC-M 2017 - Guide inspectabilité / PTAN RCC-M 2018 - Guide de Radioprotection / PTAN RM 16 263 rev A / PTAN RM 16 264 rev A / CRITERIA RCC-M 2014 / ERRATA APPENDIX ZG - Ed 2000 addenda 2007 and following editions	•	/	/	2600
RCC-M 2018	Design and Construction Rules for Mechanical Components of PWR Nuclear Islands	FR	2950**	/	Cf. Subscription
RCC-M 2017	Design and Construction Rules for Mechanical Components of PWR Nuclear Islands	FR, EN	2 950	/	
RCC-M 2016	Design and Construction Rules for Mechanical Components of PWR Nuclear Islands	FR, EN	2 950	/	
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	2 820	/	
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	/	1 620	
RCC-M 2000 + add 1 add 1= addendum 2002	Design and Construction Rules for Mechanical Components of PWR Nuclear Islands	FR	/	1 620	
CRITERIA RCC-M 2014	Prevention of damages in mechanical components. Introduction to the design, analysis and construction rules of the RCC-M	FR, EN	1 590	1 540	
PTAN Radioprotection 2018	Radiation protection guide for the design of Nuclear Pressure Equipment for PWR plants in France	FR	/	30	
PTAN Risk	Guide ADR (Analyse de risques) pour ESPN N1	FR	/	200	
PTAN Instructions	Guide for the contents of the operating instructions for nuclear pressure equipment	FR, EN	/	65	
PTAN Dimensional Ref	Dimensional reference standard of N1 nuclear pressure equipments	FR, EN	/	85	
PTAN KV Impact Test	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	/	70	
PTAN Inspectability	Guide de l'inspectabilité pour la conception des équipements sous pression nucléaires de niveau N1 des centrales REP installées en France	FR	/	40	
PTAN RM 16 263	Note support à la rédaction des EPMN pour équipements ESPN N1*, N2 et N3 Corrosion des aciers inoxydables austénitiques et austéno-ferritiques	FR	/	145	
PTAN RM 16 264	Note support à la rédaction des EPMN pour équipements ESPN N2 et N3 Vieillissement thermique des aciers inoxydables austénitiques et austéno-ferritiques	FR	/	135	
Subscription RSE-M	Publications included in the subscription: RSE-M 2018 / RSE-M 2017 / RSE-M 2016 / RSE-M 2010 + add 1, 2, 3, 4 / PTAN WPS 2016 / PTAN RS 16 007 Guide for Periodic Requalification of N2 or N3 ESPN piping / PTAN Annexe 5.4 du RSE-M / PTAN RS 16 010 rev D / PTAN RS 16 010 rev E / PTAN RS 18 007 rev A	•	/	/	1600
RSE-M 2018	In-Service Inspection Rules for Mechanical Components of PWR Nuclear Islands	FR	1760**	/	Cf. Subscription
RSE-M 2017	In-Service Inspection Rules for Mechanical Components of PWR Nuclear Islands	FR, EN	1 760	/	
RSE-M 2016	In-Service Inspection Rules for Mechanical Components of PWR Nuclear Islands	FR, EN	1 760	/	
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	1 760	/	
PTAN WPS	Principle and substantiation for taking Warm Pre-Stressing (WPS) into account in PWR vessel fast fracture resistance criterion	FR, EN	/	85	
PTAN RS 16 007	Guide for Periodic Requalification of Class N2 or N3 ESPN piping	FR, EN	/	45	
PTAN Annexe 5.4	Annexe 5.4 du RSE-M: Principes et historique de l'élaboration des méthodes analytiques de calcul des facteurs d'intensité de contrainte et du paramètre J pour un défaut plan	FR	/	210	
PTAN RS 16 010 rev D	Guide pour le dossier de réparation/modification classée notable d'un ESPN	FR	/	140	
PTAN RS 16 010 rev E	Guide professionnel pour le dossier de réparation/modification classée notable d'un ESPN soumis aux points 1 à 4 de l'annexe V de l'arrêté du 30/12/2015 modifié PTAN RS.	FR	/	110	
PTAN RS 18 007 rev A	Guide professionnel pour les interventions sur des ESPN du CPP-CSP	FR	/	40	
Subscription RCC-E	Publications included in the subscription: RCC-E 2016 / RCC-E 2012 / Gap analysis RCC-E 2005 - 2012 / Gap analysis RCC-E 2012 - 2016	•	/	/	950
RCC-E 2016	Design and construction rules for electrical and I&C systems and equipment	FR, EN	1 000	/	Cf. Subscription
RCC-E 2012	Design and construction rules for electrical equipment of nuclear islands	FR, EN	625	/	

Codes and publications	Description	Available lang.	Paper book format (€ excl tax)	PDF single format (€ excl tax)	Subscription format* (€ HT)
Subscription RCC-CW + ETC-C	Publications included in the subscription: RCC-CW 2018 / RCC-CW 2017 / RCC-CW 2016 / RCC-CW 2015 / ETC-C 2012 / ETC-C 2010 / PTAN RCC-CW 2015	•	/	/	1430
RCC-CW 2018	Rules for design and construction of PWR nuclear civil works	FR, EN	1 500	/	Cf. Subscription
RCC-CW 2017	Rules for design and construction of PWR nuclear civil works	FR, EN	1 500	/	
RCC-CW 2016	Rules for design and construction of PWR nuclear civil works	FR, EN	1 500	/	
RCC-CW 2015	Rules for design and construction of PWR nuclear civil works	FR, EN	1 500	/	
ETC-C 2012	EPR Technical Code for Civil Works	FR, EN	Only in english 1 060	1 010	
ETC-C 2010	EPR Technical Code for Civil Works	FR, EN	820	780	
PTAN Seismic Isolation	French Experience and Practice of Seismically Isolated Nuclear Facilities	FR, EN	/	190	
Subscription RCC-C	Publications included in the subscription: RCC-C 2018 / RCC-C 2017 / RCC-C 2015 / RCC-C 2005 + add 1	•	/	/	820
RCC-C 2018	Design and construction rules for fuel assemblies of PWR nuclear power plants	FR, EN	850	/	Cf. Subscription
RCC-C 2017	Design and construction rules for fuel assemblies of PWR nuclear power plants	FR, EN	850	/	
RCC-C 2015	Design and construction rules for fuel assemblies of PWR nuclear power plants	FR, EN	850	/	
RCC-C 2005 + mod 1 mod 1 = modificatif 2011	Design and construction rules for fuel assemblies of PWR nuclear power plants	FR, EN	725	/	
Subscription RCC-F	Publications included in the subscription: RCC-F 2017 / ETC-F 2013 / ETC-F 2010	•	/	/	380
RCC-F 2017	Design and Construction rules for fire protection of PWR nuclear plants	FR, EN	400	/	Cf. Subscription
ETC-F 2013	EPR technical code for fire protection	FR, EN	400	/	
ETC-F 2010	EPR technical code for fire protection	FR, EN	275	/	
Subscription RCC-MRx + RCC-MR	Publications included in the subscription: RCC-MRx 2018 / RCC-MRx 2015 / RCC-MRx 2012 + add 1 / RCC-MR 2007 / PTAN RCC-MRx 2017 / PTAN Seismic Analysis Components	•	/	/	2670
RCC-MRx 2018	Design and Construction Rules for Mechanical Components of nuclear installations : high-temperature, research and fusion reactors	FR, EN	2 940	/	Cf. Subscription
RCC-MRx 2015	Design and Construction Rules for Mechanical Components of nuclear installations : high-temperature, research and fusion reactors	FR, EN	2 940	/	
RCC-MRx 2012 + add 1 add 1 = addendum 2013	Design and construction rules for mechanical components of nuclear installations	FR, EN	2 880	/	
RCC-MR 2007	Design and construction rules for mechanical components of nuclear installations	FR, EN	/	2 140	
PTAN New Material	PTAN Guide for introducing a new material in the RCC-MRx	FR, EN	/	100	
PTAN Seismic Analysis Components	PTAN Guide for seismic analysis of components	FR, EN	/	65	

• Access to the publications in all available languages
* The subscription period is one year
** Not available yet

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

Prices as of 12/20/2018

afcen

Shaping the rules for a sustainable nuclear technology

APPENDIX C

TRAINING CATALOG

CATALOG OF TRAININGS CERTIFIED

Field	Reference	Code	Title of training	Duration	Language	Organisme
Mechanics	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		RCC-M code 2012	2 d	French	NUCLEXPERT
	M-006		Understanding of the code RCC-M	2 d	French	APAVE
	M-007		Code RCC-M	2 d	French/English	BUREAU VERITAS
	M-008		Design of class 2 & 3 equipments	3 d	French	APAVE
	M-009		Fabrication - Welding - Monitoring according to the code RCC-M	2 d	French	APAVE
	M-010		RCC-M code design	2 d	English	BUREAU VERITAS
	M-011		Discovery of the code RCC-M	3 d	French	IS GROUPE
	M-012		RCCM - Construction code for nuclear pressure equipment	3 d	French	BUREAU VERITAS
	M-013		Introduction to RCC-M code	3 d	English (India)	BUREAU VERITAS
	M-014		Architecture and application of the code RCC-M	3 d	French	APAVE
	M-015		Nuclear pressure equipments - Discovery of the code RCC-M	3 d	French	VINCOTTE
	M-016		Discovering RCC-M code	4 d	French / English	FRAMATOME
	M-017		RCC-M code	5 d	Chinese	SNPI (GROUPE CGN
	EM-001	RSE-M	Introduction to the use of the code RSE-M	3 d	French	BUREAU VERITAS
	MRx-001	RCC-MRx	Discovering the code RCC-MRx	3 d	French / English	FRAMATOME
	MRx-002		RCC-MRx Construction code for mechanical materials of nuclear plants	3 d	French / English	BUREAU VERITAS
	MRx-003		Discovery of the code RCC-MRx	3 d	French	INSTN
Civil Engineering	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
Electricity	E-001	RCC-E	Introduction to the code RCC-E (Design and construction rules regarding electric material)	1 d	French / English	FRAMATOME
	E-002		RCC-E 2012 - Qualification and manufacturing of an electrical equipment (Réf. SICA F1501 and E1602)	3 d	French / English	SICA
	E-003		Use of the RCC-E	4 d	French	APAVE
	E-004		RCC-E 2016 - Qualification and manufacturing of an electrical equipment (Réf. SICA F1701 and E1801)	3 d	French / English	SICA
	E-005		RCC-E 2012 - Specialisation "Inspection" (Réf. SICA F1502)	1 d	French	SICA
	E-006		RCC-E 2016 - Qualification and manufacturing of an electrical equipment (Réf. SICA F1703)	2 d	French	SICA
	E-007		RCC-E 2016 - Qualification and manufacturing of an electrical equipment (Réf. SICA F1704 and E1808)	2 d	French / English	SICA
	E-008		Discovry of the code RCC-E 2016 – (Réf. SICA F1802 and E1809)	1 d	French / English	SICA
	E-009		Upgrade RCC-E 2012 ->2016 (Réf. SICA F1702 and E1802)	1 d	French / English	SICA
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