afcen

Shaping the rules for a sustainable nuclear technology

# 2022

# ANNUAL REPORT

COLLABORATION
EXPERTISE
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# FOREWORD
## BY AFCEN'S PRESIDENT

**Laurent THIEFFRY,**
President

"In 2022, France's nuclear industry sprang into action in a bid to address the stress corrosion cracking issues affecting the country's in-service reactors. Industry professionals were also delighted to hear an official announcement from President Emmanuel Macron that six EPR2-type nuclear reactors would be built by 2050. In Europe and around the world, efforts to tackle global warming propelled nuclear energy to the top of the climate agenda in several countries. As the level of growth in nuclear activities continues to rise across France, Europe and the rest of the world, AFCEN is again sending out a strong signal of its determination and mission to support the nuclear industry by developing and disseminating reference publications and codes for building and operating nuclear facilities. Our ambition at AFCEN is to see our codes continue gaining traction and achieving greater recognition for their ability to guarantee safety and raise the efficiency bar in industry. Expertise, collaboration and responsibility are the hallmarks that define and shape our association, and many of our works and initiatives bear testament to these values.

AFCEN's development and achievements dovetail seamlessly with the key directions in our 2021-2025 strategic plan, which has identified three major issues, namely the editorial policy for our codes, interaction with major projects, operators and safety authorities, and support for fostering proficiency in the codes. This plan also includes a resources component with the aim of drafting in the experts that AFCEN needs.

AFCEN has been busy preparing new editions of the codes with the aim of integrating feedback, incorporating developments associated with the latest breakthroughs in technologies and practices, and reflecting changes in regulations and standards. These efforts reinforce the wealth of knowledge acquired across the nuclear industry, which can be used to lead future projects. One of the highlights of 2022 included the publication of five new editions of the codes, with four major editions for RCC-M (mechanical components of PWR nuclear islands), RCC-MRx (mechanical components in high-temperature, research and fusion reactors), RCC-E (electrical and I&C systems) and RSE-M (in-service inspection), as well as an enhanced edition of RCC-C (fuel assemblies). Work is continuing on the other two codes, i.e. RCC CW (nuclear civil works) and RCC-F (fire protection), with plans to release new editions in 2023.

AFCEN pursued its work to ensure easier application of the ESPN Regulation within the nuclear industry and is currently putting the finishing touches to its "four-year roadmap". AFCEN is still at the discussion table with GSEN (Group for Nuclear Equipment Safety) and France's Nuclear Safety Authority with the aim of seeing both bodies maintain their endorsement of the solutions proposed by the RCC-M code as being capable of satisfying the regulation's requirements. This process has led to changes in the RCC-M and RSE-M codes and also the PTAN publications, and work will continue in 2023 as part of a new format known as an "ESPN activity portfolio".

Using the funds received under the French government's "France Relance" plan (France Recovery plan) to get the country's economy back on track, AFCEN focused on its ambition of strengthening skills in the nuclear industry in 2022. As such, several guides for assessing suppliers' level of expertise in the RCC M code have been published, and a guide for the RCC-E code has also been produced. These guides will help the nuclear industry in its efforts to gain greater proficiency in AFCEN's codes.

Finally, in response to the need for improved harmonization and standardization across the nuclear industry, several initiatives are being spearheaded across Europe to develop codes. A prime example is CEN Workshop 64, which was masterminded by AFCEN in 2010. This workshop is due to complete Phase 3 in 2022 with a series of proposed changes to the codes. Industry professionals across Europe continue to keep a close eye on the workshop's activities, and AFCEN has decided to launch Phase 4, which will take place over the next four years.

I would like to pay tribute to our experts' unwavering commitment and thank our members for actively participating in our endeavors. On behalf of all our members, it gives me great pleasure to present the 2022 AFCEN Annual Report. This report clearly illustrates the many achievements and events that our association has organized and supported over the previous year.

I look forward to seeing you in Paris on March 29 and 30, 2023, during the next AFCEN Congress."

# SIGNIFICANT EVENTS
## 2022

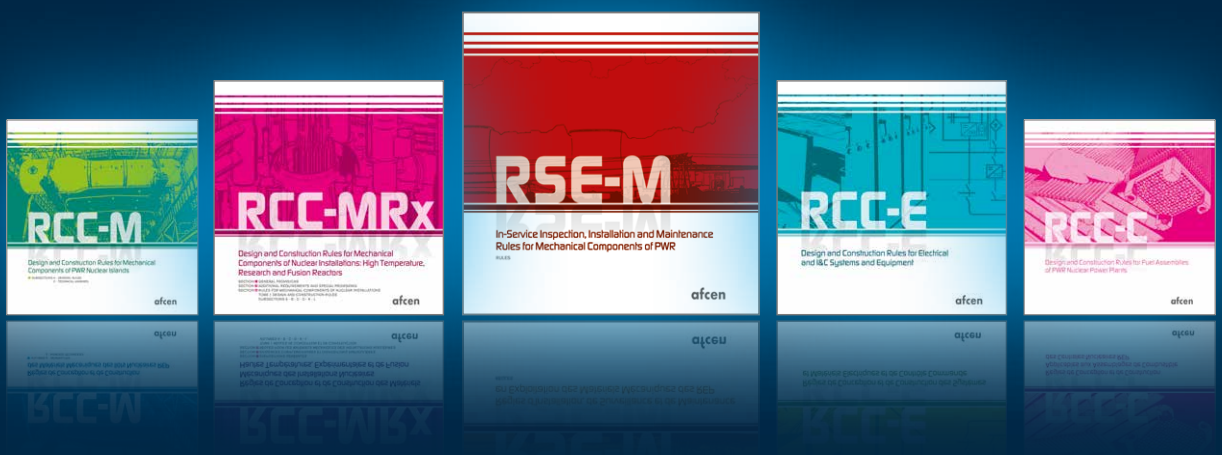
### A new General Secretary in 2022

Christine Murison retired in 2022 after serving as AFCEN's Secretary-General since 2016. All the members of the General Secretariat and the Executive Committee would like to express their heartfelt appreciation and thank her again for her work over the years in developing and leading the association. We wish her an excellent retirement.

CHRISTINE MURISON

### In 2022, AFCEN published new editions for five of its codes: RCC-M, RCC-MRx, RSE-M, RCC-E and RCC-C

In 2022, AFCEN updated its three mechanical codes: RCC-M (design and construction rules for mechanical components of PWR nuclear islands), RSE-M (in-service inspection rules for mechanical components of PWR nuclear islands) and RCC-MRx (design and construction rules for mechanical components of nuclear installations: high-temperature, research and fusion reactors). In addition, the RCC-E code is available as an enhanced version that incorporates the latest operational feedback, especially relating to improved requirements in the field of electrical architecture, while taking account of new technical standards and quality assurance requirements and introducing the necessary strategies and methods for bringing cybersecurity risks under control. Following a break in 2021, the RCC-C code resumed its policy of annual updates in 2022, with changes to the sections covering materials, fabrication and inspections, such as qualification requirements for the heat treatment of fuel products.



# SIGNIFICANT EVENTS
## 2022

## In 2022, AFCEN completed the “four-year ESPN roadmap”

In 2019, AFCEN launched its “four-year ESPN roadmap” with the aim of maintaining ASN’s and GSEN’s endorsement of its codes following the three-year programme, addressing changes in technologies and practices based on feedback from the nuclear industry as well as AFCEN, GSEN and ASN, working alongside ASN and GSEN in examining the impacts of changes in regulations, and giving the code a more industrial feel. The roadmap is due to culminate late 2022 with the 2022 edition of the RCC-M code and has garnered a string of successes along the way, including the launch of the Welding Feedback programme to incorporate feedback on the welding activities during the Flamanville 3 project into RCC-M, as well as the deliverable entitled “Methodological approach for addressing nonconformities during the manufacture of new Class 1 equipment”. In ASN’s letter of endorsement (no. CODEP-DEP-2022 035566), the authority’s senior management team explained: “I would like to draw attention to the level of quality in AFCEN’s work, which meets the requirements that ASN set out to resolve the difficulties repeatedly seen in this particular area.” This ESPN programme will be followed by a long-term sequel that pursues the same objectives as the four-year roadmap. That sequel will be none other than the “ESPN portfolio”, which will futureproof the organization and governance structure that were implemented to drive the four-year roadmap.

When wrapping up the plenary meeting of the ESPN programme’s steering committee in December 2022, ASN stated: “ASN wishes to pay tribute to the major efforts that AFCEN has been leading for several years and which will continue through the ESPN portfolio. The process of developing codes and the associated endorsement procedure are essential for providing a clearer insight into the regulation and improving its application.”

FLAMANVILLE REPLACEMENT STEAM GENERATOR ON A BARGE

## In 2022, work was completed for CEN/WS64 Phase 3

Phase 3 of CEN Workshop 64 “Design and construction codes for Gen II to IV nuclear facilities” was completed late 2022 following its launch back in early 2019.

WS64, which is the only European platform where code development experts can discuss and share their recommendations, welcomed a new group of members. Phase 3 introduced a fourth group of experts focusing on electrical equipment based on AFCEN’s RCC-E code.

This phase of the workshop led to proposed changes to AFCEN’s codes, some of which have already been accepted. Proposals for the workshop’s R&D programmes will be submitted to the EC/DG for Research and Innovation for incorporation into future European calls for proposals. This phase also identified a number of cross-cutting issues for all four working groups. The CWA report provides an

# SIGNIFICANT EVENTS
## 2022

overview of all the workshop's activities and is expected to be finalized and disseminated during the first quarter of 2023.

Spurred on by the workshop's success, the decision has been taken to kick off Phase 4 in 2023, which will last four years. The Phase 3 working groups have identified the new topics for Phase 4. The workshop is already scouting for new participants. Sign up now!

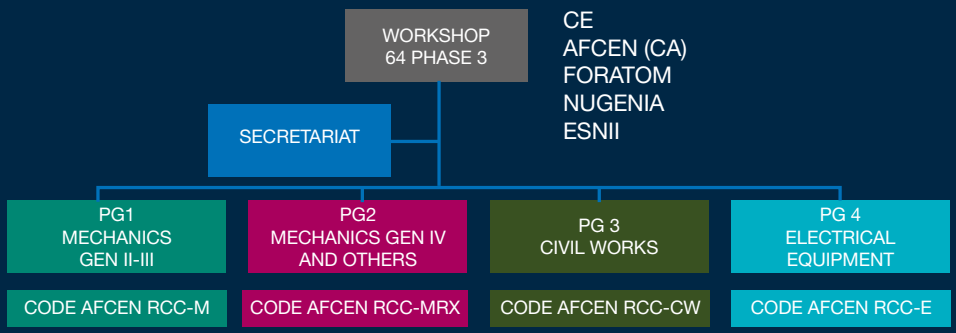



ILLUSTRATION OF AFCEN'S PARTICIPATION IN CEN

## In 2022, launch of the HARMONISE project chosen during the EURATOM 2021/2022 call for proposals

As 2021 drew to a close, AFCEN lent its support to setting up the HARMONISE project, which had been given the green light during the HORIZON-EURATOM-2021-NRT-01-06 call for proposals: Harmonisation of licensing procedures, codes and standards for future fission and fusion plants. The three-year HARMONISE project officially began in June 2022. Full details about the project are available on the website at https://harmonise-project.eu/.

AFCEN's participation in this Europe-wide collaborative and institutional project will help raise the association's profile. In addition, the way in which the HARMONISE project synergizes with the work of CEN/WS64 gives added weight to the argument for extending CEN/WS64.

harmonise
Harmonising Fission & Fusion Reactor Licensing

## In 2022, AFCEN continued its involvement in preparing the NUWARD™ project

AFCEN and the NUWARD™ project wrapped up their discussions for streamlining and strengthening AFCEN's support in defining the project's technical standards. The agreement signed on April 15, 2022, allowed both sides to hold a number of technical discussions with the aim of ensuring the proper application of AFCEN's codes, determining their suitability and potentially adapting them to the project's needs. Following the pre-FEED stage, the NUWARD™ project confirmed that AFCEN's codes form the backbone of its technical standards in all the fields where they apply, whether for the first reactor in the series that will be installed in France or the other reactors in the series that will be rolled out across Europe and the rest of the world.

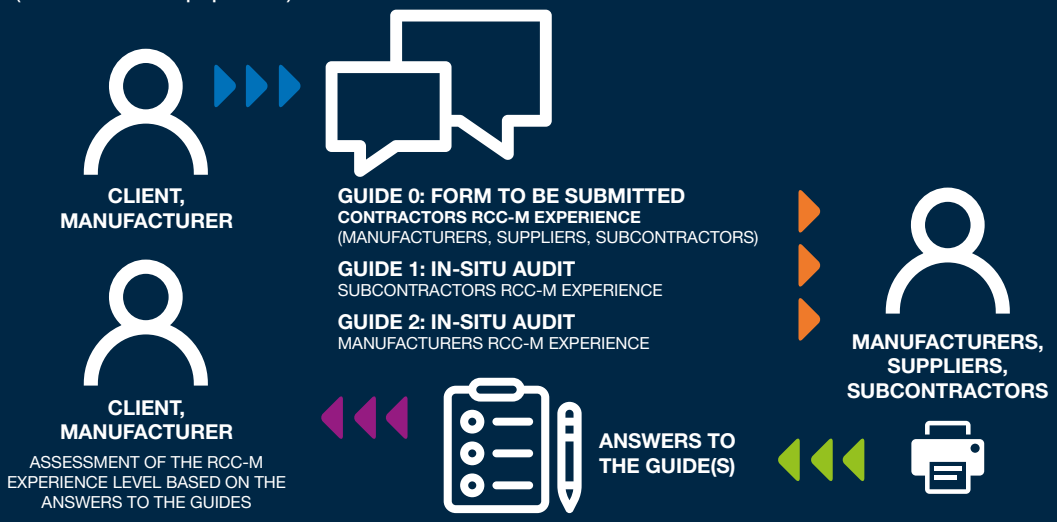
NUWARD™ REACTOR

# SIGNIFICANT EVENTS
## 2022

### In 2022, AFCEN produced guides to strengthen skills in the nuclear industry plan

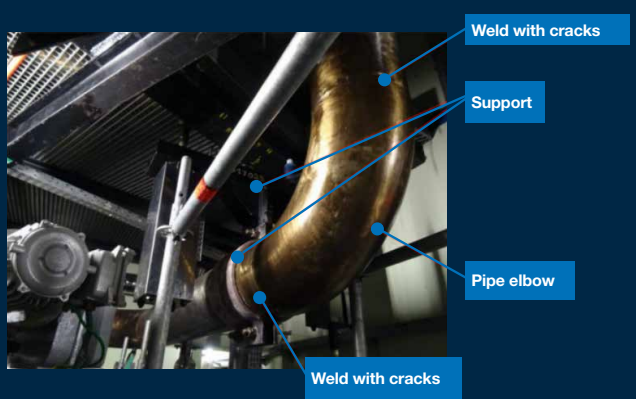
In 2022, AFCEN provided the nuclear industry with a set of tools allowing clients to assess the level of experience in the RCC-M code by means of three guides :

- Guide 0 : assess the experience of providers (manufacturers, suppliers and subcontractors) in applying the technical requirements of the RCC-M code.
- Guide 1: allow manufacturers to effectively assess a supplier's or subcontractor's level of technical experience in the RCC-M code (Class 2 & 3 equipment).
- Guide 2: allow clients to effectively assess a manufacturer's level of technical experience in the RCC-M code (Class 2 & 3 equipment).




### In 2022, AFCEN supported plans to address the stress corrosion cracking issues affecting in-service reactors

In 2022, the damage caused by stress corrosion cracking to the piping connected to the main primary system impacted several in-service reactors across France. This phenomenon leads to the formation of one or more cracks, which can spread and potentially compromise the pipe's integrity. A wide-ranging work programme has been put into action, which includes carrying out non-destructive testing, analyzing the impact of the defects (depending on the local stresses and the cracks detected), and supplying and replacing sections, which will require several in-service units to be shut down. AFCEN's RSE-M code provides criteria and simplified methods for evaluating the impact of the identified defects and assessing the area under investigation.




ELBOW AFFECTED BY STRESS CORROSION CRACKING

# SIGNIFICANT EVENTS
## 2022

### In 2022, AFCEN pursued its collaborative efforts in China

AFCEN continued providing key information to allow China's experts to accurately translate the RCC codes into Chinese. At the present time, the translations have been completed and subsequently reviewed by the relevant experts for RCC-M 2017, RSE-M 2017, RCC-CW 2018, RCC-E 2016, RCC F 2017, RCC-C 2018 and RCC-MRx 2015. Following AFCEN's consent, the Chinese versions of RCC-M 2017 (partial), RSE-M 2017, RCC-E 2016 and RCC-CW 2018 were published in August 2022.


### In 2022, AFCEN welcomed three members

HDI - Site de Guéméné, formerly MOUROT, is a HDI subsidiary that specializes in precision mechanics, weld hard facing and thin-layer surface treatment.

SIEMENS' Digital Industries Division develops and manufactures its own automation, drive technology and digitization solutions, while leading digital transformation in the manufacturing and process industries.

Basler & Hofmann was founded in 1973 and has offices in Switzerland, Germany, Italy, Slovakia, and Singapore. The company specializes in civil engineering with experts from over 30 disciplines involved in a variety of projects, such as building construction works without affecting production, tunnels, demolition work and wind power.

MOUROT
HENRY DESJONQUERES INDUSTRIES

SIEMENS

Basler & Hofmann

afcen

Shaping the rules for a sustainable nuclear technology

# 1

## NATIONAL AND INTERNATIONAL CHALLENGES

## RELATIONSHIPS WITH STAKEHOLDERS

# 1.1 AFCEN'S MISSIONS AND AMBITIONS

Founded by EDF and Framatome in October 1980, AFCEN launched its first four-year strategic plan in 2018. The appointment of a new president at AFCEN's helm in December 2020 prompted AFCEN to take its strategic plan back to the drawing board and invite members across the association to engage in the process and share their views.

AFCEN's strategic plan 2021-2025 can be credited to their collective efforts. This new plan draws strength from the association's previous work and features a number of ambitions that are geared towards the opportunities and requirements in the current environment, while providing a new insight into the role that nuclear codes play in our industry.

Our mission: Develop and provide codes and reference documents offering accurate and practical rules for the design, construction and in-service inspection

Our Ambition: provide codes chosen worldwide which contribute to the safety and economic performance of sustainable nuclear facilities

Our core values: Expertise, Collaboration, Accountability

## AFCEN's strategic plan


The strategic plan is complemented by a reflection on the industrial character of AFCEN's activities: to AFCEN, being in industrial means:

- Making nuclear safety a priority and industrial performance a goal
  - . Offer industrial solutions the Safety Authorities can trust
- Aiming for performance and efficiency:
  - . Propose graded requirement
  - . Deliver explicit and accessible codes
  - . Highlight the gain for all the stakeholders
  - . Enable the introduction of innovations
- Meeting the needs of projects and industry manufacturers:
  - . Take into account the feedback from field experience over time
  - . Select practices supported by standards (European and ISO) and applicable by industry manufacturers
  - . Strengthen the stability and reliability of projects by standardizing industrial practices

It proposes a vision based on three major issues with a resource component. It renews the analysis of Threats, Opportunities, Strengths and Weaknesses. The levers of action are then described, in coherence with this framework of reflection.

**Thus, three major issues are identified:**

**1. Editorial policy for codes**

To develop and update, at a pace shared by stakeholders, a set of consistent rules, shared with industry manufacturers, proven and optimized to ensure compliance with nuclear safety requirements and regulations.

- An editorial policy which defines: the content and pace of development for each code, objectives relating to the structure of codes, the statement of requirements, the coverage of technical topics.
- An experience feedback loop based: the participation of key business experts, experience feedback meetings with the Clients (including projects) and industry manufacturers, an experience feedback loop embedded in the subcommittee processes.
- Rules for drafting codes inspired by Requirements Engineering.
- Modification Sheets guarantying that the solutions proposed by the codes are endorsed by industry manufacturers and compliant with the regulations.

**2. Interaction with stakeholders: major projects, operators and authorities**

To be recognized by prospects and European regulators, to support projects (choice of code editions, etc.) and operators, with key levers of action:

- Increase influence in Europe and the world (China in particular)
- Interact with authorities to increase recognition of codes
- Support major projects: AFCEN tools to strengthen control and stability of the project technical reference basis:
  - . Guarantee the forward compatibility of successive editions
  - . Provide tools to justify the stability of the project technical reference basis
- Support the French NUWARD™ SMR project in choosing AFCEN:
  - . Respond to the need for codification of the project, build an international offer
- Provide guidance to operators

**3. Support and foster proficency in the codes**

To develop knowledge and proficiency in the codes, disseminate good practices to ensure the adoption of the content of codes by all users, from the owner or achitect engineer to all tiers of suppliers, with key levers of action:

- Assimilation and evaluation :
  - . Develop self-assessment guide and guides to assess the proficiency of suppliers in RCC-M and RCC-E codes, as part of the supplier qualification process.
  - . Assist with the use of codes in the course of a contract:
- Provide specialised training and support for all stakeholders: client, manufacturer, authorities.
- Expand the AFCEN-certified training catalogue
- Responsiveness in project support :
  - . Improve organization to provide quick responses (currently 3 months on average) to code Interpretation Requests (IRs) to keep up with the pace of projects.

And finally, a Resources component is committed, to ensure AFCEN's availability and quality of the experts needed to carry out its missions.

- Increase memberships among companies bringing key experts
- Give credit for the time spent within AFCEN in an expert's career
- Build a stronger presence of industry experts in the working groups of each subcommittee
- Experiment with the production of Modification Sheets by Chinese experts, for selected topics of the RCC-M code in the «design», «materials» and «technology and manufacturing» working groups.

# 1.2 AFCEN'S ACTIVITIES IN FRANCE AND AROUND THE WORLD RELATIONSHIPS WITH PROJECTS

AFCEN's activities in France are aimed at achieving the following objectives:

- Support the major reactor projects in France: Flamanville EPR, ITER and RJH
- Lay the foundations for the future reactor projects: EPR2 and SMR (NUWARD™)
- Offer assistance and guidance to nuclear operators

AFCEN's international activities are focused on achieving the following key objectives:

- Implement the proposed changes to the codes voiced by participants in CEN/WS64 "Design and construction codes for Gen II to IV nuclear facilities", a workshop that contains leading players in Europe's nuclear industry looking to improve their expertise in AFCEN's codes.
- Continue developing working platforms for the local nuclear industry in each area where its codes are used, mainly the UK and China.
- Support the MYRRHA project, developed by the SCK CEN, which has chosen the RCC-MRx as technical standards for the primary circuit.
- Support the HPC and SZC EPR projects in the UK and the JNPP EPR in India.
- Pursue AFCEN's development around the world: Asia (China, India), Europe and the UK, South Africa and the Middle East by supporting projects in France's nuclear industry.
- 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.
- Continue the policy of comparing and harmonizing AFCEN codes with the other nuclear codes within the SDO Convergence Board and in liaison with the OECD/NEA/CNRA/WGCS (Working Group on Codes & Standards, safety authorities entities) and the WNA/CORDEL association (Cooperation in Reactor Design Evaluation and Licensing).

## 1.2.1 France (EPR, EPR2, ITER, RJH, NUWARD™ and reactors currently in operation)

### FA3 activity

Feedback from the construction of reactor 3 at Flamanville continues to be incorporated into the different codes used for the project. In 2022, major efforts focused on integrating feedback from the welding work on the main secondary system into the 2022 edition of the RCC-M code. For example, Chapter S3000 on welding procedure qualification and Chapter S7600 on welded repairs have undergone a major rework. The programme has also been established for the changes that will be incorporated into future editions of the RCC-M code.

### EPR2 activity

The EPR2 project has chosen AFCEN's codes to design and build the reactors. The EPR2 project has established its technical standards and is keeping a close eye on changes to the codes with the aim of taking account of feedback from the EPR units (in service or undergoing commissioning) and fulfilling the safety requirements for EPR2. In 2022, as part of the preliminary investigations required before applying for authorization to build a pair of EPR2-type reactors, IRSN (the technical support of France's Nuclear Safety Authority) examined the RCC-F and RCC-CW codes, as well as Volume Q in the RCC-M code on the qualification of equipment under accidental conditions. The questionnaires were examined by EDF in close liaison with AFCEN's experts. The codes may be updated to reflect the findings of these examinations.

In 2022, AFCEN continued discussing with the different stakeholders involved in the EPR2 project about the recent and future changes to its codes, as well as the project's expectations. AFCEN provided support in getting to grips with the latest changes in the codes and especially worked alongside the RCC-M Subcommittee in producing a grid for classifying modification forms, which offers a clearer insight into the type and scope of the changes, and simplifies the process of analyzing the impact by the project.

### ITER activity

As members of the RCC-MRx Subcommittee, ITER project members are actively involved in the code. Their feedback was instrumental in suggesting changes to include the material used for the Vacuum Vessel (316L(N)). Members are also actively working to factor the specific characteristics of the fusion process into RCC-MRx, such as integrating copper alloys as a probationary phase rule in the 2022 edition.

### RJH activity

Feedback from the project continues to shape the RCC-MRx code through the modification requests submitted by Framatome and TechnicAtome. Support from the RJH project played a key role in incorporating some 110 modification requests into the 2022 edition of the RCC-MRx code.

### NUWARD™ activity

AFCEN and NUWARD™ finalized their discussions for streamlining and strengthening AFCEN's potential support in defining the project's technical standards, covering both the first reactor in the series, which will be installed in France, and the other reactors in the series, which will be rolled out across Europe and the rest of the world. Both parties signed an agreement on April 15, 2022. AFCEN's codes form the backbone of the project's technical standards in all the fields where they apply, which prompted the parties to hold a number of technical discussions with the aim of ensuring the proper application of AFCEN's codes, determining their suitability and potentially adapting them to the project's needs.

### Activities relating to the operating fleet

In 2022, changes were introduced to the in-service units as part of the Grand Carénage (GK) programme, which involves the use of AFCEN's codes.

In 2022, the damage caused by stress corrosion cracking to the piping connected to the main primary system impacted several in-service reactors across France. This phenomenon leads to the formation of one or more cracks, which can spread and potentially compromise the pipe's integrity. A wide-ranging work programme has been put into action, which includes carrying out non-destructive testing, analyzing the impact of the defects (depending on the local stresses and the cracks detected), and supplying and replacing sections, which will require several in-service units to be shut down.

The methods available in AFCEN's codes were used to assess the impact of the defects, whether simplified methods or based on elasto-plastic calculations. AFCEN's codes helped operator EDF produce a robust assessment of the areas requiring justification.

## 1.2.2 European Union

### 1.2.2.1 CEN Workshop 64 "Design and construction codes for Gen II to IV nuclear facilities"

CEN Workshop 64 (CEN/WS64) represents one of AFCEN's main institutional activities on a European level. CEN/WS64 was created in 2010 on AFCEN's initiative and is currently in Phase 3. After the decision had been taken to extend the phase by one year, the phase was actually brought to a close late 2022.

### Rationale for proposing Phase 3

AFCEN had many reasons for suggesting a third phase for the WS64 workshop. The first aim is to maintain and even ramp up Europe's dynamic presence in the nuclear codes sector. As a result, CEN/WS64 will extend its scope to encompass electrical aspects with the involvement of the RCC-E code. The work already started was supposed to be continued until the end of Phase 2, but several topics needed finalizing and other emerging topics needed addressing.

# 1.2 AFCEN'S ACTIVITIES IN FRANCE AND AROUND THE WORLD RELATIONSHIPS WITH PROJECTS

In addition, the Nuclear Illustrative Programme (PINC) established by the EC's Directorate-General for Energy drew attention to the need to significantly increase nuclear power generation capacities by 2030 with the aim of attaining Europe's objectives to reduce greenhouse gas emissions. Consequently, there was growing pressure to take action and carry out the groundwork for expanding this particular market, bearing in mind that fragmented industry best practices and national regulations are one of the market's defining features. The challenge involves sharpening the competitive edge of the nuclear industry, which requires a harmonized set of industry best practices, and ensuring the highest levels of safety across Europe, especially in those countries without nuclear power plants. The decision to pursue the WS64 workshop responds to this challenge by opening up the process to include EU countries without nuclear power generation capacities.

## Objectives of phase 3

The objectives of CEN/WS 64 – Phase 3 are as follows:

- Strengthen synergistic ties between European experts on nuclear codes, working in different countries on different projects, with the aim of minimizing fragmented best practices across the nuclear industry, while offering a platform for technical discussions and creating possibilities for coding practices across Europe.
- Allow future nuclear project leaders to raise awareness of their projects' constraints and suggest changes to the codes. The workshop also allows all participants to express the changes that they would like to make to the codes and lets them incorporate their industrial expertise or the lessons learned from their own practices.
- Engage nuclear power plant operators who are open to the prospect of suggesting and discussing code proposals to address the issues of aging facilities and the difficulties in sourcing spare parts. These proposals are aimed at delivering appropriate solutions to the challenge of downsizing the nuclear supply chain in Europe.
- Raise awareness of AFCEN's codes among all entities involved in evaluating large commercial nuclear reactors during invitations to tender for the purpose of enabling them to correctly assess reactors based on AFCEN's codes. For example, the EPR is a pressurized water reactor based on a European design that is strongly supported by AFCEN's codes. The workshop allows partners who are not yet using AFCEN's codes to improve their knowledge of the codes and prepare to use them during a future implementation if applicable.

## Organisation

As shown in the figure below, the Secretariat for Phase 3 of the workshop is AFNOR. A Prospective Group (PG) has been set up to address the four technical subject areas, each of which is covered by an AFCEN code. PGs are responsible for suggesting changes to the codes and issuing pre-normative R&D proposals.

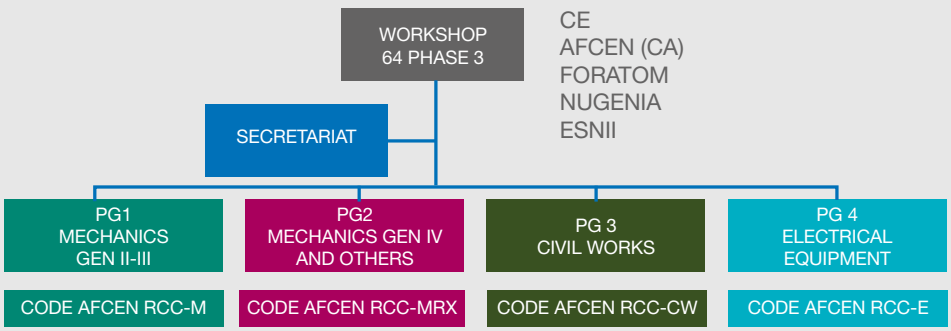



ILLUSTRATION OF AFCEN'S PARTICIPATION IN CEN

PGs hold three to four meetings a year, which are chaired by an AFCEN manager and representative. PGs also hold an annual plenary meeting to review the recommendations and proposals for the R&D programme.

Over 20 members from 12 countries took part in the workshop, representing operators, manufacturers, engineering consultancies, research centers, safety authorities and TSOs. Note that NCBJ, which is tipped to be Poland's future TSO, joined CEN/WS64 in 2022.

Undaunted by the problems caused by the lingering health crisis, CEN/WS64 members regularly pursued their activities in 2021 by organizing virtual meetings.

### Activity review during the plenary meeting on September 22, 2022

PG1 (RCC-M) has expanded its scope of activities to encompass in-service inspection and maintenance operations. The RSE-M code that covers these areas was presented to the participants. PG1 has submitted three proposed modifications relating to progressive deformation, fracture mechanics and the use of small punch test (SPT) results. These proposals are presently being examined by AFCEN. Some subjects have been analyzed (concept of distance d, impact assessment for through cracks, etc.), but ultimately they will not give rise to modification requests. To leverage the work that has gone into these subjects, the decision has been taken to incorporate them into a technical description that will be appended to the CWA (the workshop's summary report). During the next phase, a proposed modification relating to the defect geometry should be pursued for analyzing the unfinished defect assessment. Finally, members have proposed that high-cycle fatigue should be benchmarked as part of another project (Euratom or Horizon).

PG2 (RCC-MRx) drafted about 10 modification proposals encompassing quality management, material rules and properties, welded joints and SPTs. All these proposals were accepted by AFCEN. Six have been included in the 2022 edition of RCC-MRx, while the other four are part of the editorial programme for the next version planned in 2025. A proposal was submitted to lead an R&D programme focusing on the use of SPT results when evaluating mechanical properties to support the process of developing materials and managing their life cycle.

PG3 (RCC-CW) drafted eight modification proposals, which are currently being reviewed by AFCEN. These proposals mainly concern the concept of robustness with a comparison between European standards and RCC-CW, and aircraft crash protection. In addition, some technical subjects were considered to be too broad to fit within PG3's remit and have therefore been referred to the OECD-NEA/CSNI/WGIAGE programme (WGIAGE). In light of the results from the WGIAGE programme, proposed changes to the RCC-CW code will be submitted during WS64 Phase 4, as well as recommended areas warranting further research in Europe. These topics include the criteria for shear walls and aging management for spent fuel pool liners and containment liners. Finally, a proposed R&D programme has been defined for examining the correct estimation of the anchor stiffness and other anchor effects caused by the solutions implemented for this purpose.

PG4 (RCC-E) did not propose any modifications. However, several topics were examined. For example, when it comes to equipment qualification methods and criteria, members came to the conclusion that the qualification of "conventional" equipment is adequately covered by the current standard, but that an in-depth international investigation would be required in case of new software-based "smart" devices. Similarly, the topics that need addressing for SMRs have been identified. Finally, although current standards provide sufficient coverage of commercial grade items, the process of detecting counterfeit, fraudulent and suspect items and defining the critical characteristics for those items and the corresponding acceptance criteria has yet to be examined.

Cross-cutting topics spanning several PGs have been identified, such as SMRs, SPTs and advanced manufacturing processes.

# 1.2 AFCEN'S ACTIVITIES IN FRANCE AND AROUND THE WORLD RELATIONSHIPS WITH PROJECTS

During Phase 3, stronger ties were forged with the EC/DG - Research & Innovation by systematically inviting the Director of the Fission Sector to take part in the plenary meetings, as well as a member of his team for monitoring the workshop.

The topics that will potentially be covered during Phase 4 include:

- AMRs / SMRs: a distinguishing feature of these reactors is their extremely compact design, which means that components have a very specific design. Nuclear design codes will undoubtedly need to be extended to cover the specific design of these reactor components (RCC-M and RCC-MRx). In addition, there is every likelihood that these specific reactor components will require new non-destructive techniques and devices (RSE-M), as well as advanced in-line monitoring systems. The characteristically compact design also has implications for the I&C systems, meaning that changes will be required to these types of equipment (RCC-E). The requirements missing from the existing codes must be identified as part of the HARMONISE project.
- GFRs / HTRs: the ALLEGRO project and the Nuclear Cogeneration Industrial Initiative (NC2I) will specify their needs in terms of He compatibility and new material grades.
- Advanced manufacturing processes and innovative materials: the aim is to explain the qualification methods for each process (direct energy deposition, electron-beam welding, powder metallurgy, etc.) to produce or repair reactor components in line with the requirements in the nuclear codes and standards. In terms of additive manufacturing and innovative materials, results are pending from the Euratom NUCOBAM and INNUMAT projects respectively.
- New digital technologies (digital twin, artificial intelligence, intelligent instrumentation, etc.): since the nuclear industry will need to keep pace with the growing number of new technologies, they must be integrated into the codes, along with an explanation of the requirements for the different applications (design, manufacturing and in-service inspection). The needs will be identified by the HARMONISE project, especially since one of the project's subtasks is specifically focused on this topic.
- Investigate ways of using increasingly more high-quality, non-nuclear industry standard components and equipment for safety-classified structures, systems and components in current nuclear reactors.
- Continue ongoing activities into welded joints (ECCC and GEMMA), irradiation and environmental effects (EERA, JPNM, ESNII, LFR and GFR), and the rules for designing components involved in areas subject to significant creep (ECCC).

These potential topics highlight the synergistic ties between the workshop and the different European R&D projects and bodies, since their topics and data serve as inputs to the workshop. This strong bond between the workshop and European R&D is mainly forged as a result of the workshop participants' involvement in those R&D projects and bodies.

## 1.2.2.2 Participation in the HARMONISE Euratom Project

In October 2021, AFCEN responded to the **HORIZON-EURATOM-2021-NRT-01-06** call for proposals: **Harmonisation of licensing procedures, codes and standards for future fission and fusion plants.** The consortium features 15 members, most of whom come from the ETSON network of European TSOs. AFCEN's proposal proved to be successful, and the three-year project officially began in June 2022.

The aim is to initially identify innovative concepts, systems, components and manufacturing processes for future fission and fusion reactors, before proposing procedures for evaluating those reactors and finally determining how they can be harmonized on a European scale.

In addition to taking part in the work package on communicating and disseminating information, AFCEN is mainly lending its expertise to the work package entitled "Codes and standards and digital twins of innovative nuclear power plants". The idea is to map the innovations that are already covered by existing codes and use that map to identify areas where there is a lack of coverage. There are plans to take a closer look at practices in other sectors of industry and ascertain how codes and standards are developed to

address these new technologies, as well as the possibility of transferring the approval procedures (which have been successfully created to incorporate new technologies) to the nuclear sector. The objective is to weigh up the different approval options and determine which options hold the greatest promise for accelerating the speed and reliability of the procedures for authorizing and qualifying innovative nuclear reactors through codes and standards. Consortium members will subsequently propose a road map for improving and harmonizing codes and standards.

If the HARMONISE project receives the go-ahead, AFCEN's participation will help strengthen the association's reputation for collaborative and institutional projects across Europe in the short term and sharpen its credentials for taking part in Euratom's future calls for proposals. In addition, the way in which the HARMONISE project synergizes with the work of the CEN/WS64 workshop gives added weight to the argument for extending CEN/WS64.

## 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.).

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

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

Chinese experts 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 2022, 60 CSUG meetings had been held in China, during which experts presented and discussed over 600 technical topics.

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.

Over the last three years, CGN and CNNC have completed the first round of translating AFCEN's codes. The Chinese version of RCC-M (partial), RSE-M, RCC-E and RCC-CW were published in August 2022, and other codes are due for release. As part of the agreement with NEA, a new form of collaboration was launched in 2019, known as PGs or Project Groups. These groups are managed and incorporated into the CSUGs. They are aimed at providing a platform for French and Chinese experts to discuss a more

# 1.2 AFCEN'S ACTIVITIES IN FRANCE AND AROUND THE WORLD RELATIONSHIPS WITH PROJECTS

specific range of joint topics concerning French and Chinese interests in greater technical detail. The first two PGs produced benchmarks for the different methods used in non-linearity and fatigue calculations. Work was finalized in 2022, following which modification requests will be issued, based on the results of the groups' efforts. Discussions are currently being held on the prospect of creating new PGs.

With China recently bringing an end to its zero-Covid policy, AFCEN is planning to gradually resume various discussions with its Chinese partners in 2023, particularly face-to-face meetings. AFCEN is planning to continue the initiative that it launched in 2022 of setting up mirror drafting groups in China in 2022, which will be responsible for examining modification requests for the RCC-M code.

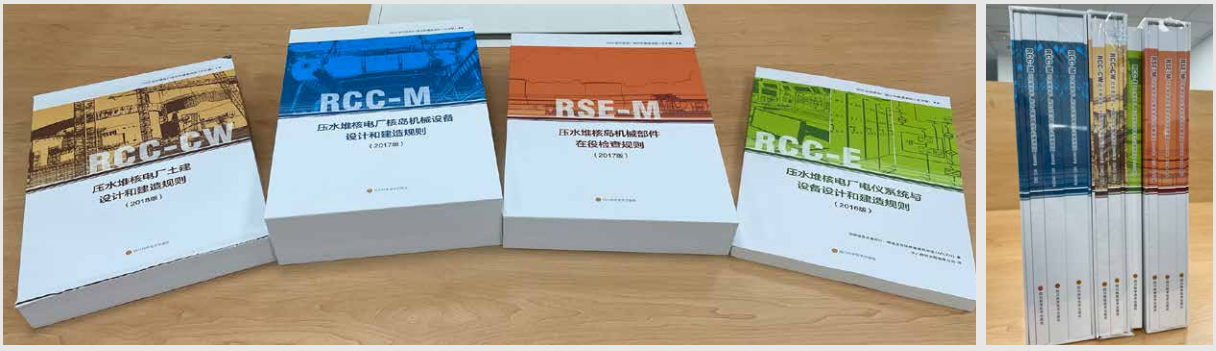
## Activities in 2022

In 2022, AFCEN's main actions relating to activities in China were as follows:

**Implementation of the NEA-AFCEN agreement:**

- AFCEN continued proving key information to allow China's experts to accurately translate the latest RCC codes into Chinese. At the present time, the translation has been completed and reviewed by the relevant experts for RCC-M 2017; RSE-M 2017; RCC-CW 2018; RCC-E 2016; RCC-F 2017; RCC-C 2018; RCC-MRx 2015. This action is a key component of the 2017 AFCEN-NEA agreement. Following AFCEN's consent, the Chinese versions of RCC-M 2017 (partial), RSE-M 2017, RCC-E 2016 and RCC-CW 2018 were published in August 2022, and other codes are due to be released in 2023. In accordance with the agreement, work is continuing on translating the most recent versions of AFCEN's codes, namely RCC-M 2020, RSE-M 2020, RCC-CW 2020, RCC-E 2019, RCC-F 2020, RCC-C 2020 and RCC-MRx 2018.
- Since 2019, technical collaboration between experts on standardization activities, which represents the second key component of AFCEN-NEA agreement, has been hosted in the CSUGs, and experts have the possibility of creating formal working groups to address technical subjects of joint interest: Project Groups (PG). In 2022, the Fatigue Benchmark project was completed. The final report has been disseminated, and six modification requests have been issued.

All the calculations identified in the "Fatigue Benchmark" PG were completed in December 2021. The final report and a proposed modification to the RCC-M code based on the PG's results are currently in the pipeline.




PUBLICATION OF THE CHINESE VERSIONS OF RCC-M, RCC-CW, RSE-M AND RCC-E

**Users Groups meetings in China and AFCEN training courses:**

- The annual meeting of the "Chinese Specialized Users Groups" (CSUGs) for the RCC-M code was held on-line in December 2022 and was attended by 40 representatives from such design institutes as CNNC, CGN and SPIC, and such manufacturers as DEC, SEC, Erzhong, Jiuli and Yingliu, as well as China's Safety Authority and its technical support arm (NNSA and NRC) with the remote participation of AFCEN's delegated experts.

- The RCC-CW CSUG held a combined online/face-to-face meeting in Shenzhen on January 11, 2022. Participants presented the civil engineering research in France and in China.
- The RCC-E CSUG held a combined online/face-to-face meeting in Beijing on January 12, 2022. AFCEN's experts fielded questions from Chinese users.
- The RSE-M CSUG meeting was successfully held in Suzhou on August 23, 2022. Approximately 20 people from different companies attended the meeting. A new member from the Huaneng High Temperature Reactor joined the RSE-M CSUG and presented the in-service inspection programme for the HTR.
- The RCC-MRx CSUG meeting was successfully held in Beijing on August 31, 2022. The meeting was attended by 25 Chinese and French participants. Progress on the ITER project in China was presented during the meeting, followed by a discussion about the comparison between HJB standards and RCC-MRx.
- A new RCC-M training session was organized in Hangzhou in July 2022. This session was subject to an agreement between SNPI and AFCEN, which was updated and signed in 2021. The session in question was the Chinese-language RCC-M course, which was formally certified by AFCEN in 2016. This is the first time that this training session has featured a combination of general content and design-specific topics.

## Outlook for AFCEN in China in 2023

In 2023, AFCEN will pursue its policy of developing cooperation on codes and standards to honour its commitments towards its Chinese partners. The main milestones and prospects are as follows :

- In keeping with the MOU with NEA, continue supporting the official publication of the Chinese translations of the RCC codes and form Project Groups (PGs) to pursue a new type of technical interaction.
- As part of the CSUGs, trial a few mirror drafting groups in 2023 in China with the hope that this new organization will build even stronger cooperative ties between French and Chinese experts on the RCC standards, with the prospect that the best practices of the Chinese nuclear industry could be transferred to AFCEN.
- Participation of Chinese experts in the international AFCEN 2023 congress, including the Subcommittee meeting 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.
- Continue organizing a new series of training courses (RCC-M Design By Analysis).


CSUG RCC-M MEETING WITH REMOTE PARTICIPATION OF FRENCH EXPERTS

# 1.2 AFCEN'S ACTIVITIES IN FRANCE AND AROUND THE WORLD RELATIONSHIPS WITH PROJECTS

## 1.2.4 United Kingdom

AFCEN's activities in the UK are tied to the EPR reactor projects, which are drawing strength from AFCEN's codes for their design, construction and in-service inspection:

- Hinkley Point C (HPC): two units (construction phase)
- Sizewell C (SZC): two units (development phase - same design as HPC)

**AFCEN is lending its support to the future operator (NNB: Nuclear New Build) and other parties involved in the UK's EPR projects in the following areas:**

- Creation of AFCEN code Users Groups
- Contribution to the working group on adapting the RSE-M code
- Support with analyzing changes to the AFCEN codes following certification of the EPR model

**The AFCEN code Users Groups (UK Users Groups), which are supervised by an NNB-led Steering Committee, have the following missions:**

- Facilitate uptake of AFCEN codes among industry and partners by minimizing discrepancies caused by poor interpretation of the codes,
- 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 offer relevant solutions,
- Establish effective communication channels with AFCEN's Subcommittees.

The RCC-M Users Group is currently waiting to be reactivated. The Users Group for the civil engineering code (ETC-C / RCC-CW) was unable to hold a meeting in 2022 but will organize its next session in June 2023 at the HPC site. The RCC-E Users Group held its second work session in May 2022 in Bristol and scheduled its next meeting for January 2023.

HPC - HYDRAULIC REACTOR PRESSURE VESSEL TEST

## 1.2.5 India

AFCEN has forged ties with India's nuclear industry since several years, 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.

AFCEN has continued its policy of developing cooperative ties with India, especially in terms of training on the RCC-M code.

These initiatives are aimed at reinforcing collaborative ties between France and India as part of the JNPP project (Jaitapur Nuclear Power Project), which is entering the final round of discussions.

In 2023, AFCEN will continue supporting the proposal for six EPR units as part of the Jaitapur project.

STYLIZED VIEW OF THE JAITAPUR SITE

# 1.3 RELATIONSHIPS WITH STAKEHOLDERS

## 1.3.1 Relationship with ASN

AFCEN has been holding monthly meetings with ASN's Nuclear Pressure Components Division since 2015. This relationship of trust between both organizations was instrumental in the success of the three-year ESPN programme, which is covered by the 2018 editions of the RCC-M and RSE-M codes followed by the four-year roadmap whose products were introduced into the 2020 and 2022 editions of the RCC-M and RSE-M codes. AFCEN will pursue its efforts as part of an ESPN portfolio, which is aimed at seeing ASN continue to endorse the solutions proposed by the RCC-M code as being capable of satisfying the regulation's requirements for mechanical components.

## 1.3.2 Cooperation between organizations developing standards and harmonizing codes

As a key player in the nuclear codes sector around the world, and as part of its determination to continually incorporate industry best practices and local regulations for its code users, AFCEN is naturally involved in the harmonization programmes (UK English) either set up by international organizations or created at its own initiative.

For example, AFCEN contributes to the objectives of harmonizing mechanical codes through its participation in the international group of standards developing organizations (SDO Convergence Board), which was founded in 2010 to simplify introduction of compatible rules in each of the different mechanical codes. The SDO Board generally holds four meetings a year in addition to the ASME (Code Week). AFCEN is member of the SDO Convergence Board, like ASME (US), JSME (Japan), KEPIC (South Corea), CSA (Canada), NIKIET (Russia), NTD (Czech Republic), ISNI (China). AFCEN voices its development objectives and contributes to convergence opportunities on the topics examined by the group. For example, AFCEN unveiled its outlook for developing codes for advanced manufacturing processes (such as ASME, JSME and KEPIC) in 2022. In 2023, the SDO Convergence Board will hold a meeting on March 28 on the eve of the AFCEN Congress (March 29-30, 2023).

Whether acting on its own behalf or through the SDO Convergence Board, AFCEN interacts with the dedicated working groups for mechanical standards and codes in OECD/NEA/CNRA (safety authorities) and WNA/CORDEL/MCSTF (industrial organizations). For instance, AFCEN is invited to share its feedback on CORDEL's reports relating to its RCC-M and RCC-MRx mechanical codes (such as in 2021 on recommendations for implementing mechanical non-linear analyses).

# 1.4 USE OF AFCEN CODES AROUND THE WORLD BACKGROUND

AFCEN codes are used as a reference for nuclear components and structure in over 100 power plants currently in operation (103), under construction (18) or in planning stages (28) around the world.

Since 1980, AFCEN codes have served as the basis for design and fabrication of specific Class 1 mechanical components (vessels, internals, steam generators, primary motor pumps 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 renamed Hanul). These reactors actually represent the first applications of AFCEN's codes. AFCEN codes will subsequently be used to design, build and operate the Daya Bay and Ling Ao power lands and main reactors in China, including 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 | E | | for design and/ or construction | before commissioning and/ or for operation | RCC-M | RSE-M | RCC-E | RCC-CW | RCC-C | RCC-F | RCC-MRx |
| Nuclear power plants | France | | | 56 | 56 | 16 | 56 | x | x | x | x | x | | |
| CP1 | South Africa | | | 2 | 2 | 2 | | x | | | x | | | |
| | South Korea | | | 2 | 2 | 2 | | x | | | x | | | |
| M310 | China | | | 4 | 4 | 4 | 4 | x | x | x | x | | | |
| CPR 1000 & ACPR1000 | China | | | 28 | 28 | 28 | 28 | x | x | x | x | | | |
| CPR 600 | China | | | 6 | 6 | 6 | 6 | x | x | x | x | | | |
| EPR | Finland | | | 1 | 1 | 1 | | x | | | | | | |
| | France | | 1 | | 1 | 1 | 1 | x | x | x | x | x | x | |
| | China | | | 2 | 2 | 2 | 2 | x | x | x | x | x | x | |
| | UK | 2 | 2 | | 4 | 4 | 4 | x | x | x | x | x | x | |
| | India | 6 | | | 6 | 6 | | x | x | x | x | x | x | |
| HPR1000 | China | 9 | 11 | 2 | 23 | 23 | 23 | x | x | x | | x | x | |
| | UK | 2 | | | 2 | 2 | 2 | x | x | x | | x | x | |
| ACP 100 | China | | 1 | | 1 | 1 | 1 | x | | | | | | |
| EPR2 | France | 6 | | | 6 | 6 | 6 | x | x | x | x | x | x | |
| PFBR | India | | 1 | | 1 | 1 | | | | | | | | x |
| RJH | France | | 1 | | 1 | 1 | | | | | | | | x |
| ITER | France | | 1 | | 1 | 1 | | | | | | | | x |
| MYRRHA | Belgium | 1 | | | 1 | 1 | | | | | | | | x |
| ASTRID | France | 1 | | | 1 | 1 | | | | | | | | x |
| | | 27 | 18 | 103 | 149 | 109 | 133 | | | | | | | |

SUMMARY OF THE USE OF AFCEN CODES AROUND THE WORLD

In addition to these formal applications of the codes and given their reputation, AFCEN codes also serve for designing many other nuclear facilities and equipment, despite not being official standards. Examples include:

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

## 1.4.1 France

### Nuclear power plants

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

The RCC-M, RSE-M, RCC-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 modeled on the EPR design but builds on the feedback from the design and construction of the Flamanville 3 and Taishan 1-2 projects. Recent editions of AFCEN codes are being used, which have been updated to reflect feedback from previous EPR projects.

- RCC- M edition 2018
- RCC-E edition 2019
- RCC-CW edition 2018
- RCC-F edition 2017
- RCC-C (not yet defined)
- RSE-M (not yet defined)

Subsequent changes to the codes are occasionally monitored and analyzed by the EPR2 project.

### 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.

This project is currently on standby.

# 1.4 USE OF AFCEN CODES AROUND THE WORLD BACKGROUND

## RJH

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.

RJH: FACTORY ASSEMBLY OF THE RJH REFLECTOR

## 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 (2012, 2015 and 2018 editions) has also been used for other components, such as the test blanket modules (China and Europe) and diagnostic systems (vertical neutron camera, and divertor neutron flux monitors)...

**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) is based on a technical reference system known as the PN Compendium.
It is structured identically to the RCC-M code, since Naval Group's internal rules are technically very close to those of the RCC-M.

This particular organization is related to the history of nuclear propulsion: the skills of this industry were quickly codified into instructions and procedures that were progressively enriched by feedback and external normalization. In particular, since the publication of the code RCC-M, Naval Group has ensured the consistency of its rules with those of the code, and the overall consistency of design / manufacturing 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.). In order to improve the clarity of these rules, it became logical to adopt the editorial structure of the RCC-M.

AFCEN and Naval Group signed an agreement in 2019 to develop a code for marine propulsion systems while maintaining interaction with the RCC-M Subcommittee. Naval Group is bolstering its presence in the RCC-M Subcommittee and giving AFCEN access to some of the modifications introduced into the marine propulsion code.

In 2022, an expert from the RCC-M Subcommittee was appointed to take part in establishing the technical reference system known as the PN Compendium and evaluate the relevance of the chosen modifications for the PN Compendium, which could potentially be used by AFCEN.

## 1.4.2 China

AFCEN codes are widely used in China for the design, construction, in-service inspection of Chinese Generation II+ nuclear power plants (based on developments of the M310 technology introduced from France, called CPR-1000 and ACPR-1000) and Generation III reactors (especially EPR units and Hualong HPR-1000 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 2022, 54 of the 76 units in operation or under construction in China were using AFCEN codes, with 42 in operation and 12 under construction.

These units correspond to the M310, CPR-1000, ACPR-1000, HPR-1000, ACP-100, CPR-600 and EPR projects in blue font in the table below.

LINGLONG ONE

# 1.4 USE OF AFCEN CODES AROUND THE WORLD BACKGROUND

**During 2022:**

The first concrete was poured in 2022 for Lufeng 1, a new HPR-1000 unit whose design has been modeled on AFCEN's codes.

The last Generation II+ reactor in China (Hongyanhe 6, ACPR-1000) was commissioned.

| Type of reactor | Units in operation (no.) | Units under construction (no.) | Total number |
|---|---|---|---|
| 300 MWe | Qinshan I (1) | | 1 |
| **M310** | **Daya Bay (2) Ling'Ao (2)** | | **4** |
| **CPR1000 & ACPR1000** | **Ling'Ao (2) Hongyanhe (6) Ningde (4) Yangjiang (6) Fangchenggang (2) Fuqing (4) Fangjiashan (2) Tianwan phase III (2)** | | **28** |
| **HPR 1000** | **Fuqing (2)** | **Fangchenggang (2) Zhangzhou (2) Taipingling (2) SanAo (2) Changjiang (2) Lufeng (1)** | **13** |
| **CPR600** | **Qinshan II (4) Changjiang (2)** | | **6** |
| CANDU 6 | Qinshan III (2) | | 2 |
| AP1000 | Sanmen (2) Haiyang (2) | | 4 |
| CAP1000 | | Sanmen (1) Haiyang (1) | 2 |
| **EPR** | **Taishan (2)** | | **2** |
| VVER-1000/428 (AES-91) | Tianwan (4) | | 4 |
| VVER-1200 (AES-2006) | | Tianwan IV (1) Xudapu (1) | 4 |
| HTR-PM | | Shidaowan (1) | 1 |
| CFR-600 | | Xiapu (2) | 2 |
| CAP1400 | | Shidaowan (2) | 2 |
| ACP100 | | Changjiang (1) | 1 |
| **Total number** | **54** | **22** | **76** |

LIST OF REACTORS CURRENTLY UNDER CONSTRUCTION OR IN OPERATION IN CHINA AS OF LATE 2022
(REACTORS HIGHLIGHTED IN BLUE ARE THOSE USING AFCEN CODES)

## 1.4.3 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.

## 1.4.4 United Kingdom

### EPR projects

**AFCEN's ambitions for the United Kingdom are tied to the development of EPR projects:**

- Two reactors under construction at the Hinkley Point C site (HPC),
- Two other reactors in the planning stages at Sizewell C (SZC).

**The future operator (NNB: Nuclear New Build) has chosen the following AFCEN codes for designing and building the reactors:**

- RCC-M 2017 edition 2007 (+ 2008-2009-2010 addenda) for mechanical components,
- RCC-E 2012 edition for electrical components,
- ETC-C 2010 edition for civil engineering works,
- 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), including a specific appendix to incorporate British fire protection regulations.

AFCEN codes were evaluated by the British Safety Authority (ONR – Office for Nuclear Regulation) as part of the GDA (Generic Design Assessment), which culminated in design acceptance confirmation for the EPR design in the United Kingdom in December 2012. The project sets out the terms for applying the codes through a number of project-specific requirements.

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

In addition, a group of independent experts endorsed the methods for analyzing the impacts of defects detected during operation in RSE-M (Appendix 5.4), which are used in design justification studies, against current practices in the United Kingdom (R6 Rules).

In a bid to offer support and assistance to the parties involved in the UK's EPR projects in using AFCEN's codes, three UK Users Groups have been set up: the first on the RCC-M code (created in 2013), the second on the ETC-C / RCC-CW civil engineering code (created in 2016) and the third on the RCC-E code (created in 2021).

Work on the HPC project has been ongoing since the final investment decision was taken in September 2016. Significant progress was achieved in 2022 on the buildings (reactor containment, machine room and pumping station) and marine structures (tunnels and water intakes), and in preparing the electromechanical equipment.

In 2022, the UK Government gave the green light for the development of the EDF-led project to build two EPRs at the Sizewell site, while taking the decision to invest in the SZC project, which paves the way for a likely final investment decision from EDF in 2023. Work is also forging ahead on preparing the SZC project with the aim of achieving the final investment decision in 2022, based on a replication of the HPC design and the use of the same codes.

### HPR1000 project

The UK version of the HPR-1000 reactor featuring Chinese technology (UK Hualong) has been granted Design Acceptance Confirmation by the British Safety Authority after successfully completing the GDA. The design for this reactor is mainly based on a reactor that is currently being built in China (Fangchenggang 3). The design is primarily inspired by AFCEN's codes, thereby taking advantage of the lessons learned from the EPR project (incorporated in the codes). However, there are no longer any plans to build this reactor on UK soil.

# 1.4 USE OF AFCEN CODES AROUND THE WORLD BACKGROUND

## 1.4.5 Finlande

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.

## 1.4.6 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.

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# 2

## EDITORIAL ACTIVITY

# REVIEW

# 2.1 CODES AND OTHER EDITORIAL PRODUCTS

AFCEN's published materials include design and construction codes, and technical publications (PTAN).

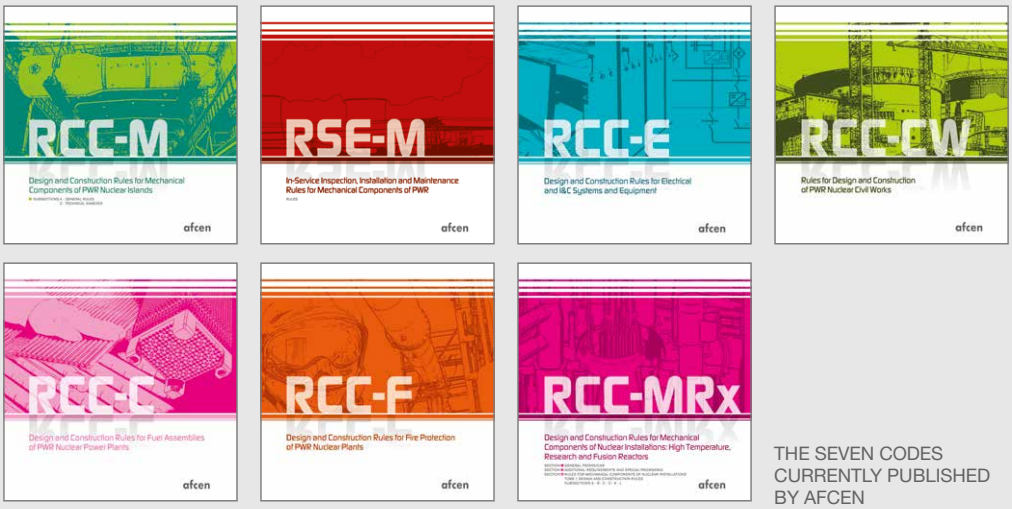
**AFCEN's editorial activities involve:**

- Producing and monitoring the work programme for the codes and technical publications,
- Authoring and investigating proposed changes to the codes and technical publications,
- Approving the release of changes to the codes and technical publications.

Editorial activities are performed by the Subcommittees in charge of the codes, and by the Editorial Committee in case of cross-functional topics. The Editorial Committee is also responsible for giving work the final seal of approval.

## 2.1.1 AFCEN codes

AFCEN currently publishes seven codes.




THE SEVEN CODES CURRENTLY PUBLISHED BY AFCEN

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

Five codes were revised in 2022: all the mechanical codes (RCC-M, RSE-M and RCC-MRx), RCC-E and RCC-C.

The following table lists the codes available from AFCEN codes distributors.

| CODE | | EDITIONS AVAILABLE |
|---|---|---|
| RCC-M | Design and Construction Rules for Mechanical Components of PWR Nuclear Islands | . 2000 and 2007 editions, with addenda<br>. 2012 edition, with addenda in 2013, 2014, 2015<br>. 2016, 2017 and 2018 editions<br>. 2020 and 2022 editions |
| RSE-M | In-Service Inspection, Installation and Maintenance Rules for Mechanical Components of PWR | . 2010 edition, with addenda in 2012, 2013, 2014, 2015<br>. 2016, 2017 and 2018 editions<br>. 2020 and 2022 editions |

| CODE | | EDITIONS AVAILABLE |
|---|---|---|
| RCC-C | Design and construction rules for fuel assemblies of PWR nuclear power plants | . 2005 edition, with addenda in 2011<br>. 2015 edition<br>. 2017, 2018, 2019, 2020 editions<br>. 2022 edition |
| RCC-F | Design and Construction rules for fire protection of PWR nuclear plants | . 2010 and 2013 ETC-F editions<br>. 2017 and 2020 RCC-F editions<br>. Next edition: 2023 |

LIST OF AFCEN CODES EDITIONS AVAILABLE

| CODE | | EDITIONS AVAILABLE |
|---|---|---|
| RCC-E | Design and construction rules for electrical and I&C systems and equipment | . 2012 edition<br>. 2016 edition<br>. 2019 edition<br>. 2022 edition |
| RCC-CW | Rules for design and construction of PWR nuclear civil works | . 2010 and 2012 ETC-C editions<br>. Annual RCC-CW since 2015<br>. RCC-CW editions every two years, starting in 2021<br>. Next edition: 2023 |

| CODE | | EDITIONS AVAILABLE |
|---|---|---|
| RCC-MRx | Design and Construction Rules for Mechanical Components of nuclear installations: high-temperature, research and fusion reactors | . 2012 edition, with addenda in 2013<br>. 2015 edition<br>. 2018 edition<br>. 2022 edition |

LIST OF AFCEN CODES EDITIONS AVAILABLE

**There are several reasons for updating AFCEN codes:**

- the need to incorporate feedback,
- developments prompted by scientific and technical breakthroughs,
- changes to legislation and standards,
- extensions to the scope of the codes.

These changes bear testament to AFCEN's ambition of ensuring that its codes reflect the latest and highest level of technical knowledge in order to guarantee safe nuclear facilities, while making sure that they are continually relevant to industry (implementation capacities, effectiveness and optimization) and satisfy regulatory requirements. Some changes are introduced into the codes as probationary phase rules (RPP). Users are under no obligation to apply the RPP rules. The decision to apply the rules is at the user's discretion and should help gather the necessary feedback before imposing the rules in the codes. The main changes to the codes are described in the specific sections of this annual report for each Subcommittee.

Some codes are accompanied by documents that describe the changes between successive editions (RCC-E and RCC-F gap analysis). AFCEN is working on reinforcing how the different changes are characterized (type, scope, etc.) so that people using earlier versions of the code can easily assess the impact of the modifications and determine whether there is any need to update their codes and standards according to the context and challenges specific to their projects. This especially applies to the RCC-M code.

**In 2022, the Editorial Committee was involved in the following activities:**

- Requirements engineering: in the wake of the opportunity assessment and definition of the methods for implementation in 2021, the requirements engineering strategy was launched for a number of codes (especially RSE-M, RCC-E and RCC-F), while additional tests are pending for the other codes (particularly RCC-M and RCC-C).
- Comparison between AFCEN and other international standards: studies identifying the main areas where the codes and standards converge and diverge have now been completed in the electrical and I&C sector (RCC-E vs. IEEE), and the fire protection sector (RCC-F vs. NFPA). The findings will be scrutinized, evaluated and potentially supplemented with the aim of shedding greater light on the challenge of obtaining approval for reactor projects modeled on different industrial standards.
- Mechanical glossary: a working group has been set up to produce an English/French glossary of terms and definitions applicable to AFCEN's mechanical codes (RCC-M, RCC-MRx and RSE-M) in 2023, based on a detailed review of the RCC-M code in 2021-2022.

# 2.1 CODES AND OTHER EDITORIAL PRODUCTS

## 2.1.2 AFCEN's technical publications (PTAN)

**AFCEN's technical publications (PTAN) comprise the following types of documentation:**

- Studies to complement and develop certain topics within the codes,
- Criteria that expand on the reasons for the rules in the codes,
- Guides to accompany the use of the codes.

### Studies

AFCEN carries out a host of studies to explore topics relating to the fields covered by the codes (review of industry best practices, R&D dvelopments, etc.). They are not directly related to the use of the codes.

Examples include:

- RCC-CW: two studies on seismic dissipative and isolation devices.

### Criteria

AFCEN is focused on its objective of publishing documents called criteria, which provide background information on the rules in its codes. The criteria provide useful and educational insight into the codes.

Examples include :

- The RCC-M code criteria,
- The criteria on Appendices 5.4 and 5.5 of RSE-M (methods and criteria for analyzing the impacts of defects), and the criteria for taking account of the warm pre-stressing (WPS) phenomenon in the vessel's fast fracture resistance.

### Guides

The guides are designed to help interested parties use the codes by offering recommendations, solutions or alternatives for meeting the requirements in the codes. They tend to be referenced by the codes or complement their use.

**Examples include :**

- RCC-E: a guide identifying the requirements needed to provide Class III qualification for systems using equipment families certified according to IEC 61508; a guidebook for defining the project data associated with the code,
- RCC-F: an analysis of the code's conformity with WENRA reference safety levels,
- RCC-MRx: a guide containing a series of recommendations for the seismic design rules for components; a guide to obtain the characteristic data of a new material needed for the application of the design rules,
- RCC-M, RSE-M: a complete set of guides that explain how to fulfil the essential safety requirements of the ESPN regulation,
- RSE-M : a guide for qualifying ultrasonic NDT (Non-Destructive Testing) processes.
- RCC-C: a guide specifying the measures that need to be taken to demonstrate qualification of the scientific computing tools for fuel core studies in response to Guide 28 issued by the French Nuclear Authority.

The technical publications available are listed in Appendix B.

In 2022, a guide in the RCC-E series was published on the requirements for taking cybersecurity issues into account when designing I&C systems.

In 2022, AFCEN published three guides aimed at improving proficiency in the RCC-M code.

## 2.1.3 ESPN programme

In light of the difficulties that the nuclear industry encountered in attempting to apply the requirements of the ESPN Regulation, AFCEN decided to create and lead a « three-year » programme between 2015 and 2018. The aim behind the programme was to produce technical standards (AFCEN professional guides, and modifications to RCC-M and RSE-M) that would be recognized by all the parties involved in assessing conformity: ASN and GSEN (association of inspection bodies for Nuclear Equipment Safety). At the end of the programme, ASN recognized that « applying the 2018 edition of the RCC-M code provides a solid foundation for implementing the ESPN regulation ». These technical standards can now be used to obtain convincing results when assessing the conformity of new N1 and N2/N3 equipment, as well as for their repairs, modifications and installation.

To go even further, AFCEN and GSEN unveiled their joint vision at the end of 2019 of what constitutes a successful conformity assessment:

**AFCEN / GSEN joint vision of the ESPN conformity assessment process**

“Stakeholders confidently engaged in a stable, predictable and organised conformity assessment process with manufacturers, who ensure that nuclear pressure equipment conforms to requirements, and with Inspection Bodies, who verify compliance, so that compliant equipment can be provided to operators on time”

Building on the work for the 2018 edition and in keeping with this vision, AFCEN launched a “four-year roadmap” (2019 – 2022) in 2019 to sustain the momentum and allow manufacturers and operators to integrate the regulation into their industrial processes with greater reliability.

As part of the four-year roadmap, AFCEN’s experts will ultimately produce over 45 deliverables for the areas covered by RCC-M and RSE-M.

**This ambitious programme recorded a number of achievements:**

- In response to its members’ feedback on a number of recent industrial projects, AFCEN produced a Welding Feedback programme which sets out the related modifications that will be worked into the 2022 and later editions of the RCC-M code. The Welding Feedback programme was presented to ASN in April 2021 and is currently being implemented. An initial series of modifications has been worked into the 2022 edition of the RCC-M code.
- AFCEN produced its standpoint on ASN’s Guidance and Justification Document for the revision of Guide 8 “Conformity assessment for nuclear pressure components”, which is a highly strategic document for assessing the conformity of nuclear pressure components (*https://www.asn.fr/l-asn-reglemente/guides-de-l-asn/guide-de-l-asn-n-8-evaluation-de-la-conformite-des-equipements-sous-pression-nucleaires).*
- AFCEN held discussions with ASN throughout 2021 in relation to ASN’s draft decisions about Article 8.2 (concerning the performance of certain tests and analyses on nuclear pressure components) and Article 8.4 (relating to the integration of certain nuclear components pending a conformity assessment into a basic nuclear facility) of the ESPN Regulation. AFCEN voiced its views on the draft decisions during the associated public consultation processes. AFCEN has taken account of ASN’s decisions approved by the decree of January 6, 2022, by introducing modifications into the 2022 edition of the RCC-M code.

## 2.1 CODES AND OTHER EDITORIAL PRODUCTS

- AFCEN has produced deliverables aimed at improving the conformity assessment process:
  - "Organization of the conformity assessment for N1 nuclear pressure equipment according to module G"
  - "Organization of the conformity assessment for N2/N3 nuclear pressure equipment according to module G"
  - "Guide for preparing specific evaluations for N1 nuclear pressure equipment"
- AFCEN has produced a methodological procedure for addressing nonconformities when manufacturing new Class 1 equipment in risk categories I to IV. This publication is designed to help organizations improve their culture for dealing with nonconformities.
- AFCEN has revised the radiation protection guide to reflect feedback from ASN.
- AFCEN has released a guide that specifies the necessary arrangements for carrying out drop-weight testing according to ASTM E208-75. This guide brings greater reliability to the tests and applies to the 2022 edition of the RCC-M code.

Work will continue as part of the "ESPN portfolio", which is focused on the same objectives as the four-year roadmap:

- Maintain the endorsement received from ASN and GSEN following the three-year programme,
- Incorporate changes in technologies and practices into the codes, following feedback from industry professionals, AFCEN, GSEN and ASN,
- Work alongside ASN and GSEN in examining the impacts of changes in regulations,
- Give the code a more industrial feel, especially by aiming to ensure consistency between AFCEN's methodological guides and the assessment standards produced by GSEN/AQUAP or ASN.

In contrast to the four-year roadmap, the aim is to move from a programmatic vision of the overall work set at the beginning of a period (four-year roadmap) to a living, priorised and shared vision between AFCEN, ASN and GSEN ("ESPN portfolio" of subjects to be worked on collectively AFCEN / ASN / GSEN).

AFCEN is also continuing to take part in developing « ESPN Digital » tool, which aims to standardize and enhance conformity assessments based on the work led by AFCEN and GSEN. AFCEN is checking that its technical publications are correctly incorporated in the ESPN Digital process. For further information about ESPN Digital, visit the LinkedIn page for the ESPN Digital project (*https://www.linkedin.com/groups/13885206*)

# 2.2 MECHANICAL FIELD FOR PRESSURIZED WATER REACTORS 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 levels 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 behavior analysis,
- 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 imperfections,
- documentation associated with the different activities covered, and quality assurance.

The design, manufacture and examination 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.

## 2.2.2 Use and background

### Use

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

# 2.2 MECHANICAL FIELD FOR PRESSURIZED WATER REACTORS RCC-M

- France's last 16 nuclear units (P'4 and N4),
- 4 CP1 reactors in South Africa (2) and South Korea (2),
- 50 M310 (4), CPR-1000 (28), CPR-600 (6), HPR-1000 (10) 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 1,300 MW electrical output (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 in 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 changes resulting from the commissioned studies relating to 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.

Building on the 2016 edition, the 2018 edition includes the remainder of the work on the "three-year ESPN programme" (2015-2018). ASN has qualified this latest edition as a "solid foundation" for implementing the ESPN Regulation.

The 2020 edition integrates 90 modification forms, some of which relate to the commissioned studies into the ESPN Regulation; some modifications concern Appendices ZY and ZZ, while others are improvements resulting from the work on the three-year ESPN programme (2015-2018). ASN is currently analyzing whether the 2020 edition of the code conforms to the requirements of the ESPN Regulation. AFCEN provided GSEN with the modification forms relating to appendices ZY and ZZ of the 2020 edition of the code. After examining the forms, GSEN concluded that the code continued to conform to the requirements of the ESPN Regulation.

## 2.2.3 Edition available in 2022

By the end of 2022, the 2020 edition was the most recent version of the code. The 2022 edition is due to be published early 2023 and integrates 136 modification forms to reflect users' needs, the latest developments in technology, feedback and changes in regulations and standards.

**The changes implemented in the 2022 edition relate to the following provisions :**

- Incorporation of the improvements that were identified when 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), or during their evaluation, with design-related changes,
- Additional requirements in Appendix ZY relating to compliance with specific requirements of the Regulation of December 30, as amended, i.e. Article 8-1, Article 8-2 and Article 8-4,
- An overhaul of the rules in A 5000 on the requirements for establishing and implementing a quality management system,
- An overhaul of RPP no. 1, which is now based on the quality management systems standard ISO 19443, which specifies requirements for the nuclear energy sector,
- The introduction of a new STR (M 3209) concerning the supply of bars for manufacturing latch housings of control rod mechanisms,
- The introduction of additional requirements for carrying out drop-weight tests with reference to an AFCEN technical publication (PTAN),
- An overhaul of Appendix Z G,
- The introduction of RPP no. 7 and RPP no. 8, which propose alternative methods for analyzing fatigue,
- The introduction of RPP no. 9 on the behavioral analysis of the multi-perforated medium for tube sheets,
- The introduction of RPP no. 10, which proposes alternative rules for designing bolted circular flanged connections,
- The introduction of the measures that need to be taken for TOFD and PA ultrasonic testing, and the acceptance criteria for full penetration butt welds with level 3 ferritic stee,l
- A complete overhaul of the measures that need to be taken for magnetic particle testing,
- Changes in welding requirements based on feedback,
- Incorporation of the requirements specified in the 2017 version of ISO 15614-1 on the welding procedure test,
- The addition of a requirement for preventing adverse thermal gradients during the local heat treatment of circumferential welds on cylindrical bodies,
- A complete revision of the paragraphs in RPP no. 4 covering the seismic qualification of valves, and the addition of procedures for qualifying safety valves under normal and accidental conditions, and the introduction of rules for pump testing.

CONTENTS OF THE 2022 EDITION OF THE RCC-M CODE

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

# 2.2 MECHANICAL FIELD FOR PRESSURIZED WATER REACTORS RCC-M

## 2.2.4 Next edition

In accordance with its sales model, AFCEN is now planning to publish editions every two years instead of addenda.

In addition to pursuing its activities relating to the ESPN Regulation, AFCEN has produced an editorial programme for the RCC-M Subcommittee to cover the 2023-2026 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 2024. This edition will continue incorporating the modifications relating to the follow-up work on the ESPN Regulation.

The new 2024 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 and China Users Groups) by ASN or in international groups (Europe and MDEP).

AFCEN proposed a programme to take account of feedback from welding on the main secondary system of the FA3 EPR. The programme contains 29 code modification targets divided into nine categories. There are plans to add some of the targets to the 2022 edition of the code. The nine categories are listed below:

- Welding quality and organization (post-2022)
- Suitability of basic materials for welding (2022)
- Selection, qualification and acceptance of welding consumables (2022 + post-2022)
- Qualification of welding procedures (QWP) (2022)
- Welding authorization (2022)
- Stress-relieving heat treatment (SRHT) (post-2022)
- Non-destructive testing (NDT) (post-2022)
- Welded repairs (2022)
- Weld test coupons (post-2022)

## 2.2.5 RCC-M technical publications

### Publication of interpretation requests

In 2018, the RCC-M Subcommittee released an initial compilation of the interpretation requests relating to the editions of the RCC-M code published since 2007 and their addenda. This publication is presented as a compilation of anonymous interpretation requests arranged by edition and topic. An update was published in 2020 to encompass the interpretation requests up to the 2018 edition.

IT development work has been carried out to allow users to view interpretation requests directly on the AFCEN website. The work was completed in 2021 and will provide users with an easier way of looking up information about all interpretation requests. Interpretation requests can be looked up by their number or by the section in the code. A filter is also available: by drafting group and/or edition and addendum and/or section.

The tool for viewing interpretation requests is available directly in the RCC-M section of the www.afcen.com website.

### 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.

### Guides

All PTAN relating to the ESPN Regulation and referenced by the 2020 edition of RCC-M have been made available to users.

**Some PTAN publications have been released in English:**

- AFCEN-RM-16-282-C: Guide to identifying the allowable limits of the MPS/MSS (application of the ESPN Regulation),
- AFCEN-RM-18-018-C: Guide to identifying the allowable limits of nuclear pressure components (not including the MPS/MSS) (application of the ESPN Regulation),
- AFCEN-RM-16-274-D: Guidelines on the execution of manufacturing visual examinations required by the hazard analysis,
- AFCEN-RM-16-455-B: Dimensional reference standard for N1*, N2 or N3 nuclear pressure equipment,
- AFCEN-RM-16-264-A: Note to support the preparation of the specific evaluations for N2/N3 nuclear pressure equipment and thermal aging of austenitic and austenitic-ferritic stainless steels,
- AFCEN-RM-15-149-C: Inspectability guide for the design of N1 level nuclear pressure equipment,
- AFCEN-RM-17-461-B: Inspectability guide for the design of N2 or N3 level nuclear pressure equipment in PWR plants in France,
- AFCEN-RM-18-056-A: Retention of material resulting from the manufacture of parts of N1 level nuclear pressure equipment,
- AFCEN-RM-17-094-B: Guide to “Pressure accessories - Safety devices”; analysis of the regulatory texts for classifying the parts of a valve-type pressure accessory and safety valve-type safety accessory.

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

The ESPN programme is described in Section 2.1.3 of this annual report. An initial three-year programme (2015-2018) was launched. With the aim of maintaining ASN’s and GSEN’s endorsement of the RCC-M code following the three-year programme, AFCEN released a four-year road map in 2019 (2019-2022). The rules for organizing the follow-up to the programme are being changed to adopt an active and prioritized vision shared between AFCEN, ASN and GSEN of the subjects that they will work on together (“ESPN portfolio”).

## 2.2.7 2023-2026 editorial programme

In addition to the topics relating to the ESPN Regulation, the RCC-M Subcommittee has defined its editorial roadmap, which identifies the different technical topics that it wishes to develop over the 2023-2026 period with assistance from its members, with the focus on the 2024 and 2026 editions.

**The programme has been defined to address a number of issues:**

- respond to the requirements expressed by our users and projects,
- incorporate feedback from users and projects,
- integrate developments prompted by technical and scientific progress,
- incorporate changes in industry practices and standards,
- include changes in safety regulations and standards,
- assist with harmonizing practices in the different codes,
- extend the code’s scope of application.

# 2.2 MECHANICAL FIELD FOR PRESSURIZED WATER REACTORS RCC-M

**As part of these activities, some working groups are actively looking to propose changes to the code on the following topics (some of which are part of the ESPN portfolio):**

- update to Volume H on supporting roles,
- continued work on modifying Appendix Z G on fast fracture resistance with the aim of introducing new exemption criteria and supplementing the material data,
- coverage of progressive deformation in Appendix Z C on non-linear finite element analyses,
- update to Volume S 8000 on hard coatings,
- continued work on the rules for calculating flanged joints and characterizing and accepting joints,
- integration of advanced UT methods (TOFD and Phased Array), digital radiography and eddy current methods for inspecting pipe welds.

**A number of topics identified in this programme should be given the green light in 2023, including:**

- the integration of “environmental fatigue” RPPs into the code,
- the development of rules for temperature control during local heat treatment.

## 2.2.8 International challenges

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

In terms of the events in 2022, a half-day session was organized in December 2022 for the CSUG (Chinese Specialized Users Group) with three experts from the RCC-M Subcommittee. This session was conducted as a videoconference, this year was marked, once again, by the Covid19 epidemic. A robust logistics effort ensured that the session could go ahead. This meeting attracted over 67 Chinese members from various local companies and allowed the experts to answer several dozen questions which, where applicable, resulted in code interpretation or modification requests. Members were shown the main changes introduced into the 2022 edition of RCC-M and the potential updates.

In 2022, 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. AFCEN’s insights into advanced manufacturing technologies were presented during the SDO Convergence Board meeting in November 2022.
- At the European level, Phase 3 (launched in 2019) of the GEN II/III Prospective Group (PG1) of CEN workshop WS 64 was brought to a conclusion (refer to the dedicated paragraph in Section 1.2.2), and Phase 4 is currently being prepared.

In 2023, there are plans to maintain international initiatives:

- focusing on international comparisons by reviewing the studies performed by WNA/CORDEL and the SDO Convergence Board in line with the expectations of the other SDOs,
- furthering the aims of OECD/NEA/CNRA, by continuing relevant work on equivalent codes and regulations alongside the Safety Authorities in the WGCS,
- by leading AFCEN’s Chinese Users Groups, and the corresponding international training courses,
- at the European level as part of the CEN/WS 64 workshop.

# 2.3 MECHANICAL FIELD FOR PRESSURIZED WATER REACTORS (OPERATION) RSE-M


THE RSE-M CODE

## 2.3.1 Purpose and scope

The RSE-M code defines the installation, in-service inspection and maintenance rules for PWR mechanical components. It applies to pressure equipment used in PWR plants, as well as spare parts for such equipment.

It may be 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 French regulations.

**To date:**

- the 56 units of France nuclear fleet enforce the in-service inspection rules of the RSE-M code,
- the operation of 38 commissioned units in China's nuclear infrastructure, corresponding to the M310, CPR-1000, ACPR-1000, CPR-600 and EPR 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 basis 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 an overhaul in 2010.

# 2.3 MECHANICAL FIELD FOR PRESSURIZED WATER REACTORS (OPERATION) RSE-M

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 (FA3).

The 2017 and 2018 editions supplement the technological, legislative (especially ESPN) and international developments that occurred in 2016.

## 2.3.3 Edition available in 2022

Until such time as the 2022 edition is published (planned for the end of the first quarter of 2023), the 2020 edition is the most recent edition of the RSE-M code.

It builds on the technological and legislative developments that have occurred since the 2018 edition. The changes made to this new edition mainly involve:

- Introduction of two ultrasonic inspection methods into A 4220 (TOFD US, echo method and multi-element translators)
- To clarify the case of examinations that should not be considered to be NDTs, incorporation of two new sections on thickness measurements (A 4630) and cleanliness examinations (A 4640)
- Rewriting of section A 4700 - Qualification and certification of testing personnel: supplements and alignment with Appendix 4.3 – IX
- Creation of a section in Volume D, entitled “Aims and techniques of examinations performed during inspections”
- Incorporation of AFCEN-RS-18-006-A for equipment subject to the French regulation in D 8410
- Clarification on the terms for examining significant variation in A 5000
- Further details about the possibility of using the mechanical justification rules in Appendix 5.7 on volumetric defects
- Addition of table B 8500-8-1 specifically relating to the SEBIM RCP controlled valve to the tables in B 8500 for classifying maintenance operations
- Clarification of the terms for performing pre-service inspections of components at the factory (case of replacement steam generators)
- Modification to the status in Appendix 5.2 (changed from “to be defined by the operator” to “for guidance only”)
- Definition of the welding requirements for volumetric examinations during maintenance operations.

The 2022 edition, which is scheduled for publication by the end of Q1 2023, has the objective to consolidate and build on technological, legislative and international developments. It also integrates about 20 modification forms in response to users’ needs.

The 2022 edition of RSE-M will be presented in a requirements engineering format, which means overhauling the code. Users will require support to ensure their uptake of the new format, but this major change will make the code easier to read for all French and international users.


ULTRASONIC EXAMINATION OF WELDS

## Work relating to France's nuclear pressure equipment regulation (2015/12/31 ESPN order)

As part of its involvement in France's ESPN Regulation, the RSE-M Subcommittee has commissioned studies with the aim of producing professional guides, which have been published since 2016 as modification files for the code and PTAN. The following diagram shows how the PTAN are arranged as Repair / Modification / Installation according to the equipment level as of late 2020.

# 2.3 MECHANICAL FIELD FOR PRESSURIZED WATER REACTORS (OPERATION) RSE-M

## INSTALLATION OF NPE (Nuclear Pressure Equipment)

### NPE subject to appendix V, points 1 to 4

**AFCEN-RS-18-003-A**
**Permanent joining**
(30/12/2015 order, appendix V § 4.1.a 1st bullet of 1s § & 2nd §)
- Applicable requirements from 2014/68/UE directive + 30/12/2015 order
- Expected documentation
- Adapted modules: Fi

**AFCEN-RS-18-004-C**
**Protection against exceeding the allowable limits**
(30/12/2015 order, appendix V § 4.1.a 2nd bullet of 1st § & 2nd §)
- Method
- Adapted modules: Ap, Bp, Fp
- Applicable requirements for NPE built according to 1926 or 1943 decree

### NPE subject to appendix V, point 5

**AFCEN-RS-18-005-A**
(30/12/2015 order, appendix V §5)
- Permanent joining
- Protection against exceeding the allowable limits

## PIPING REQUALIFICATION

**AFCEN-RS-16-007-E**
(30/12/2015 order appendix V § 3.4)

## N2 OR N3 NPE REPAIR OR MODIFICATION

**AFCEN-RS-18-006-A**
**Requirements**
(30/12/2015 order, appendix V §4.2.a)
Applicable requirements from PED + 30/12/2015 order

**AFCEN-RS-16-009-B**
**Classification**
(30/12/2015 order, appendix V § 4.2.a)
- Classification
- Adapted modules: ($A_R$, $B_M$, $B_R$, $B_{PSI}$, $F_{PS}$, $F_{RM}$, $G_{RM}$, $F_{CDS}$, $G_{BOU}$)
- Expected documentation

**AFCEN-RS-16-010-E**
**Documentation**
(30/12/2015 order, appendix V § 4.2.a)
- Expected documentation
- Methods :
  . Hazards and risks analysis (& template)
  . Nuclear material appraisal (& template)
  . Material qualification
  . Unacceptable defects
  . Sizes : determination and control to prove essential safety requirements respect
  . Means of examination (& template)
  . Operating instructions (& template)

## N1 NPE OF PWR MPS (Main Primary System) OR MSS (Main Secondary System)

**AFCEN-RS-18-022-B**
**MPP (Main Pressure Part) procurement**
(10/11/1999 order, art. 10.IV.b)
- Requirements
- Expected documentation
  . For modified MPP
  . For identical MPP
- Methods
  . Hazards and risks analysis (& template)
  . Nuclear material appraisal (& template)
  . Material qualification
  . Unacceptable defects specification
  . Sizes: determinalion and control to prove essential safety requirements respect
  . Means of examination
  . Operating Instructions
- Identical material
- Adapted modules ($B_{ppp}$, $F_{ppp}$, $G_{ppp}$)

**AFCEN-RS-18-007-A**
**Maintenance Operation**
(10/11/1999 order, art.10)
- on MPP
- on MPS or MSS with MPP
- on MPS or MSS without MPP
- Assessment of welds between MPS or MSS and NPE subject to appendix V of 30/12/2015 order
- Assessment of maintenance operation on a safety device protecting an NPE subject to appendix V of 30/12/2015 order against exceeding allowable limits

Guides approved by ASN: AFCEN-RS-16-009-B , AFCEN-RS-17-022-B, AFCEN-RS-18-003-A, AFCEN-RS-18-004-C, AFCEN-RS-18-006-A
Guides recognised as relevant by ASN: AFCEN-RS-16-007-E, AFCEN-RS-16-010-E, AFCEN-RS-18-007-A

CONTENTS OF THE 2020 EDITION OF THE RSE-M CODE

## 2.3.4 Outlook and next edition

In keeping with its 2023-2026 programme, the RSE-M Subcommittee is planning to direct its efforts towards the following topics:

- 2024 edition: introduction of advanced inspection technologies, clarification of the procedure for qualifying NDT tests (not including MPS/MSS), and additional methods and data for mechanical analyses
- 2026 edition: introduction of advanced inspection technologies (continued), additional methods and data for mechanical analyses (continued), and clarification of the procedure for qualifying maintenance operations

## 2.3.5 Other RSE-M technical publications

**PTAN AFCEN-RS-16-018-A "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.

**PTAN AFCEN-RS-17-019-A Criteria "Appendix 5.4"**

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.

**PTAN AFCEN-RS-18-026-A Criteria "Appendix 5.5"**

These criteria were finalized in 2018 and published in Q1 2019.

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

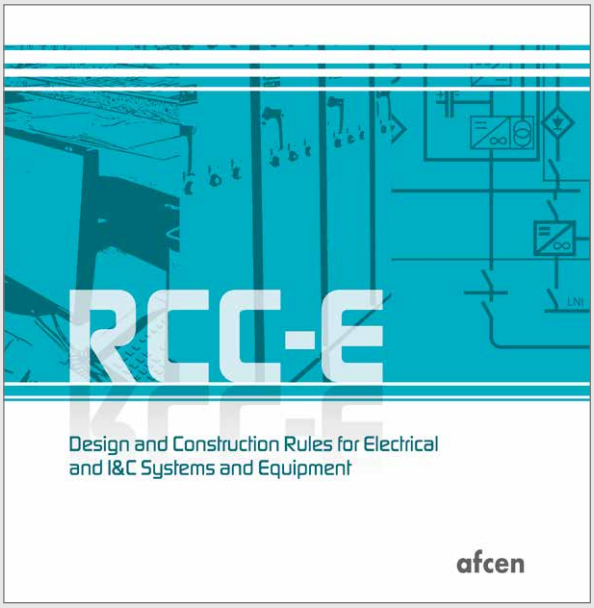
**PTAN AFCEN-RS-19-013-A "Guide for qualifying ultrasonic NDT processes - Definition of performance"**

This methodological guide for defining NDT qualifications with ultrasonic processes was published in 2020.

**Are you familiar with the technical publications (PTAN) of the RSE-M code?**

PTAN DESCRIPTION VIDEO

# 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, as well as for 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:**

- electrical and I&C architectures and the associated systems,
- materials engineering and the qualification procedure for normal and accidental environmental conditions, including consideration for internal and external hazards,
- 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.

### 2.4.2 Use and background

#### Use

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

- France's last 12 nuclear units (1,300 MWe (8) and 1,450 MWe (4)),
- 2 CP1 reactors in South Korea (2),
- 50 M310 (4), CPR-1000 (28), CPR-600 (6), HPR-1000 (10) and EPR (2) reactors in service or undergoing construction in China,
- 1 EPR reactor in France and 2 reactors in the UK (Hinkley Point C).
- The RCC-E code is used for maintenance operations in French power plants (56 units) and 32 Chinese M310 and CPR-1000 power plants.

**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, 2016 and 2019 editions concern Generation II and III reactors. As from the 2005 edition, project specifications must be written to supplement and implement the rules in the RCC-E code and allow the code to be used in the project. With the 2019 revision, AFCEN has created a PTAN that provides users with guidelines on how to produce project specifications.

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

The 2005 and 2016 editions were translated into Chinese and published under CGN's authority.

## 2.4.3 Edition available in 2022

The RCC-E 2019 edition is the most recent version. It is available in French and English.

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

- 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 2019 edition:

- is an update of the previous edition,
- addresses Generation II, III and IV reactors, research reactors and naval reactors,
- organizes requirements into four key areas for easier identification and greater clarity: monitoring, systems, equipment, and component and systems installation. Each key area covers all lifecycle activities,
- takes account of IAEA requirements as applicable to the scope of the code,
- clearly defines the supplements to the requirements in the chosen IEC standards for I&C systems.

**Reasons for updating the code include:**

- a clearer insight into safety approaches (defense-in-depth examinations, design standard, events and deterministic approach, failure-oriented principle to encourage protective action, consistency of hazards with the French Regulation on basic nuclear facilities, etc.),
- 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,
- extended scope for power sources, especially to ensure the long-term management of potential serious accidents: internal power sources, control sources and mobile power sources,
- consolidation of the design for the electrical power supply architecture.

# 2.4 ELECTRICAL AND I&C SYSTEMS RCC-E

**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 2019 EDITION OF THE RCC-E CODE

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

A 2022 revision will be available early 2023 in English and French.

This revised edition introduces a new set of topics including:

- analysis and, if necessary, incorporation of the specific requirements for the NUWARD™ SMR project,
- incorporation of operational feedback to improve the requirements,
- changes in the electrical architecture for integrating interfaces between mobile emergency power sources and internal power sources, total loss of electrical power sources, resistance of electrical and I&C systems to electrical or electromagnetic disturbances and hazards,
- clarification of the interfaces between the electrical architecture and the I&C architecture, especially for the power distribution from the I&C cabinets,
- incorporation of new standards, including IEC 63046, IEC 62003 and IEC 60079-0, update in the code to reflect the application of IEC 61508 for Class III equipment, and IEC 62808 for the design of isolation devices,
- incorporation of requirements based on ISO 19443:2018 in addition to ISO 9001,
- introduction to the strategies required to bring cybersecurity risks under control.

## 2.4.4 Technical publications of the RCC-E Subcommittee

### Edition gap analysis

AFCEN is producing a document that compares the most recent edition of the code against the previous edition.

For the 2019 edition, this document “RCC-E 2019 Gap Analysis” compares the 2019 and 2016 editions, and ties into the former chapters of RCC-E 2012.

Since 2012, such documents have always been produced to accompany each new edition.

For future code editions, this comparison will include a high-level impact assessment of the changes introduced with the aim of helping project owners take informed decisions.

In addition, a “Guide to preparing project specifications associated with RCC-E 2019” is provided with RCC-E 2019. This guide aims to simplify the process of identifying the requirements stipulated for the RCC-E 2019 code and help users when producing project specifications. Crosstabs are available for tracking down the requirements in the 2012 / 2016 / 2019 revisions that are referenced in the project specifications. Users can click on the link in this document to download an electronic template of the document to be completed.

Since 2019, such guides for preparing project specifications have consistently been produced for each new edition.

### PTAN “Class III design qualification of systems using equipment families certified according to IEC 61508”

This PTAN supplements Volume 3 of RCC-E 2019.

It offers an alternative approach for the Class III qualification of I&C systems based on equipment families with IEC 61508 certification.

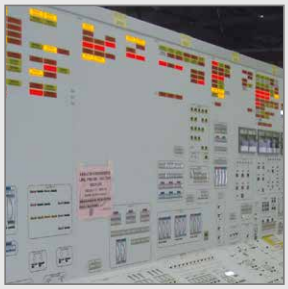
This approach has been introduced in addition to the standard qualification method according to the requirements of RCC-E for Class III I&C systems. It can only be used for Class III systems when a number of prerequisites have been satisfied, especially relating to compatibility between the planned safety function and the function for which the equipment family has been certified.

It is available in French and English.

As of the 2022 code revision, this PTAN has been fully integrated into Volume 3.

**PTAN "Requirements for the consideration of cybersecurity in the design of I&C systems" (AFCEN-PTAN-05001-2022)**

After five years of work, the collection of RCC-E publications has been enriched with a guide on the requirements for taking cybersecurity into account in the design of I&C systems, released at the end of 2022.


## 2.4.5 Outlook

The 2022 revision of the code was finalized in 2022.

New prospects are already in the pipeline for the 2025 revision. The work topics will include:

- new specific requirements for the NUWARD™ SMR project,
- investigation into the opportunity of integrating the IEEE requirements not covered by the code,
- rules for using commercial off-the-shelf components (Commercial Grade Dedication),
- impact of solar storms and the induced geomagnetic currents,
- greater harmonization between the RCC-F and RCC-E codes,
- in-depth implementation of requirements engineering,
- new applicable standards,
- feedback from the use of RCC-E 2019.

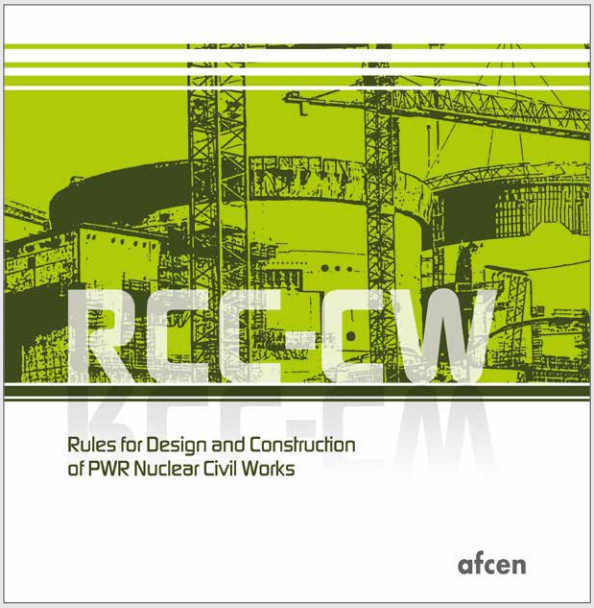
## 2.4.6 International activities

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.

Due to the health pandemic, the CSUG seminar in 2022 was held as a virtual meeting. Note that Chinese participants in the CSUG were keenly interested in the changes relating to their work on developing new designs.

The UK Users Group also held its first meetings in 2022. The specific situation in the UK serves as the ideal opportunity to strengthen support for users and illustrate how the codes can be implemented to meet the needs of current British projects (Hinkley Point and Sizewell).

# 2.5 CIVIL WORKS RCC-CW




THE RCC-CW CODE

## 2.5.1 Purpose and scope

The RCC-CW code describes the rules for design, construction and ageing management of civil engineering structures 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 by the RCC-CW Subcommittee, which includes all the actors 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, construction and aging management of civil engineering structures 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,
- joints, paints, coatings and geomembranes,
- containment leak tests.

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

## 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 basis 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: 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 in the United Kingdom.

| 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 | HPC, SZC |
| 2015 - 2016<br>2017 - 2018<br>2019 - 2020<br>2021 | Renewed edition:<br>. post-Fukushima level & methods<br>. improvements & updates<br>. extensions of scope | Updated editions to be used as reference for New Build Projects |

SUCCESSIVES VERSIONS OF RCC-CW

## 2.5.3 Edition available in 2022

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 EPR2 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 assessment process for Flamanville 3 and the generic design assessment of the EPR in the United Kingdom,
- the experience acquired by members through their participation in the Olkiluoto, Flamanville and Taishan projects.

## 2.5 CIVIL WORKS RCC-CW

**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 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 DANCH and CANCH chapters,
- 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).

**The 2019 edition of the RCC-CW code includes the following improvements:**

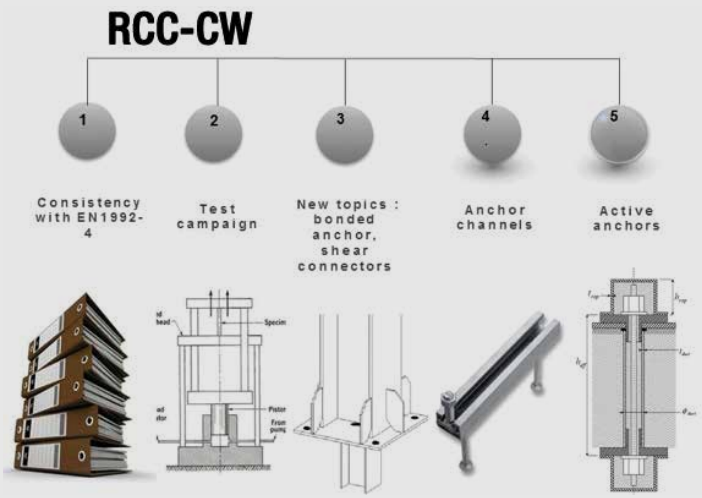
- evolution of the scope of durability requirements (DCONC § 3000, 4110, 9000),
- removal of diameter pressure failure mode for anchor design (DANCH),
- improvement of requirements for bending steel on site (CREIN),
- evolution of leak detection requirements for pools and tanks (DPLIN & CPLIN),
- introduction of industrial feedback for containment testing and monitoring (MCONT).

**The 2020 edition of the RCC-CW code includes the following improvements:**

- update to the requirements of the quality management system (GGENP, GA) with the possibility of applying ISO 19443,
- clarification of the load combination (LC10) for structural steelwork (DGENR 3400),
- requirements relating to deep foundations (DGEOT 7000, CGEOT 8000),
- evolution of leak-tightness requirements SLS (DCONC 6000),
- evolution of durability requirements: reinforced concrete cover (DCONC, CA),
- optimization of requirements for the minimum reinforcement rate: scale effect for containments (DCONC),
- evolution of requirements for the design and installation of anchors (DANCH, CANCH),
- evolution of the seismic appendix (DA),
- general revision of prestress requirements (CPTSS, CC, CCONC, DCONC),
- new CGEOM section on geomembranes,
- new CCONT section on containment construction,
- new AM part (aging management) with two new sections:
  - AMGENR: general requirements,
  - AMCONT: containment aging management.

**The 2021 edition of the RCC-CW code includes the following improvements:**

- revised terminology for pool temperature loads (DGENR),
- improvement of the code requirements concerning water levels (DGENR),
- change in requirements for liquefaction (DGEOT-CGEOT),
- change in requirements for liner mean yield stress (DCONC, CCLIN),
- change in requirements for lamellar tearing (DSTLW),
- introduction of T-head bolts and shear connectors (DANCH 5000, DANCH 6000),
- rewording of the requirements in the seismic appendix (DA),
- improvement of the code requirements for concrete shrinkage (DB),
- changes to the welding for anchor systems (CANCH),
- changes to construction joints (CCONC),
- concerning Part AM (aging management):
  - AMCONT: clarification of aging management requirements for containments,
  - AMCONC: aging management for reinforced concrete structures (new chapter),
  - AMGEOT: aging management for geotechnical structures and structures in strong interaction with the soil (new chapter).




THE RCC-CW CODE COVERS ANCHOR-RELATED TOPICS

**Do you have good knowledge of the RCC-CW code?**

RCC-CW CODE DESCRIPTION VIDEO

# 2.5 CIVIL WORKS RCC-CW

CONTENTS OF THE 2021 EDITION OF THE RCC-CW CODE

**PART G - GENERAL**
GUSER - NOTE TO THE USER
GTABL - ORGANIZATION OF RCC-CW
GREFD - STANDARDS AND DOCUMENTS MENTIONED IN RCC-CW
GDEFN - DEFINITIONS, NOTATIONS AND ABBREVIATIONS
GGENP - GENERAL PROVISIONS
GA - APPENDICES
**PART D - DESIGN**
DGENR - GENERAL DESIGN REQUIREMENTS
DGEOT - GENERAL RULES FOR GEOTECHNICAL ENGINEERING
DCONC - GENERAL RULES FOR CONCRETE STRUCTURES
DCLIN - LEAK-TIGHT METAL PARTS ON CONTAINMENTS
DPLIN - METAL PARTS INVOLVED IN THE WATERTIGHTNESS OF THE POOLS AND TANKS
DSLTW - GENERAL RULES FOR STRUCTURAL STEELWORK
DANCH - DESIGN REQUIREMENTS FOR ANCHORING SYSTEMS EMBEDDED IN CONCRETE
DA to DN - APPENDICES
**PART C - CONSTRUCTION**
CGEOT - EARTHWORKS AND SOIL TREATMENT
CCONC - CONCRETE
CREIN - REINFORCEMENT FOR REINFORCED CONCRETE
CPTSS - POST-TENSIONING SYSTEM
CPREF - PREFABRICATED CONCRETE ELEMENTS AND REINFORCEMENT CAGES
CCLIN - LEAK-TIGHT METAL PARTS ON CONTAINMENTS
CPLIN - POOLS AND TANKS
CSTLW - STRUCTURAL STEELWORK
CANCH - DESIGN REQUIREMENTS FOR ANCHORING SYSTEMS EMBEDDED IN CONCRETE
CBURP - REINFORCED CONCRETE PIPELINES
CJOIN - JOINT SEALING
CCOAT - PAINTS AND COATINGS
CGEOM - GEOMEMBRANE LEAK-TIGHTNESS SYSTEM
CTOLR - SURVEY NETWORKS, TOLERANCES AND MONITORING SYSTEMS
CCONT - LEAK AND MECHANICAL TESTS AND INSPECTION OF THE CONTAINMENT
CA to CI - APPENDICES
**PART AM - AGING MANAGEMENT**
AMGENR - GENERAL REQUIREMENTS FOR AGING MANAGEMENT
AMGEOT - AGEING MANAGEMENT OF GEOTECHNICAL STRUCTURES AND STRUCTURES IN STRONG INTERACTION WITH THE SOIL
AMCONC - REINFORCED CONCRETE STRUCTURES
AMCONT - AGEING MANAGEMENT FOR CONTAINMENT

## 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/WS 64 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 AFCEN code users' countries.

**The work programme includes the following core topics:**

- composite steel and concrete structures,
- marine structures,
- incorporation of changes in the Eurocodes,
- improved reinforcement rates,
- evolution of design criteria for metal liners,
- aging management.

## 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 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" was released early 2019. This PTAN compiles the collective experience of AFCEN's corporate members on seismic dissipative devices.

## 2.5.6 International activities

### CEN/WS64

The Subcommittee is involved in the activities of CEN Workshop 64 - Phase 3 and will also be active in Phase 4.

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. As an example, work will begin in 2023 to improve the appendix covering the impact of projectiles.

### 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.

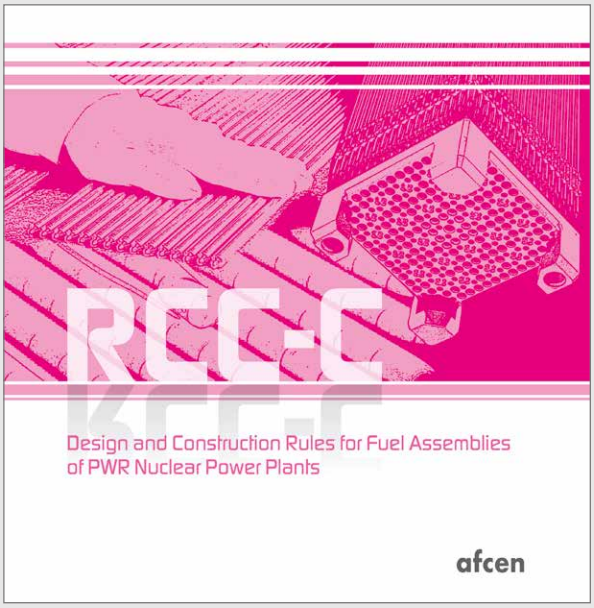
Any interpretation requests for AFCEN codes issued during the meetings are examined by the Subcommittee.

### UK Users Group

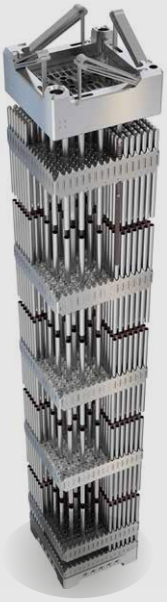
The UK Users Group on civil engineering codes includes the main companies involved in the Hinkley Point C project. The Users Group was officially launched during the AFCEN 2017 Congress. The group held two meetings in 2017 and one meeting in 2018, 2019 and 2020.

The next meeting is due to be held in 2023.

# 2.6 FIELD FOR FUEL ASSEMBLIES FOR PRESSURIZED WATER REACTORS RCC-C




THE RCC-C CODE



©WESTINGHOUSE
RFA900 PWR FUEL ASSEMBLY

## 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, fuel rods and associated elements (core components),
- the characteristics to be checked for products and parts,
- fabrication methods and inspection methods,
- safety-oriented integrated management systems for all activities concerned by the above-mentioned areas.

## 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, with a focus given on 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 were missing in 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 | 1 - General provisions | 1 - General provisions |
| 2 - Product and part characteristics | 2 - Product and part characteristics | 2 - Description of the fuel |
| 3 - Fabrication and related testing and inspection | 3 - Fabrication and related testing and inspection | 3 - Design |
| 4 - Tables of inspection requirements | 4 - Tables of inspection requirements | 4 - Manufacturing |
| 5 - Inspection methods | 5 - Inspection methods | 5 - Handling and storage |
| Appendices | 6 - Design | |

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 in 2022

RCC-C 2020 is the most recent edition, but the 2022 edition was released early January 2023 with the following main changes:

- The heat treatment requirements were adjusted to clarify how they apply to factories.
- Adjustment to the requirements governing material supplies and product manufacturing processes: intercrystalline corrosion of stainless-steel materials, Mn content of structurally hardened austenitic stainless-steel alloys, material requirements for the alloy 718 spring wires of AIC/B4C absorber rods, check of the hydrogen content in pellets, and visual inspection of the pellets.

# 2.6 FIELD FOR FUEL ASSEMBLIES FOR PRESSURIZED WATER REACTORS RCC-C

CONTENTS OF THE 2020 EDITION OF THE RCC-C CODE



The professional guide on the qualification of scientific calculation tools used in the safety demonstration (first barrier) is available in English and French. It provides the elements of industrial practice required by the French Nuclear Safety Authority (ASN) Guide no. 28.

### Next edition

The next edition (in French and English) is scheduled for 2023.

## 2.6.4 Outlook

The code will be updated in alignment with IAEA general safety requirements no. GSR Part 2 “Leadership and Management for Safety”, superseding GS-R-3. This work was completed during 2022 and should appear in a future edition of the code (2023).

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’s follow-up letter has been examined.

Manufacturing process requirements will be modified according to the proposals and feedback from Subcommittee members. Efforts are currently underway to clarify the requirements for introducing new products or processes in relation to the industry’s current projects.

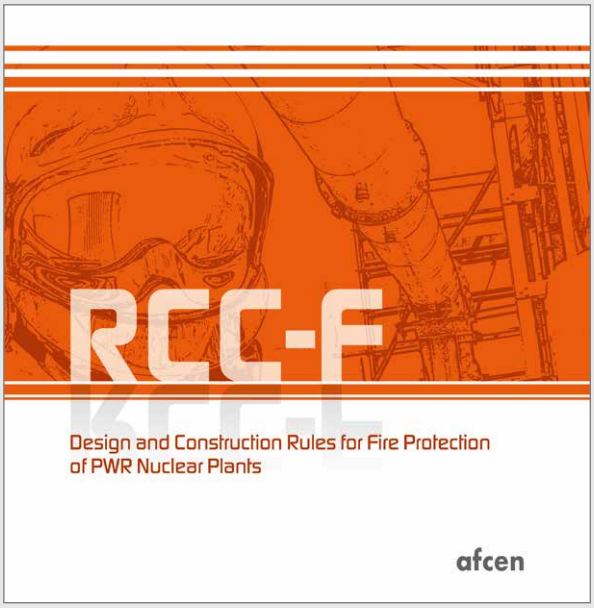
The cleanliness requirements specified in RCC-C are still being analyzed, and modifications. Code users are gathering feedback from the plants.

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

The process of applying the Requirements Engineering methodology to the RCC-C code was launched in 2022 and will continue over the coming months.

Finally, there are plans to update the chapters on special assemblies and core components with the aim of formally and explicitly implementing experimental products.

# 2.7 FIRE PROTECTION FOR PRESSURIZED WATER REACTORS RCC-F




THE RCC-F CODE

## 2.7.1 Purpose and scope

The RCC-F is intended for the organizations in charge of the design, construction and installation of PWR nuclear power plants to manage the risk of a fire outbreak inside the facility in regard with nuclear safety and the management of the necessary safety functions. The code also defines the rules for analyzing and justifying the means used to assess the safety case.

**This code is therefore targetting:**

- engineers in charge of the design, construction and installation of the buildings constituting a PWR,
- engineers responsible for analyzing fire hazards and establishing the safety demonstration from a fire hazard perspective,
- engineers 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.

Compliance with the code requirements can be supported by design studies.

**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 FOR PRESSURIZED WATER REACTORS 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 applicable 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 (EPR Technical Code for Fire Protection) for the design of fire protection systems. This document harnesses the experience acquired through several decades of designing and operating France's nuclear power stations.

**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,
- the publication of the RCC-F 2017 code, which is generally suited to light-water reactors, such as PWRs,
- finally, the publication of the RCC-F 2020 code, including various technical improvements.

The ETC-F and RCC-F codes are currently being applied to various projects that are either in operation or under examination, including FA3 EPR, Jaitapur EPR project, HPC and SZC EPRs, Taishan EPR, EPR2 project, SMR/NUWARD™ project and EPR-1200 project.

## 2.7.3 Edition available in 2022

The RCC-F 2020 edition is the most recent version. The English reference version of RCC-F 2020 was published late December 2020, while the French version was released in January 2022.

Amendments have been made based on the RCC-F 2017 edition and concern the following key topics:

**Technical improvements to the code**

- development of an appendix on fire hazard analyses, presenting the different types of analyses and calculation methods to be implemented, while incorporating the previous appendices G (fire barrier justification) and H (functional criteria),
- creation of a section giving greater consideration to fire protection hazards (sprinklers, gas, etc.) and the management of protection system incidents (e.g., detection),
- clarification on how to factor in external fires within the basic nuclear facility and the site,
- clarifications and additional information on combined hazards,
- creation of a paragraph on Beyond Design Basis events and feedback on the Fukushima Daiichi accident,
- migration to ISO 9001: 2015,
- minor modifications for the purpose of improving compatibility with WENRA Safety Levels 2014,
- improvements to the fire resistance of ventilation ducts,

- clarification on sizing fire pumps*,
- additional information about cable arrangements*,
- deletion of Appendix F on EDF proprietary documents and dissemination of practical information and relevant requirements in the body of the text,
- various editorial or minor improvements, translations*, organization of certain sections.

(*) Includes requests resulting from the activities of the Chinese mirror committee (CSUG, NEA agreement)

### Update to the appendices on regulations and standards

All the standards used by the code have been analyzed and updated to reflect the latest versions. At the same time, an introductory paragraph has been added to explain the status of the standards versions specified in RCC-F.

Appendix A of RCC-F incorporates the specificities of the French and English regulations. The French appendix has been updated according to the latest standards. The content of the UK appendix remains unchanged, but changes in the standards have been identified and reported in a dedicated section.

Finally, the 2020 edition of RCC-F consolidates the 2017 edition by introducing a number of improvements and additional technical details, especially in the applicable sections and appendices.

CONTENTS OF THE 2020 EDITION OF THE RCC-F CODE

# 2.7 FIRE PROTECTION FOR PRESSURIZED WATER REACTORS RCC-F

## Other publications of the RCC-F Subcommittee:

The analysis of the RCC-F 2020 code's conformity with WENRA 2014 safety levels (PTAN) was published in 2021.

The gap analysis between the 2017 and 2020 editions was published in 2021 as a PTAN associated with the RCC-F 2020 edition.

A comparison with US regulations (NFPA standards) was finalized in 2022.

## 2.7.4 International activities

The Chinese working group comprises 19 permanent members and was created in March 2015 (Beijing). Every year, a meeting is organized in China to improve interaction and help address the interpretation and/or modification requests issued by the CSUG. In 2019, the meetings (in November) culminated in a joint visit with RCC-F representatives at CGN's Taishan site. Meetings have been successively rescheduled since 2021 in light of the difficulties caused by the health crisis. Interactions were maintained for the purpose of addressing the CSUG's requests.

As part of the AFCEN/NEA memorandum of understanding, a Chinese-language version of RCC-F 2017 was published in 2021.

As for the UK, EDF Energy is a member of the Subcommittee, but there is no mirror committee.

## 2.7.5 Outlook and preparation of the RCC-F 2023 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. Depending on the needs, 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).

### Requirements engineering

There are plans to incorporate AFCEN's "Requirements engineering" process into the RCC-F code, and a prototype of RCC-F-2020 was prepared in an appropriate format. The process will be continued and fine-tuned in successive versions of the code.

### Edition RCC-F 2023

The next edition of RCC-F is scheduled for 2023. The general ambition with this version is to include an initial "Requirements Engineering" format and pursue efforts on incorporating the improvements identified in the editorial programme.

New changes were requested when examining the RCC-F code as part of the EPR2 project (answers to the questionnaires issued by IRSN). Those requests are currently being addressed.

Some of the modification requests were issued by the CSUG.

To examine the other requests, the Subcommittee's technical work was organized into "macro-topics" based on the experts' observations and proposals:

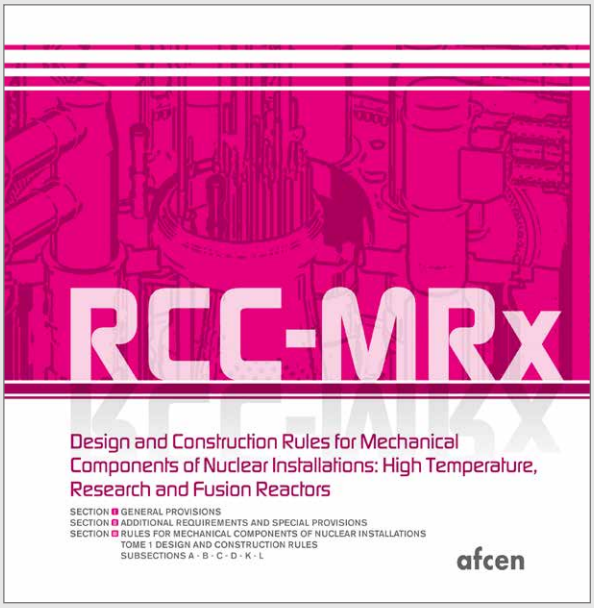
- Fire containment (especially the definition of fire volumes)
- Regulatory aspects (protective measures for people)
- Evacuation
- Type of common methods
- Nuclear safety principles
- Fire hazard analysis
- Fire-fighting/extinguishing
- Detection
- Fire resistance
- Earthquake
- Installation
- Ventilation
- Other codes

The appendix on UK regulations is being updated to reflect analyses on the codes for Sizewell C.

**Do you have good knowledge of the RCC-F code?**

RCC-F CODE DESCRIPTION VIDEO

# 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).

In particular, it provides the rules for designing and building mechanical components involved in areas subject to significant creep and/or significant irradiation. 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 several 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 (now Framatome), 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).

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. Three new editions of RCC-MRx have since been published (in 2015, 2018 and 2022).

The RCC-MRx code is serving as a reference for the design of the systems in the RJH project and 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 2022 Edition

CONTENT OF THE 2022 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 G (RG): Core internals
. 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 2022 edition is the most recent version.

The 2022 edition of the code incorporates feedback from the use of the 2018 edition of the code (or its earlier editions). Feedback from the (ongoing) construction of the Jules Horowitz reactor has proven to be especially valuable for updating this edition of the RCC-MRx code, for example:

- Material supplies: creation of an STR covering 6061-T6 aluminum alloy flanges obtained by ring forging for the RJH core vessel or an STR for supplying beryllium billets.
- Manufacturing operations:
  - Authorization for polymer quenching (as an alternative to oil quenching)
  - Reinforcement of the requirements for qualifying nitriding treatments and introduction of ionic processes
  - Introduction of specific shearing and forming rules for the exchange plates in plate and gasket exchangers.

# 2.8 MECHANICAL FIELD FOR HIGH-TEMPERATURE, EXPERIMENTAL AND FUSION REACTORS RCC-MRX

The following major changes have also been added:

- Creation of a set of characteristics including the data for nitrogen alloyed X2CrNi19-10 steel [“304L(N)”] in RPP no. 18.
- Introduction of the CuCrZr grade (one STR and Appendix A3) in RPP no. 23.
- Improved rules for taking account of creep-fatigue.
- Creation of volume G focusing on core internals.
- Complete reorganization of Volume II to ensure easier use by creating a single place within the code to address supplies based on product standards.

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 and regulations (e.g., updated versions of France’s nuclear regulations). Therefore, all the work involved in demonstrating the RCC-M code’s compliance with the ESPN Regulation has been included and incorporated into the 2022 edition (Chapter REC 3000).

As part of the aim to open the code to international needs, the 2022 edition features the initial results of the CSUGs and AFCEN’s collaboration with NEA. In terms of the code’s application in China, REC 2300 defines the potential approaches for using Chinese standards in alignment with the requirements of the code. Only standards published by a recognized body in the Chinese standardization system may be offered as alternatives. In all cases, evidence must be provided that they are equivalent to the code’s requirements.

The 2022 edition has also factored in feedback from CEN Workshop 64 - Phase 3 by incorporating the following changes:

- Inclusion of a probationary phase rule (RPP no. 20) to introduce small punch tests as an addition to the code-based procedures for characterizing materials, whether at the time of procurement or when characterizing the material’s in-service behavior.
- Introduction of additional requirements and special measures in REC 4000 to take account of NQA-1, when NQA-1 is required for compliance with regulations (e.g. installations built in Belgium).
- Addition of a probationary phase rule (RPP no. 19) to introduce an alternative method for preventing creep-fatigue damage to steels subject to cyclic softening.
- Addition of a 19Cr12Ni2Mo welding consumable datasheet for the TIG process in Volume IV and Appendix A9.

## 2.8.4 Outlook

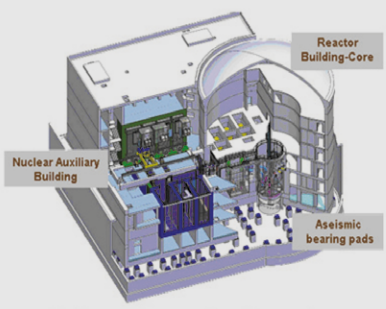
Between 2023 and 2025, efforts will be dedicated at preparing the next edition of the code, which is due to be published in 2025. Building on the previous editions, the aims for the new edition of RCC-MRx are to improve the code’s modularity and clarity, so that it can be adapted to the many projects that are likely to use it as a reference. The new edition will also incorporate the requests submitted by European partners through CEN/WS64 (latest modifications from Phase 3 and new modifications from Phase 4).

## 2.8.5 Technical studies

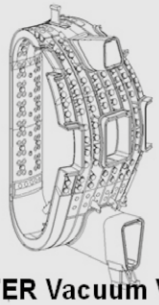
In 2016, work was finalized on the commissioned study entitled “Terms for introducing a new material into RCC-MRx”. This study led to the publication of a methodological guide (AFCEN/RX.17.004 “Guide for introducing a new material in RCC-MRx”), which explains, when introducing a non-codified material into RCC-MRx, the methods for obtaining the characteristics in Appendix A3 (expected / authorised tests, meaning of the data). This document will be updated in 2022 to include the precautions relating to intergranular corrosion.

**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 was completed in 2019 and identifies opportunities for improving the code accordingly.
- 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 was completed in 2020 and resulted in a modification to the code.
- 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.

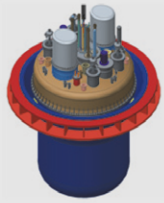



Jules Horowitz Reactor

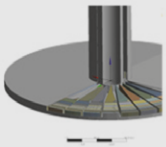


ITER Vacuum Vessel

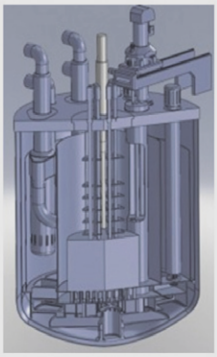
Indian PFBR



MYRRHA primary system

European Spallation Source target



ASTRID

afcen

Shaping the rules for a sustainable nuclear technology

# 3

# SUPPORT
## FOR THE INDUSTRY

# 3.1 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 partners, 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 2022, the 11 organizations that have signed a partnership agreement with AFCEN to deliver technical training are as follows: APAVE, BUREAU VERITAS, EFECTIS, Framatome, INSTN, PONT FORMATION CONSEIL, SICA NUCLEAIRE, SNPI (Groupe CGN), UFPI, VINCOTTE Academy and SOCOTEC.

PARTNERSHIP AGREEMENTS SIGNED BY AFCEN AND TRAINING ORGANIZATIONS BY THE END OF 2022

## 3.1.1 Certified training

In 2021, AFCEN set up a certification scheme for remote learning courses and proposed the scheme to its training partners. Three partners have now obtained certification for their remote courses: Framatome, SOCOTEC and BUREAU VERITAS.

In 2022, the Committee had 41 certified courses in the catalog. 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.

| Code | Type de formation | Durée | Langue | Partenariat |
|---|---|---|---|---|
| RCC-M | Introduction & further study of the code | 2 to 5 days | FR / EN / CH | 7 partners |
| | Structure and application of the code | 3 days | FR | 2 partners |
| | Procurement of materials according to the code | 1 day | FR | 1 partner |
| | Quality assurance | 1 day | FR | 1 partner |
| | Examination methods | 2 days | FR | 1 partner |
| | The RCC-M code applied to meet NPE regulations | 2 to 5 days | FR / EN | 2 partners |
| | Design and sizing | 2 days | FR / EN | 2 partners |
| | Manufacturing - Welding | 2 days | FR | 1 partner |
| RSE-M | Introduction to the code | 2 days | FR | 1 partner |
| | Use of the RSE-M code and its requirements | 5 days | FR | 1 partner |
| RCC-E | Introduction to the code | 1 day | FR/EN | 2 partners |
| | Comprehensive code training 2012 / 2016 / 2019 | 2 to 4 days | FR/EN | 2 partners |
| | Qualification and long-term fabrication of mechanical components qualified under accidental conditions (2012 & 2016 & 2019 editions) | 2 to 3 days | FR/EN | 1 partner |
| | RCC-E code 2012 edition - "Inspection" Specialization | 1 day | FR | 1 partner |
| | Gap 2012 – 2016 - 2019 | 1 day | FR/EN | 1 partner |

| Code | Type de formation | Durée | Langue | Partenariat |
|---|---|---|---|---|
| RCC-CW | General introduction | 1 day | FR/EN | 1 partner |
| | Construction | 2 days | FR/EN | 1 partner |
| | Design | 3 days | FR/EN | 1 partner |
| RCC-C | Introduction and use of the RCC-C code | 2 days | FR | 1 partner |
| RCC-F | Comprehensive code training | 4 days | FR/EN | 1 partner |
| RCC-MRx | Introduction to the code | 2 to 3 days | FR/EN | 3 partners |

AFCEN TRAINING CATALOG AS OF LATE 2022 (DETAILS IN APPENDIX C)


afcen

ATTESTATION

*de suivi de la session de formation*

« TITRE DE LA FORMATION »

Titre du Code

Logo Organisme

***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
Prénom Nom

***Pour l'***Organisme
**Le Responsable de la Formation**
Prénom Nom

www.afcen.com

www.site organisme

AFCEN CERTIFICATE OF ATTENDANCE

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.

## 3.1.2 Training courses delivered in 2022

In 2020, AFCEN and its partners finished developing courses focusing on the ESPN documentation (guides, changes to the RCC-M code, etc.). The first sessions were available early 2021, and Framatome held a training session in 2022 (nine trainees).

In 2022, 82 training sessions were held and covered all codes, representing 737 trainees and 2150 days of training. The training quality was assessed per code and organization, with specific attention to ensure that all associated messages related to nuclear safety were effectively delivered. Training managers took part in the in-class evaluation of five courses.

At the end of 2022, the certified training catalog was enhanced with a redesigned course, several distance learning courses and the possibility for trainees to access electronic versions of the codes during their course.

By the end of 2022, the certified training catalog comprised 41 courses.

# 3.1 TRAINING

## 3.1.3 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 2022, courses were delivered in China and India.

A partnership agreement was renewed for China with SNPI (CGN group) in 2021. The RCC-M training course provided by this organization was certified in 2016. 52 trainees completed the RCC-M course in 2022.

In India, a partnership was set up by AFCEN, EDF, BUREAU VERITAS et LARSEN & TOUBRO to facilitate the provision of certified training in the country and thereby accompany projects currently being spearheaded by the French nuclear industry. In 2021, 46 trainees completed the online RCC-M course. A webinar providing an introduction to the RCC-E code was attended by 35 participants from approximately 20 companies (including five from NPCIL). No training courses were delivered in 2022.

# 3.2 PRESENTATIONS OF THE CODES IN HIGHER EDUCATION

As part of the key development area identified when preparing the strategic plan, efforts are currently being made to present AFCEN's codes in certain undergraduate courses in nuclear engineering. It is effective for students on the following programmes:

- Masters of Nuclear Energy (MNE), for the specialities: Nuclear Plant Design (RCC-M, RCC-E and RCC-CW)
- Engineering degree with honors in nuclear engineering offered by CNAM (RCC-M, RCC-F and RCC-CW)
- Nuclear engineering degree offered by ENSI Caen

The related course content is coordinated by the Training Committee and reviewed by the training managers to ensure that it is relevant and regularly updated with the latest editions of the codes

# 3.3 AFCEN'S "FRANCE RELANCE" - CERTIFIED PROJECT - IMPROVING THE SECTOR'S EXPERTISE IN THE CODES

## 3.3.1 Project objectives launched in June 2021

AFCEN codes form an essential part of the technical standards used by France's nuclear industry. For example, they were used as a benchmark by at least 25% of the engineering, equipment and systems contracts awarded for the Flamanville 3 project (those contracts accounted for two thirds of the external expenditure committed to the project). There is every likelihood that these ratios are even higher for the EPR2 project, where approximately 60% of contracts should be aligned with AFCEN's codes. As such, it is vitally important for France's nuclear industry to be proficient in using the codes.

**The aim of AFCEN's "France Relance"-certified project is to quickly provide the industry with two major types of tools:**

- Tools for assessing a supplier's expertise in the codes
- Tools for improving the effectiveness of training courses on AFCEN's codes

Rolling out and using assessment tools for all the companies in the industry will help raise the level of technical expertise in AFCEN's codes through training or investments if knowledge gaps or discrepancies are observed, by identifying the suppliers offering the greatest maturity in the codes, and by encouraging suppliers to invest in training on the codes.

The tools for reinforcing training effectiveness are focused on improving the quality of the distance learning courses (an easier way of making the codes available during training), as well building on the courses that AFCEN provides for universities and other institutes of higher education.

## 3.3.2 - Progress achieved in 2022

### 3.3.2.1 Tools for self-assessing and assessing suppliers' expertise in the RCC-M and RCC-E codes

In 2022, AFCEN provided the nuclear industry with a set of tools allowing **clients to assess** the level of experience in the RCC-M code by means of three guides:

- Guide 0: assess the experience of providers (manufacturers, suppliers and subcontractors) in applying the technical requirements of the RCC-M code (Level 2 and 3).
- Guide 1: allow manufacturers to effectively assess a supplier's or subcontractor's level of technical experience in the RCC-M code (Class 2 & 3 equipment).
- Guide 2: allow clients to effectively assess a manufacturer's level of technical experience in the RCC-M code (Class 2 & 3 equipment).
- In 2022, AFCEN continued developing a solution allowing clients to assess the level of experience in the RCC-E code by means of a guide:
- Guide RCC-E: allow clients to effectively assess a manufacturer's level of technical experience in the RCC-E code.

In 2022, AFCEN also pursued its aim of providing suppliers with tools to self-assess their proficiency in the RCC-M code (mechanical components for pressurized water reactors) and the RCC-E code (electricity and I&C systems).

The self-assessment tools are being developed in electronic format to increase their appeal (anonymous correction system, questions picked at random, and so on).

### 3.3.2.2. Tools for improving the effectiveness of training courses on AFCEN's codes

In 2022, AFCEN, in collaboration with AFNOR, has developed a specific secure tool for the temporary availability of AFCEN codes during the training period, in digital and read-only format.

This tool uses AFNOR's distribution platform (CObaz). Not only is this platform secure, but it also has the necessary features for providing this particular service. This tool is available to all AFCEN training partners.

In 2022, AFCEN worked alongside the Framatome training academy and SICA Nucléaire in developing the PERF 1 and PERF 2 modules for the RCC-M and RCC-E codes. These modules are available for integration into university programmes.

# 3.3 AFCEN'S "FRANCE RELANCE" - CERTIFIED PROJECT - IMPROVING THE SECTOR'S EXPERTISE IN THE CODES

**Presentation of AFCEN in higher education (engineering degrees)**

Three levels of proposals for engineering undergraduates majoring in nuclear engineering.

**1/ GENERAL:** a foundation module that introduces AFCEN's codes and provides an overview of how AFCEN's codes contribute to the safety demonstration of a basic nuclear facility. The module ties together such aspects as safety requirements, the level of quality and robustness required for nuclear components and equipment, the safety functions and the stakeholders of a nuclear project. It shows first-year undergraduates (on nuclear engineering or general engineering syllabuses) that the codes exist and provides a clearer insight into their value for the nuclear industry. This module can also highlight the interactions between the different codes, since the process of installing equipment and components may involve mechanical engineering, civil engineering, electrical engineering and fire protection.
Duration: three hours
Final assessment: yes, with questions that emphasize the role that the codes play in ensuring safety
Module developed and already in use

**2/ PERF 1:** a bespoke programme containing an introductory module on AFCEN's codes [GENERAL] as well as an introduction to the content and use of AFCEN's different codes. The university can choose the code, based on the top major subjects among its students: mechanical engineering (three codes = RCC-M - design and construction rules for mechanical components, RSE-M - in-service inspection rules for mechanical components, RCC-MRx - design and construction rules for mechanical components of nuclear installations: high-temperature, research and fusion reactors), electrical engineering (one code = RCC-E), civil engineering (one code = RCC-CW), fuel assemblies (one code = RCC-C), and fire protection (one code = RCC-F). Note that the process of installing equipment and components may involve civil engineering, electrical engineering and fire protection.
Duration: three hours (GENERAL) + three hours for each code chosen
Final assessment: yes
Modules developed and already in use

**3/ PERF 2:** a programme that builds on the previous programme by adding a "practical case study" module that is tailored to the students' major subject. A specific part of the code is presented in detail (three hours). Students work on an industrial project (outside of class time), which is subsequently commented on and corrected in class (three hours). Industrial project examples include designing a building's concrete walls, verifying the concrete design studies, calculating the thickness of the main sections of a vessel with a hemispherical base, sizing the sections for reinforcing openings, developing a fire containment system for a building, identifying the test sequence for electrical equipment, and installing electrical equipment in a room.
This programme offers students a hands-on approach to the codes and introduces them to the engineering tools that are widely used by nuclear equipment manufacturers and clients. It shows the wealth of technical demonstrations required to prove a reactor's safety. Allowing students to explore the code for their chosen major subject improves their understanding of the industrial aspects surrounding the nuclear industry. Taking part in an industrial project that addresses the code for their area of specialization gives them a closer look at the real challenges facing nuclear equipment manufacturers and consultancies designing nuclear power plants.
Module duration: three hours for the common core syllabus [GENERAL] + three-hour general presentation of the code [PERF 1] + six hours (detailed presentation followed by corrections of the industrial project) + time spent working on the industrial project outside of class
Final assessment: yes, with corrections to the industrial project
Modules developed for RCC-M and RCC-E

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# 4

# AFCEN
## RESOURCES

## 4.1 GOVERNING MEMBERS

AFCEN is an international association which was founded by EDF and Framatome in 1980 and bring together all 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 is managed by a Board of Directors, which reports to members on its activities during the General Meeting according to the terms defined in its articles of association.

EDF and Framatome (AFCEN's founder members) and CEA sit on AFCEN's Board of Directors. AFCEN's Board of Directors manages and administers the association, and defines the strategic objectives and provisional budget. EDF serves as AFCEN's President, while Framatome acts as Vice-President.

The Board designates an Executive Committee, which is tasked with achieving its work programme. 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). The General Secretariat oversees AFCEN's operation, proposes strategic directions to the Board of Directors and implements the actions chosen by the Board.

AFCEN does not have any regular employees. Board members designate the association's Secretary-General and the Deputy Secretary-General, the Chairs of the Editorial and Training Committees, and the Chairs of the seven Subcommittees responsible for developing the codes.

## 4.2 MEMBERS AND THEIR INVOLVEMENT IN THE SUBCOMMITTEES

AFCEN is aiming to increase membership levels among companies providing key experts who can draw on their expertise to move codes development forward. By the end of 2021, AFCEN had 71 members, all involved in the nuclear industry both in France and at the international level. As part of the membership process, each company prepares an application that explains its reasons to join the association, as well as the Subcommittees in which it wishes to participate and send its experts to help develop codes. Board members approve applications after examining the company's reasons for wishing to join the association, and following feedback from the Chairs of the Editorial Committee and the relevant Subcommittees.

Every member joining a Subcommittee takes part in that Subcommittee's meetings and designates which experts would like to participate in the drafting groups. Each Subcommittee Chair approves the member's involvement in the drafting groups after verifying its skills and/or expertise in the chosen field. In some Subcommittees, leadership of the drafting groups may be entrusted to an expert from an industrial company if the following three conditions are met:

1. The expert possesses the required level of expertise in the relevant field
2. The expert is chosen by the Subcommittee Board
3. The expert's company grants the necessary time for the expert to lead the drafting group's activities

As such, AFCEN is striving to ramp up the proportion of industry experts in each Subcommittee's drafting groups.

By the end of 2022, AFCEN had 73 members:

**Membership renewed in 2022** **New member for 2022**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | ALPHATEST | FR | 26 | FLOWSERVE | FR | 51 | PONTICELLI | FR |
| 2 | ALTRAD ENDEL | FR | 27 | FRAMATOME | FR | 52 | REEL SAS | FR |
| 3 | APAVE | FR | 28 | FRAMATOME GRENOBLE (ex-ROLLS ROYCE) | FR | 53 | SCHNEIDER ELECTRIC | FR |
| 4 | AUBERT ET DUVAL | FR | 29 | FUSION FOR ENERGY | ES | 54 | SCK CEN | BE |
| 5 | BERNARD CONTROLS | FR | 30 | GE STEAM POWER SYSTEMS | FR | 55 | SICA NUCLEAIRE | FR |
| 6 | BOUYGUES TP | FR | 31 | GEODYNAMIQUE ET STRUCTURE | FR | 56 | SIGEDI | FR |
| 7 | BUREAU VERITAS | FR | 32 | GISMIC | FR | 57 | SITES | FR |
| 8 | CEA | FR | 33 | HILTI France | FR | 58 | SNCT | FR |
| 9 | CETIM | FR | 34 | INSTITUT LAUE LANGEVIN (ILL) | FR | 59 | SULZER | FR |
| 10 | CGNPC | CN | 35 | INTERCONTROLE | FR | 60 | TECHNICATOME | FR |
| 11 | CLYDEUNION PUMPS SAS | FR | 36 | ITER | FR | 61 | TERRASOL | FR |
| 12 | CNNC | CN | 37 | JACOBS | GB | 62 | TRACTEBEL Engineering | FR |
| 13 | CSTB | FR | 38 | JIULI (ZHEJIANG JIULI HI-TECH METALS CO LTD) | CN | 63 | TRILLIUM FLOW TECHNOLOGIES) | FR |
| 14 | DAHER VALVES | FR | 39 | LEVIAT GMBH | DE | 64 | TUV UK Ltd | GB |
| 15 | DEXTRA MANUFACTURING | TH | 40 | LISEGA SAS | FR | 65 | TUBES NUCLEAIRES MONTBARD | FR |
| 16 | EDF | FR | 41 | MANGIAROTTI SPA | ITA | 66 | VELAN SAS | FR |
| 17 | EDVANCE | FR | 42 | NAVAL GROUP SA | FR | 67 | VINCI CONSTRUCTION | FR |
| 18 | EFECTIS France | FR | 43 | NFM SYSTEMS | FR | 68 | VINCOTTE SA | BE |
| 19 | EGIS INDUSTRIES | FR | 44 | NNB | GB | 69 | WESTINGHOUSE FR | FR |
| 20 | EIFFAGE GC | FR | 45 | NUVIA PROTECTION | FR | 70 | WUERTH | DE |
| 21 | EMERSON PROCESS MANAGEMENT | FR | 46 | OMEXOM (CEGELEC) | FR | 71 | HDI | FR |
| 22 | ENSA (EQUIPOS NUCLEARES S.A, SME) | ES | 47 | ONET TECHNOLOGIES | FR | 72 | SIEMENS SAS | FR |
| 23 | EPM INC | US | 48 | ORANO | FR | 73 | BASLER & HOFMANN AG | CH |
| 24 | ESI GROUP | FR | 49 | ORTEC | FR | | | |
| 25 | FIVES NORDON | FR | 50 | PETERCEM | FR | | | |

AFCEN MEMBERS IN 2022

# 4.2 MEMBERS AND THEIR INVOLVEMENT IN THE SUBCOMMITTEES

## Member involvement in the Subcommittees

In 2022, AFCEN members were involved in the Subcommittees as described in the box below.

**RCC-M (43 members)**
ALPHATEST, ALTRAD ENDEL, APAVE, AUBERT & DUVAL, BUREAU VERITAS EXPLOITATION, CEA, CETIM, CGNPC, CLYDEUNION PUMPS SAS, CNNC, DAHER VALVES, EDF, EDVANCE, EMERSON AUTOMATION SOLUTIONS, ENSA, ESI GROUP, FIVES NORDON, FLOWSERVE SAS, FRAMATOME, FUSION FOR ENERGY, GISMIC, HDI, INTERCONTROLE, JIULI, LISEGA SAS, MANGIAROTTI SPA, NAVAL GROUP SA, NNB, ONET TECHNOLOGIES, ORTEC, PONTICELLI, REEL SAS, SIGEDI, SNCT, SULZER, TECHNICATOME, TRACTEBEL ENGINEERING, TRILLIUM FLOW TECHNOLOGIES, TUV UK Ltd, TUBES NUCLEAIRES MONTBARD, VELAN SAS, VINCOTTE SA, WESTINGHOUSE FR.

**RSE-M (20 members)**
ALTRAD ENDEL, APAVE, BUREAU VERITAS EXPLOITATION, CEA, CGNPC, CNNC, EDF, EDVANCE, ESI GROUP, FRAMATOME, INTERCONTROLE, ITER, NNB, OMEXOM, ONET TECHNOLOGIES, ORANO, ORTEC, TECHNICATOME, TRILLIUM FLOW, WESTINGHOUSE FR.

**RCC-E (20 members)**
APAVE, BERNARD CONTROLS, CEA, CGNPC, CNNC, EDF, EDVANCE, FRAMATOME, FRAMATOME GRENOBLE, GE STEAM POWER SYSTEMS, JACOBS, NNB, PETERCEM, REEL SAS, SCHNEIDER ELECTRIC, SICA NUCLEAIRE, SIEMENS SAS, TECHNICATOME, TRACTEBEL ENGINEERING, WESTINGHOUSE FR.

**RCC-CW (28 members)**
APAVE, BASLER & HOFMANN AG, BOUYGUES TP, CEA, CGNPC, CNNC, CSTB, DEXTRA MANUFACTURING, EDF, EDVANCE, EGIS INDUSTRIES, EIFFAGE GC, FRAMATOME, FUSION FOR ENERGY, GEODYNAMIQUE ET STRUCTURE, HILTI FRANCE, JACOBS, LEVIAT GMBH, NFM SYSTEMS, NNB, ONET TECHNOLOGIES, ORANO, SITES, TECHNICATOME, TERRASOL, TRACTEBEL ENGINEERING, VINCI CONSTRUCTION, WUERTH.

**RCC-C (7 members)**
CEA, CGNPC, CNNC, EDF, FRAMATOME, NNB, WESTINGHOUSE FR

**RCC-F (10 members)**
CEA, CGNPC, CNNC, EDF, EDVANCE, EFECTIS FRANCE, EPM INC, FRAMATOME, NNB, NUVIA PROTECTION.

**RCC-MRx (19 members)**
APAVE, BUREAU VERITAS EXPLOITATION, CEA, CNNC, EDF, ENSA, FRAMATOME, FUSION FOR ENERGY, ILL, ITER, MANGIAROTTI SPA, NNB, ONET TECHNOLOGIES, ORANO, SCK CEN, TECHNICATOME, TRACTEBEL ENGINEERING, TUBES NUCLEAIRES MONTBARD, VINCOTTE SA.

AFCEN MEMBER INVOLVEMENT IN THE SUBCOMMITTEES IN 2022

## 4.3 EXPERTS

Each member company sends its experts to participate in the activities of the Subcommittees, working groups and drafting groups. Experts taking part in a drafting group provide their expertise and enhance the group's performance by comparing and contrasting their views with the opinions of the other experts. Involvement in AFCEN allows experts to broaden their area of expertise and help move the nuclear industry forward.

The number of experts made available by the members to take part in the activities of the Subcommittees and working/drafting groups is as follows for 2022 (not including the Users Groups): 824.


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

**Studies related to the four-year ESPN programme: 65**
**Foreign experts in the Users Groups: 249 (China), 41 (UK)**

## 4.4 NEW MEMBERS IN 2022

### Three new organizations became AFCEN members in 2022:

MOUROT
HENRY DESJONQUERES INDUSTRIES

HDI - Site de Guéméné, formerly MOUROT, is a HDI subsidiary that specializes in precision mechanics, weld hard facing and thin-layer surface treatment. This company joined the RCC-M Subcommittee to bring its expertise in weld hard facing, especially stelliting.

SIEMENS

SIEMENS' Digital Industries Division develops and manufactures its own automation, drive technology and digitization solutions, while leading digital transformation in the manufacturing and process industries. SIEMENS joined the RCC-E Subcommittee to bring its industrial experience of the nuclear industry.

Basler & Hofmann

Basler & Hofmann was founded in 1973 and has offices in Switzerland, Germany, Italy, Slovakia, and Singapore. The company operates in the civil engineering sector with experts from over 30 disciplines involved in a variety of projects, such as building construction works without affecting production, tunnels, demolition work and wind power. Basler & Hofmann joined the RCC-CW Subcommittee to bring its technical expertise.

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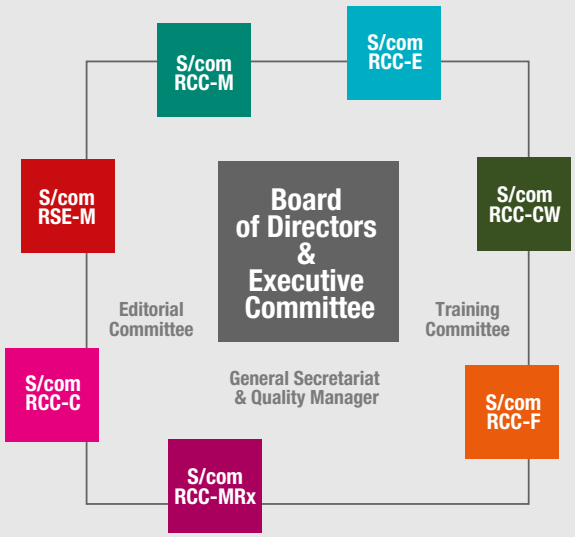
# A ORGANIZATION AND OPERATION OF L'AFCEN

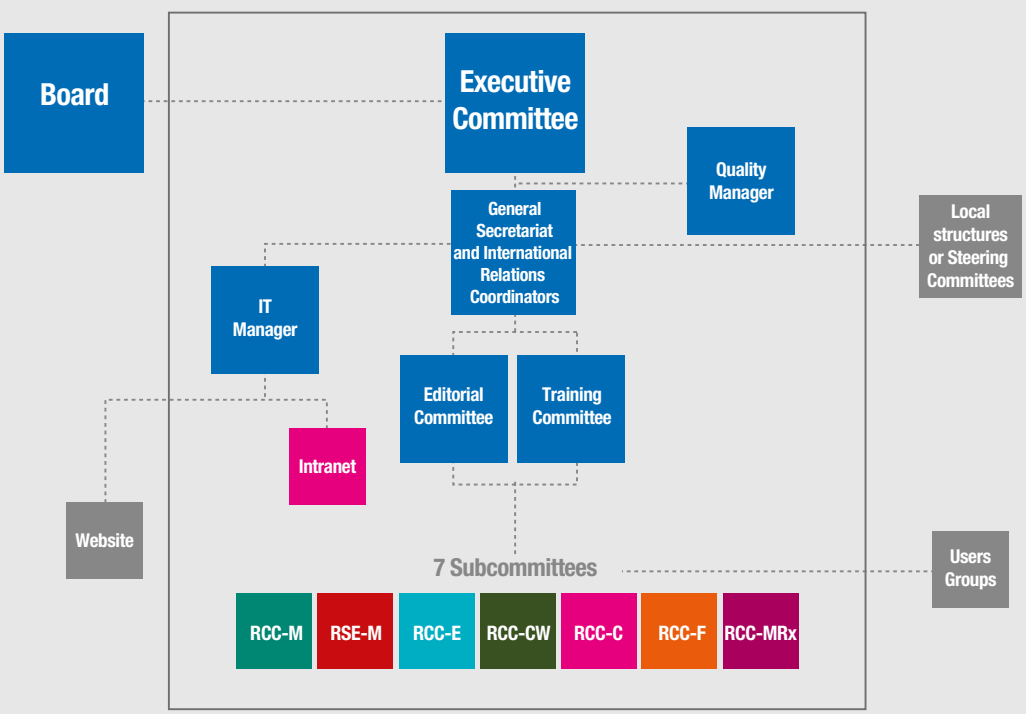
# A.1 ORGANIZATION AND OPERATION

## A.1.1 General organization

The general organization of AFCEN is detailed on the website *www.afcen.com* and represented in the diagram below.




AFCEN'S ORGANIZATIONAL STRUCTURE




GENERAL ORGANIZATION OF AFCEN

## A.1.2 General Meeting and Board of Directors

The AFCEN's Board of Directors members.

**LAURENT THIEFFRY**
PRESIDENT, EDF ADMINISTRATOR

**FRANÇOISE DE BOIS**
VICE-PRESIDENT TREASURER, FRAMATOME ADMINISTRATOR

PARTICIPATE IN BOARD MEETINGS

**LUCIEN ALLAIS**
CEA ADMINISTRATOR

**ÉRIC PROUST**
CEA ADMINISTRATOR

**MANUEL CARRASCO**
EDF ADMINISTRATOR

**NICOLAS GILLET**
FRAMATOME ADMINISTRATOR

**DIDIER HERVIEU**
GENERAL SECRETARY

**BRUNO MARQUIS**
DEPUTY GENERAL SECRETARY

AFCEN'S BOARD OF DIRECTORS

- In 2022, AFCEN's Board of Directors held two meetings, and members organized their General Meeting on June 24, 2022. During the General Meeting, members validated the :
- financial results for 2021, and the 2022 budget
- membership fees for 2023
- general strategic directions prepared by the Board of Directors

### AFCEN GENERAL ORIENTATIONS IN 2022

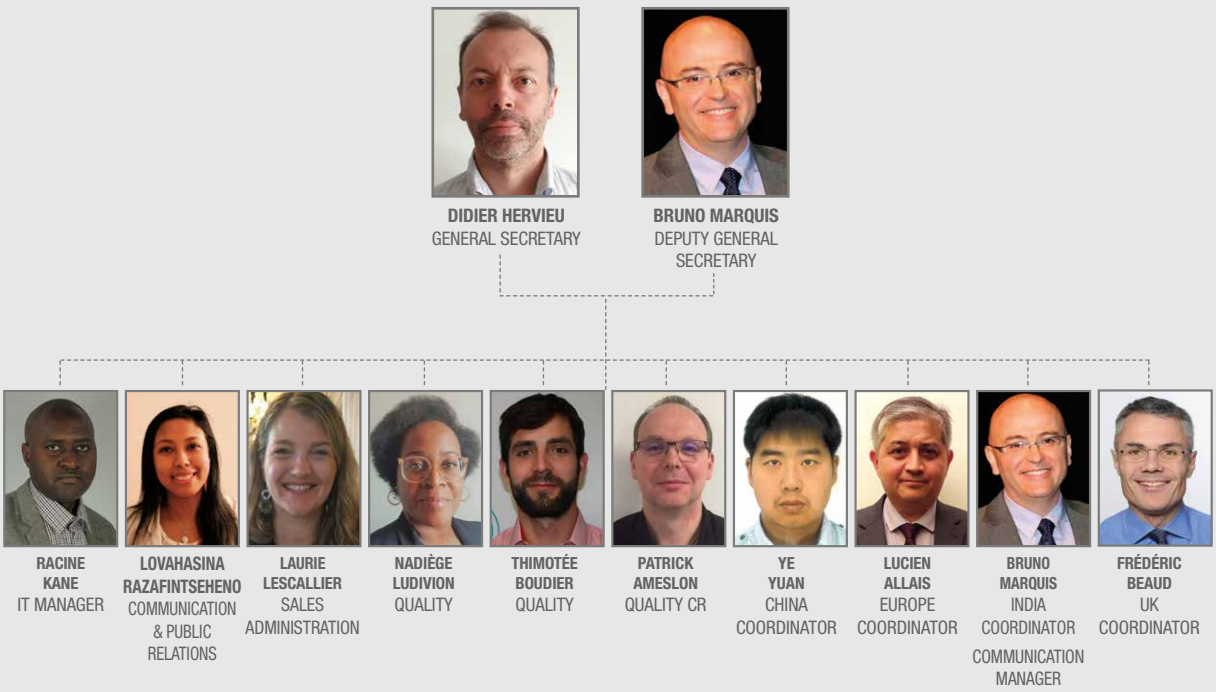
- In France, keep our commitments for conformity of mechanical construction code with French ESPN regulations and strengthen exchanges with the authorities
- Support EDF in preparation of PWR international nuclear offers and SMR
- Support the Major Order Givers in the implementation of the requirement to master AFCEN codes in the supplier qualification process
- Reinforce AFCEN international position to be reference in Europe
- Pursue the development of our open policy towards new members and reinforce their technical participation
- Strengthen and adapt to industrial demand the AFCEN certified training offer and code management tools
- Strengthen ties with GIFEN by opening a channel of exchange with members (GIFEN counter)
- Continue to implement digitalization within the Association
- Maintain AFCEN financial performance and organization efficiency

# A.1 ORGANIZATION AND OPERATION

## A.1.3 General Secretariat

The General Secretariat 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. It oversees AFCEN's communication and biennial international Congress, as well as the association's participation in international trade fairs, such as WNE.

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




AFCEN'S GENERAL SECRETARIAT

## A.1.4 Editorial Committee

The Editorial committee Chair and the Deputy Chairs are appointed by the Board of Directors. In addition to the Chair and the Deputy Chair in charge of ESPN programme, the Editorial Committee is attended by the Chairs from the 7 Subcommittees. The General Secretary and the Deputy General Secretary, 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 works programmes commissioned by the Editorial Committee.

**FRÉDÉRIC BEAUD**
CHAIRMAN OF THE EDITORIAL COMMITTEE

**HADRIEN LEROYER**
DEPUTY

**MANUELA TRIAY**
CHAIRMAN
OF THE RCC-M
SUBCOMMITTEE

**MATHIEU DOLL**
CHAIRMAN
OF THE RSE-M
SUBCOMMITTEE

**BENEDICT WILLEY**
CHAIRMAN
OF THE RCC-E
SUBCOMMITTEE

**GUILLAUME ZAMMOUT**
CHAIRMAN
OF THE RCC-CW
SUBCOMMITTEE

**KADER NIANG**
CHAIRMAN
OF THE RCC-C
SUBCOMMITTEE

**BERNARD GAUTIER**
CHAIRMAN
OF THE RCC-F
SUBCOMMITTEE

**CÉCILE PETESCH**
CHAIRWOMAN
OF THE RCC-MRx
SUBCOMMITTEE

AFCEN'S EDITORIAL COMMITTEE

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

The Editorial Committee oversees the quality of AFCEN's publications while giving special consideration to the safety, availability and technical/economic performance of nuclear facilities.

# A.1 ORGANIZATION AND OPERATION

The Editorial Committee's editorial programme 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 AFCEN's general meetings or any events organized by the Association, as well as during meetings between AFCEN and its different stakeholders (major projects, nuclear safety authority, etc.). The various international schemes set up by AFCEN (Users Groups, CEN/WS 64, etc.) are intended to ascertain potential requirements. These needs are addressed in the different Subcommittees or directly by the Editorial Committee where topics concern several Subcommittees.

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

**General activity of the Editorial Committee in 2022:**

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 programme (codes, overarching studies, ESPN programme, etc.) with subject presentations
e. Subcommittee reporting

In addition to amending the codes in the permanent working groups within each Subcommittee, dedicated working groups are regularly set up to examine specific technical subject areas at the request of the Subcommittees or Editorial Committee. As such, the ESPN programme led by the Editorial Committee coordinates a set of working groups focusing on the terms for applying the ESPN Regulation in relation to the RCC-M and RSE-M codes.

## A.1.5 Training Committee

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

Training programmes 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

**DIDIER HERVIEU**
DEPUTY

**RÉMI MORITZ**
MANAGER FOR TRAININGS ON RCC-M

**ANNE DE BUTTET**
MANAGER FOR TRAININGS ON RSE-M

**ISABELLE MORGADO ELLEBOODE**
MANAGER FOR TRAININGS ON RCC-E

**ALEXANDRE BOULE**
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

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 2022

The Training Committee held four meetings in March, June, September and December. These regular meetings enabled members to discuss:

- General information and latest news (conferences, international activities, organization and quality, etc.)
- Certified training (review of all agreements signed and certifications pending, number of training sessions delivered, etc.)
- Subcommittee reporting (certified training strategy, in-class evaluations, feedback from trainees, etc.)
- The actions required to guarantee and/or develop certified training courses, especially in light of the Covid-19 pandemic

The Training Committee has adapted to the health crisis accordingly. As part of a collaborative effort with the voluntary training organizations, virtual training sessions were carried out at the end of summer in accordance with the principles for certification. Certification has been arranged for distance learning courses, and three partners offer AFCEN-certified distance courses.
The training Committee consolidated 41 training courses and issued 434 certificates of attendance for courses on AFCEN codes.
The Training Committee has continued developing videos to present AFCEN codes. Videos are currently being produced for six codes.

# A.1 ORGANIZATION AND OPERATION

## A.1.6 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 2022**

In 2022, seven Subcommittees were active:

**. RCC-M:** Design and construction rules for mechanical components of PWR nuclear islands
**. RSE-M:** In-service inspection, installation and maintenance rules for mechanical components of PWR
**. 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 fuel assemblies of PWR nuclear power plants
**. RCC-F:** Design and construction rules for fire protection of PWR nuclear plants
**. RCC-MRx:** Design and construction rules for mechanical components of nuclear installations: 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.

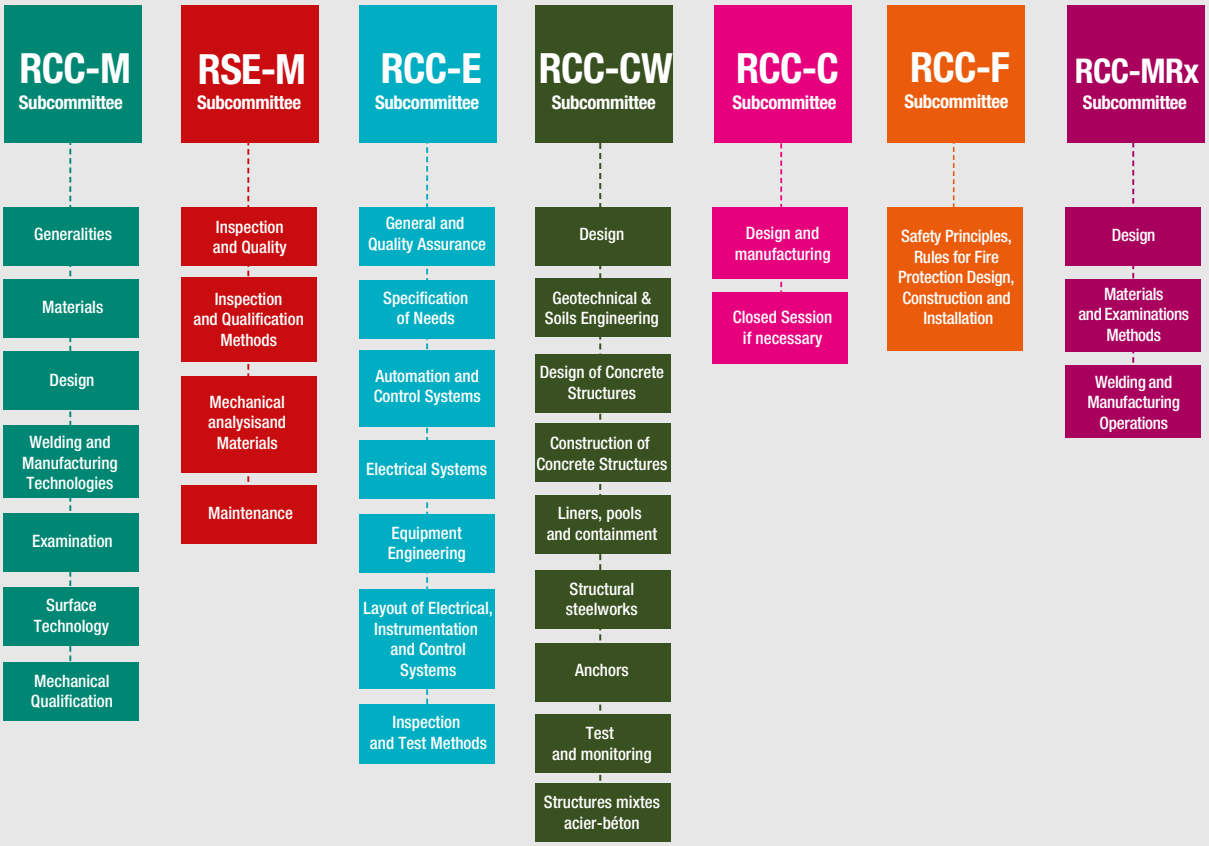
The Subcommittee Board represents the Subcommittee's decision-making and arbitration body, and features a Chair, a Vice-Chair and a restricted number of experts appointed by the Subcommittee Chair based on their skills. The Subcommittee Chair designates the working group leaders from the experts in the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




AFCEN'S SUBCOMMITTEES AND PERMANENT WORKING GROUPS

# A.1 ORGANIZATION AND OPERATION

## A.1.7 Users Groups

Users Groups are local structures (for each country and Subcommittee) that are responsible for coordinating code activities at the international level in liaison with local industry. 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 national Steering Committee coordinates activities of all the Users Groups in a given country. The 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 2022 in the UK :**
Three Users Groups are in operation in the UK.
The RCC-M Users Group is currently waiting to be reactivated.
The Users Group for the civil engineering codes postponed its 2022 session to June 2023.
The RCC-E Users Group held its first work session in May 2022.

**In 2022 in China:**
The Chinese Specialized Users Groups (CSUGs) successfully held their annual meetings despite the difficulties caused by the health situation in China, with AFCEN's experts taking part by videoconference: RCC-CW and RCC-E in January 2022, RSE-M and RCC-MRx in August 2022, and RCC-M in December 2022.
A new RCC-M training session was organized in Hangzhou in July 2022.

Note that the CSUGs also host the working groups between AFCEN and NEA (National Energy Administration) based on collaborative projects with Chinese standards, including the translation of AFCEN's codes into Chinese.

GENERAL ACTIVITY OF THE AFCEN CODE USERS GROUPS IN 2022

# A.2 AFCEN QUALITY MANAGEMENT

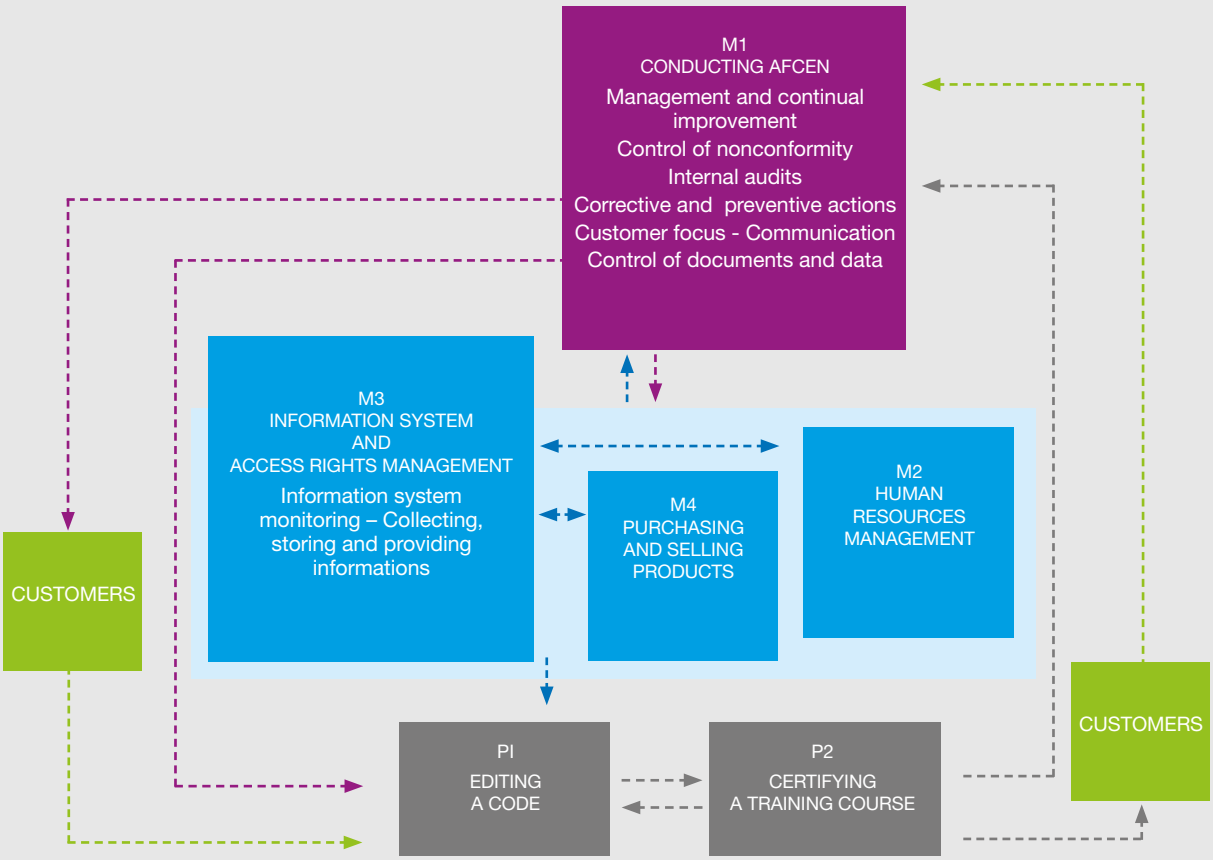
AFCEN has set up a process-based management system to perform its missions, namely produce and disseminate reference publications and codes for building, operating and using nuclear facilities.

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 programmes.

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.

# A.2 AFCEN QUALITY MANAGEMENT

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

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

AFCEN has been ISO 9001-certified since January 2014. In 2017, AFCEN migrated its quality management system to the 2015 version of ISO 9001. In 2022, the certification follow-up audit concluded that AFCEN's quality management system was sufficiently mature and effective.

AFCEN's general quality management activities in 2022 are summarized in the box below.

**Two internal audits were carried out in 2022 into the process for managing AFCEN and developing codes.**

Two process reviews were performed, one for managing kills and the other for managing information systems and access rights.

The AFCEN management review was held on February 9, 2022. It enabled the association to:

- identify key performance indicators
- check the actions taken to resolve any identified nonconformities and implement the association corrective actions,
- consider the interested parties and assess their expectations,
- decide what actions to implement to reduce risks and consider the opportunities of these processes
- analyse feedback from the WNE held in December 2021,
- check that the customer focus principle is correctly applied when dealing with requests from AFCEN members, and the French and English Safety Authorities.

An interim management review was organized and held on July 21, 2022, to:

- monitor the key performance indicators and decide on which actions should be taken,
- address any areas for concern identified during the internal audits.

The quality policy and strategy were communicated at every opportunity. In particular, the actions associated with the Strategic Plan were deployed, especially the resources component aimed at strengthening expertise in the drafting groups and developing experts' participation in AFCEN.

**Certification follow-up audit:**

On October 22, 2022, AFCEN passed the certification renewal audit on its quality management system (ISO 9001: 2015). The auditor highlighted a number of strengths, including the deployment of the 2021-2025 strategic plan with the action records for the strategic plan (M1), operational control of processes (P1 and P2), the level of protection of the information system (M3) and the increasing revenue, which proves that the association is in good health (M4).

AFCEN'S GENERAL QUALITY MANAGEMENT ACTIVITIES

# A.3 INFORMATION AND SALES SYSTEM

## A.3.1 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, ensures data security 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 2021, AFCEN continued offering training sessions for its main users in the collaborative space available to its expert members. Over 1,000 users have registered. Each Subcommittee manages its space independently. In 2021, efforts focused on keeping shared information up-to-date by the technical secretaries, using tables for numbering chronological lists and saving information.

Sharing the tables ensures faster access to information. The shared calendar featuring the main events is now operational.

## A.3.2 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 afcen.com website was given a makeover in 2020 to improve clarity and enhance the navigation experience.

The afcen.com website allows users to:

- purchase AFCEN's publications with access via the online library. Since 2019, users can also sign up for AFCEN's events on the website. Some publications are available free of charge.
- subscribe to the Association,
- access the forms for submitting interpretation and modification requests,
- discover the training courses on AFCEN's codes by our partners.

AFCEN applies the provisions required by the General Data Protection Regulation (GDPR) for information exchanges. AFCEN's data privacy policy and its terms and conditions of sale are available on the *www.afcen.com* website to ensure complete transparency.

## A.3.3 Sales model for AFCEN's publication

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,

# A.3 INFORMATION AND SALES SYSTEM

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.3.4 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.

In 2021, the SAGAWEB solution was gradually replaced with CObaz, a platform that offers users a wider range of features. There are plans to switch WEBPORT users over to CObaz by 2023 at the latest.

These solutions are aimed at both large industrial organizations and small businesses / industries, and are designed to provide users with 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 | Publications included in the subscription: RCC-M 2022 / RCC-M 2020 / RCC-M 2018 / RCC-M 2017 / RCC-M 2016 / RCC-M 2012 + addendum 2013, 2014, 2015 / RCC-M 2007 + addendum 2008, 2009, 2010 / RCC-M 2000 + addendum 2002 / Criteria 2014 RCC-M Prevention damage mechanical components / AFCEN-RM-13-067-A / AFCEN-RM-13-067-B / AFCEN-RM-14-309-A / AFCEN-RM-14-309-C / AFCEN-RM-15-001-A / AFCEN-RM-15-149-B / AFCEN-RM-15-149-C / AFCEN-RM-15-150-A / AFCEN-RM-15-166-A / AFCEN-RM-15-166-C / AFCEN-RM-16-218-C / AFCEN-RM-16-263-A / AFCEN-RM-16-264-A / AFCEN-RM-16-271-D / AFCEN-RM-16-274-D / AFCEN-RM-16-282-C / AFCEN-RM-16-455-B / AFCEN-RM-17-094-B / AFCEN-RM-17-110-B / AFCEN-RM-17-428-B / AFCEN-RM-17-461-B / AFCEN-RM-18-018-C / AFCEN-RM-18-056-A / AFCEN-RM-18-198-B / AFCEN-RM-19-327-A / PTAN 2020 AIP conception fabrication / AFCEN-PTAN-01001-2022 | • | / | / | 2600 |
| RCC-M 2022 | Design and Construction Rules for Mechanical Components of PWR Nuclear Islands | FR, EN | 2 950 | / | Cf. Subscription |
| RCC-M 2020 | Design and Construction Rules for Mechanical Components of PWR Nuclear Islands | FR, EN | 2 950 | / | |
| RCC-M 2018 | Design and Construction Rules for Mechanical Components of PWR Nuclear Islands | FR, EN | 2 950 | / | |
| 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 + addendum 2013, 2014, 2015 | Design and Construction Rules for Mechanical Components of PWR Nuclear Islands | FR, EN | 2 820 | / | |
| RCC-M 2007 + addendum 2008, 2009, 2010 | Design and Construction Rules for Mechanical Components of PWR Nuclear Islands | FR, EN | / | 1 620 | |
| RCC-M 2000 + addendum 2002 | Design and Construction Rules for Mechanical Components of PWR Nuclear Islands | FR | / | 1 620 | |
| Criteria 2014 RCC-M Prevention damage mechanical components | Prevention of damages in mechanical components. Introduction to the design, analysis and construction rules of the RCC-M | FR, EN | 1 590 | 1 540 | |
| AFCEN-RM-13-067-A | Radiation protection guide for the design of Nuclear Pressure Equipment for PWR plants in France | FR, EN | / | 30 | |
| AFCEN-RM-13-067-B | Guide de radioprotection pour la conception des équipements sous pression nucléaires des centrales REP installées en France (rev B) | FR | / | 30 | |
| AFCEN-RM-14-309-A | Guide Analyse de risques pour ESPN N1 (rev A) | FR | / | 210 | |
| AFCEN-RM-14-309-C | Guide Analyse de risques pour ESPN N1 (rev C) | FR | / | 255 | |
| AFCEN-RM-15-001-A | 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 | |
| AFCEN-RM-15-149-B | Guide de l'inspectabilité pour la conception des équipements sous pression nucléaires de niveau N1 des centrales REP installées en France (rev B) | FR | / | 30 | |
| AFCEN-RM-15-149-C | Inspectability guide for the design of N1 level nuclear pressure equipment of PWR plants installed in France (rev C) | FR, EN | / | 40 | |
| AFCEN-RM-15-150-A | Dimensional reference standard of N1 nuclear pressure equipments | FR, EN | / | 85 | |
| AFCEN-RM-15-166-A | Guide for the contents of the operating instructions for nuclear pressure equipment | FR, EN | / | 85 | |
| AFCEN-RM-15-166-C | Guide pour le contenu de la notice d'instructions d'un équipement sous pression nucléaire | FR | / | 65 | |
| AFCEN-RM-16-218-C | Methodological guide for preparing NPMAs for N2/N3 nuclear pressure equipment | FR, EN | / | 80 | |
| AFCEN-RM-16-263-A | Note support à la rédaction des EPMN pour équipements ESPN N1*, N2 et N3<br>Corrosion des aciers inoxydables austénitiques et austéno-ferritiques | FR | / | 145 | |
| AFCEN-RM-16-264-A | Note support à la rédaction des EPMN pour équipements ESPN N2 et N3 Vieillissement thermique des aciers inoxydables austénitiques et austéno-ferritiques | FR | / | 135 | |
| AFCEN-RM-16-271-D | Guide sur les modalités de réalisation de la Vérification Visuelle dans le cadre de l'Examen Final | FR | / | 25 | |
| AFCEN-RM-16-274-D | Guideline about the execution of manufacturing visual examinations requested by the hazard analysis | FR, EN | / | 25 | |
| AFCEN-RM-16-282-C | Identification of allowable limits of the MPS/MSS (Application of the Nuclear Pressure Equipment (ESPN) Order) | FR, EN | / | 50 | |
| AFCEN-RM-16-455-B | Référentiel dimensionnel des équipements sous pression nucléaires N1*, N2 ou N3 | FR, EN | / | 80 | |
| AFCEN-RM-17-094-B | Analysis of the regulatory texts for the classification of the parts of a valve type pressure accessory and of a safety valve type safety accessory | FR, EN | / | 60 | |
| AFCEN-RM-17-110-B | Analyses de risques pour les équipements ESPN de niveau N2 fabriqués selon RCC-M | FR | / | 325 | |
| AFCEN-RM-17-428-B | Guide de conception des SRMCR installés sur les REP pour protéger les ESPN de niveau N2 ou N3 | FR | / | 95 | |
| AFCEN-RM-17-461-B | Guide de l'inspectabilité pour la conception des équipements sous pression nucléaires de niveau N2 ou N3 des centrales REP installées en France | FR | / | 30 | |
| AFCEN-RM-18-018-C | Identification of allowable limits of nuclear pressure equipmentexcluding MPS/MSS (Application of the Nuclear Pressure Equipment (ESPN) Order) | FR, EN | / | 45 | |
| AFCEN-RM-18-056-A | Retention of Material resulting from the Manufacture of parts of Level 1 Nuclear | FR, EN | / | 70 | |

| Codes and publications | Description | Available lang. | Paper book format (€ excl tax) | PDF single format (€ excl tax) | Subscription format* (€ HT) |
|---|---|---|---|---|---|
| AFCEN-RM-18-198-B | Guide méthodologique pour la surveillance de la fabrication des composants non soumis à qualification technique spécifique | FR | / | 70 | Cf. Subscription |
| AFCEN-RM-19-327-A | Qualification technique ESPN | FR | / | 845 | |
| PTAN 2020 AIP conception fabrication | Démarche d'identification des AIP et des exigences définies relatives à l'intégrité pour la conception et la fabrication des équipements sous pression nucléaires | FR | / | 125 | |
| AFCEN-PTAN-01001-2022 | Démarche méthodologique pour le traitement des non-conformités lors de la fabrication des équipements neufs N1 de catégorie de risque I à IV : principes, processus, difficultés et bonnes pratiques | FR | / | Free | |
| Subscription RSE-M | Publications included in the subscription: RSE-M 2022 / RSE-M 2020 / RSE-M 2018 / RSE-M 2017 / RSE-M 2016 / RSE-M 2010 + addendum 2012, 2013, 2014, 2015 / AFCEN-RS-16-007-E / AFCEN-RS-16-009-B / AFCEN-RS-16-010-E / AFCEN-RS-16-018-A / AFCEN-RS-17-019-A / AFCEN-RS-17-022-B / AFCEN-RS-18-003-A / AFCEN-RS-18-004-C / AFCEN-RS-18-005-A / AFCEN-RS-18-006-A / AFCEN-RS-18-007-A / AFCEN-RS-18-026-A / AFCEN-RS-19-013-A | • | / | / | 1600 |
| RSE-M 2022 | In-Service Inspection, Installation and Maintenance Rules for Mechanical Components of PWR | FR, EN | 1 760 | / | Cf. Subscription |
| RSE-M 2020 | In-Service Inspection, Installation and Maintenance Rules for Mechanical Components of PWR | FR, EN | 1 760 | / | |
| RSE-M 2018 | In-Service Inspection, Installation and Maintenance Rules for Mechanical Components of PWR | FR, EN | 1 760 | / | |
| 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 + addendum 2012, 2013, 2014, 2015 | In-Service Inspection Rules for Mechanical Components of PWR Nuclear Islands | FR, EN | 1 760 | / | |
| AFCEN-RS-16-007-E | Guide for Periodic Requalification of Class N2 or N3 ESPN piping | FR, EN | / | 45 | |
| AFCEN-RS-16-009-B | Professional guide to repairs and modifications of nuclear pressure equipment subject to Points 1 to 4 of Appendix V of the amended Order of 12/30/2015 | FR, EN | / | Free | |
| AFCEN-RS-16-010-E | Professional guide to significant repairs/modifications of nuclear pressure equipment subject to Points 1 to 4 of Appendix V of the amended Order of 12/30/2015. This guide applies to revision E with PTAN AFCEN-RS-18-006-A and AFCEN-RS-16-009-B. | FR, EN | / | 110 | |
| AFCEN-RS-16-018-A | Principle and substantiation for taking Warm Pre-Stressing (WPS) into account in PWR vessel fact fracture resistance criterion | FR, EN | / | 85 | |
| AFCEN-RS-17-019-A | Appendix 5.4 of RSE-M: Principles of and background to the formulation of analytical methods for calculating stress intensity factors and the J integral for a planar defect. | FR, EN | / | 210 | |
| AFCEN-RS-17-022-B | Professional guide for the design and manufacture of main pressure parts (MPP) intended for nuclear pressure Equipment in the MPS-MSS | FR, EN | / | Free | |
| AFCEN-RS-18-003-A | Professional guide covering the requirements and procedures for assessing the conformity of permanent joints used to install NPEs that are subject to Appendix V, paragraph 4.1.a of the amended order of 12/30/2015 | FR, EN | / | Free | |
| AFCEN-RS-18-004-C | Guide méthodologique de la protection pour l'installation d'un ESPN | FR | / | Free | |
| AFCEN-RS-18-005-A | Guide professionnel pour les dispositions d'installation d'un ESPN soumis au point 5 de l'annexe V de l'arrêté du 30/12/2015 modifié | FR | / | Free | |
| AFCEN-RS-18-006-A | Professional guide to the requirements applicable to repairs and modifications of nuclear pressure equipment subject to Points 1 to 4 of Appendix V of the amended Order of 12/30/2015 and procurement of parts for this purpose. This guide applies with PTAN AFCEN-RS-16-009-B and AFCEN-RS-16-010-E | FR, EN | / | Free | |
| AFCEN-RS-18-007-A | Guide professionnel pour les intervention ssur des ESPN du CPP-CSP | FR | / | 40 | |
| AFCEN-RS-18-026-A | Principles of and background to the formulation of the criteria in Appendix 5.5 of the RSE-M code relating to the fast fracture strength of pressure equipment displaying a planar defect during operation | FR, EN | / | 110 | |
| AFCEN-RS-19-013-A | Guide to Qualification of NDT processes using ultrasound Establishing performance data | FR, EN | / | 80 | |
| Subscription RCC-E | Publications included in the subscription: RCC-E 2022 / RCC-E 2019 / RCC-E 2016 / RCC-E 2012 / Gap analysis RCC-E 2019 - 2022 (only EN) / Gap analysis RCC-E 2016 - 2019 (only EN) / Gap analysis RCC-E 2005 - 2012 (only EN) / Gap analysis RCC-E 2012 - 2016 (only EN) / PTAN 2019 RCC-E Guidebook for defining RCC-E 2019 Book of Project DATA / PTAN 2019 RCC-E Qualification en classe 3 / AFCEN-PTAN-05001-2022 | • | / | / | 950 |
| RCC-E 2022 | Design and construction rules for electrical and I&C systems and equipment | FR, EN | 1 000 | / | Cf. Subscription |
| RCC-E 2019 Gap Analysis RCC-E 2016-2019 | Design and construction rules for electrical and I&C systems and equipment + PTAN Guidebook for defining RCC-E 2019 Book of Project DATA | FR, EN | 1 000 | / | |
| RCC-E 2016 Gap analysis RCC-E 2012 - 2016 | Design and construction rules for electrical and I&C systems and equipment | FR, EN | 1 000 | / | |
| RCC-E 2012 Gap analysis RCC-E 2005 - 2012 | Design and construction rules for electrical equipment of nuclear islands | FR, EN | 625 | / | |
| PTAN 2019 RCC-E Qualification Classe 3 | Class 3 design qualification of systems using equipment families certified according to IEC 61508 | FR, EN | / | 45 | |
| AFCEN-PTAN-05001-2022 | Prescriptions pour la prise en compte de la cybersécurité lors de la conception des systèmes de contrôle-commande | FR | / | 110 | |

# B PUBLICATIONS PRICES

| 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 2021 / RCC-CW 2020 / RCC-CW 2019 / RCC-CW 2018 / RCC-CW 2017 / RCC-CW 2016 / RCC-CW 2015 / ETC-C 2012 / ETC-C 2010 / PTAN 2015 RCC-CW seismic isolation / PTAN 2018 RCC-CW Seismic Dissipative Devices | • | / | / | 1430 |
| RCC-CW 2021 | Rules for design and construction of PWR nuclear civil works | FR, EN | 1 500 | / | Cf. Subscription |
| RCC-CW 2020 | Rules for design and construction of PWR nuclear civil works | FR, EN | 1 500 | / | |
| RCC-CW 2019 | Rules for design and construction of PWR nuclear civil works | FR, EN | 1 500 | / | |
| RCC-CW 2018 | Rules for design and construction of PWR nuclear civil works | FR, EN | 1 500 | / | |
| 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 EN version 1 060 | 1 010 | |
| ETC-C 2010 | EPR Technical Code for Civil Works | FR, EN | 820 | 780 | |
| PTAN 2015 RCC-CW seismic isolation | French experience and practice of seismically isolated nuclear facilities | FR, EN | / | 190 | |
| PTAN 2018 RCC-CW seismic dissipative devices | Study report on seismic dissipative devices | EN | / | 390 | |
| Subscription RCC-C | Publications included in the subscription: RCC-C 2022 / RCC-C 2020 / RCC-C 2019 / RCC-C 2018 / RCC-C 2017 / RCC-C 2015 / RCC-C 2005 + addendum 2011 / PTAN 2019 RCC-C Qualification OCS | • | / | / | 820 |
| RCC-C 2022 | Design and construction rules for fuel assemblies of PWR nuclear power plants | FR, EN | 850 | / | Cf. Subscription |
| RCC-C 2020 | Design and construction rules for fuel assemblies of PWR nuclear power plants | FR, EN | 850 | / | |
| RCC-C 2019 | Design and construction rules for fuel assemblies of PWR nuclear power plants | FR, EN | 850 | / | |
| RCC-C 2018 | Design and construction rules for fuel assemblies of PWR nuclear power plants | FR, EN | 850 | / | |
| 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 + addendum 2011 | Design and construction rules for fuel assemblies of PWR nuclear power plants | FR, EN | 725 | / | |
| PTAN 2019 RCC-C Qualification OCS | Qualification of scientific computing tools used in the nuclear safety case – 1st barrier | FR, EN | / | 50 | |
| Subscription RCC-F | Publications included in the subscription: RCC-F 2020 / RCC-F 2017 / ETC-F 2013 / ETC-F 2010 / Gap Analysis RCC-F 2020 (only EN version) / PTAN RCC-F 2020 Compatibilty analysis with reference documents | • | / | / | 380 |
| RCC-F 2020 Gap Analysis RCC-F 2020 | Design and Construction rules for fire protection of PWR nuclear plants | FR, EN | 400 | / | Cf. Subscription |
| RCC-F 2017 | Design and Construction rules for fire protection of PWR nuclear plants | FR, EN | 400 | / | |
| ETC-F 2013 | Design and Construction rules for fire protection of PWR nuclear plants | FR, EN | 400 | / | |
| ETC-F 2010 | Design and Construction rules for fire protection of PWR nuclear plants | FR, EN | 275 | / | |
| PTAN RCC-F 2020 Compatibility analysis with reference documents | RCC-F 2020 Compatibility analysis with reference documents – WENRA SRL 2014 | EN | / | 65 | |
| Subscription RCC-MRx + RCC-MR | Publications included in the subscription: RCC-MRx 2022 / RCC-MRx 2018 / RCC-MRx 2015 / RCC-MRx 2012 + addendum 2013 / RCC-MRx 2007 / PTAN 2017 RCC-MRx new material / PTAN 2018 RCC-MRx seismic analysis components | • | / | / | 2670 |
| RCC-MRx 2022 | Design and Construction Rules for Mechanical Components of nuclear installations : high-temperature, research and fusion reactors | FR, EN | 2 940 | / | Cf. Subscription |
| RCC-MRx 2018 | Design and Construction Rules for Mechanical Components of nuclear installations : high-temperature, research and fusion reactors | FR, EN | 2 940 | / | |
| 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 + 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 2017 RCC-MRx new material | Guide for introducing a new material in the RCC-MRx: requirements and recommendations for obtaining the data necessary for preparing the Properties Groups for the materials in Appendix A3 of RCC-MRx | FR, EN | / | 100 | |
| PTAN 2018 RCC-MRx seismic analysis components | Guide for seismic analysis of components: recommendations for the seismic design of equipment according to Appendix A1 of RCC-MRx | FR, EN | / | 65 | |
| EVALUATION GUIDES | | | | | |
| AFCEN-CF-22-002-A | Guide 0 d'évaluation de l'expérience des fabricants et fournisseurs mettant en oeuvre le RCC-M | FR | / | Free | |
| AFCEN-CF-22-014-A | Guide n° 1 d'évaluation du niveau de maîtrise du RCC-M par les fournisseurs – Version allégée | FR | / | Free | |
| AFCEN-CF-22-015-A | Guide n° 1 d'évaluation du niveau de maîtrise du RCC-M par les fabricants – Version allégée | FR | / | Free | |
| AFCEN-PTAN-02001-2022 | Guide d'évaluation au code RCC-E hors "installation" et "systèmes électriques" | FR | / | Free | |

• 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 February 2023

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# CATALOG OF TRAININGS CERTIFIED BY AFCEN
## January 2023

| 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 the RCC-M code | 1 d | French | APAVE |
| | M-003 | | Control methods according to the RCC-M code | 1 d | French | APAVE |
| | M-006 | | Understanding of the RCC-M code | 2 d | French | APAVE |
| | M-007 | | RCC-M code introduction | 2 d | French / English | BUREAU VERITAS |
| | M-008 | | Design - Sizing according to RCC-M code Materials Lev. 2 and 3 | 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 | French/English | BUREAU VERITAS |
| | M-012 | | Introduction to the use of the code RCC-M | 3 d | French/English | BUREAU VERITAS |
| | M-013 | | RCC-M code training ed.2012 (+add.2015) | 4 d | English | 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 / English | VINCOTTE |
| | M-016 | | Discovering RCC-M code | 4 d | French / English | FRAMATOME |
| | M-017 | | RCC-M code | 5 d | Chinese | SNPI (GROUPE CGN) |
| | M-018 | | RCC-M 2018 - Level 2 & 3 | 3 d | French | SICA |
| | M-019 | | Knowing and applying the code RCC-M | 4 d | French / English | SOCOTEC |
| | M-020 | | Discovery of RCC-M code | 1 d | French / English | SOCOTEC |
| | M-021 | | RCC-M in application of the ESPN | 2 to 5 d | French | FRAMATOME |
| | M-022 | | RCC-M code training (without design) | 4 d | English | BUREAU VERITAS |
| | M-023 | | RCC-M code training (with design) | 4 d | English | BUREAU VERITAS |
| | EM-001 | RSE-M | Introduction to the use of the code RSE-M | 3 d | French | BUREAU VERITAS |
| | EM-002 | | Use of the RSE-M code and its reference document | 5 d | French | EDF UFPI |
| | MRx-001 | RCC-MRx | Discovering the code RCC-MRx | 3 d | French / English | FRAMATOME |
| | MRx-002 | | RCC-MRx - Experimental Reactor Specific Construction Code | 3 d | French / English | BUREAU VERITAS |
| | MRx-003 | | Discovery of the code RCC-MRx | 3 d | French | INSTN |
| | MRx-004 | | Discovery of the code RCC-MRx | 2 d | French / English | BUREAU VERITAS |
| Civil Engineering | CW-001 | RCC-CW | Civil engineering for nuclear (ETC-C and RCC-W) : Construction | 2 d | French / English | ECOLE DES PONTS |
| | CW-002 | | Civil engineering for nuclar (ETC-C and RCC-CW) : Design | 3 d | French / English | ECOLE DES PONTS |
| | CW-003 | | Civil engineering for nuclear (ETC-C and RCC-CW) : General introduction | 1 d | French / English | ECOLE DES PONTS |
| | E-002 | RCC-E | RCC-E 2012 - Qualification and manufacturing of an electrical equipment | 3 d | French/English | SICA |
| | E-003 | | RCC-E 2016 - Qualification and manufacturing of an electrical equipment | 3 d | French/English | SICA |
| | E-004 | | RCC-E 2012 - Specialisation "Inspection" | 1 d | French | SICA |
| | E-005 | | RCC-E 2012 - Qualification and manufacturing of an electrical equipment | 2 d | French | SICA |
| | E-006 | | RCC-E 2016 - Qualification and manufacturing of an electrical equipment | 2 d | French/English | SICA |
| | E-007 | | RCC-E 2016 - Overview | 1 d | French/English | SICA |
| | E-008 | | Upgrade RCC-E 2012 - 2016 | 1 d | French/English | SICA |
| | E-009 | | RCC-E 2019 - Qualification and manufacturing of an electrical equipment | 3 d | French/English | SICA |
| | E-010 | | Upgrade RCC-E 2012 - 2016 - 2019 | 1 d | French | SICA |
| | E-011 | | RCC-E 2019 - Qualification and manufacturing of an electrical equipment | 2 d | French/English | SICA |
| | E-012 | | Upgrade RCC-E 2012 - 2016 - 2019 | 1 d | French | SICA |
| | E-013 | | RCC-E 2019 - Qualification and manufacturing of an electrical equipment | 2 d | French / English | SICA |
| Fuel | C-001 | RCC-C | Complete training on the Code | 2 d | French / English | UFPI |
| Fire protection | F-001 | RCC-F | ETC-F : fire protection conception and construction rules | 4 d | French | 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**

# GLOSSARY

| | FR | EN |
|---|---|---|
| **ASN** | AUTORITÉ DE SÛRETÉ NUCLÉAIRE | FRENCH SAFETY AUTHORITY |
| **CEN** | COMITÉ EUROPÉEN DE NORMALISATION | - |
| **CSUG** | | CHINESE SPECIALIZED USERS GROUPS |
| **DI/ IR** | DEMANDE D'INTERPRÉTATION | INTERPRETATION REQUEST |
| **DM/MR** | DEMANDE DE MODIFICATION | MODIFICATION REQUEST |
| **ECCC** | | EUROPEAN CONSULTATIVE CREEP COMMITTEE |
| **EERA** | ALLIANCE EUROPÉENNE DE LA RECHERCHE ÉNERGÉTIQUE | EUROPEAN ENERGY RESEARCH ALLIANCE |
| **EPMN** | EVALUATION PARTICULIÈRE MATÉRIAUX NUCLÉAIRE | - |
| **ESNII** | - | EUROPEAN SUSTAINABLE NUCLEAR INDUSTRIAL INITIATIVE |
| **ETSON** | - | EUROPEAN TECHNICAL SAFETY ORGANIZATION NETWORK |
| **ESPN** | EQUIPEMENT SOUS PRESSION NUCLÉAIRE | - |
| **FM** | FICHE DE MODIFICATION | MODIFICATION FORM |
| **GDA** | - | GENERIC DESIGN ASSESMENT |
| **GEMMA** | - | GENERATION IV MATERIALS MATURITY (PROJET EUROPÉEN H2020) |
| **GFR** | - | GAS FAST REACTOR |
| **GK** | GRAND CARÉNAGE | - |
| **GMPP** | GROUPE MOTORISÉ DES POMPES PRIMAIRES | REACTOR COOLANT PUMP |
| **GR** | GROUPE DE RÉDACTION | - |
| **GSEN** | GROUPEMENT POUR LA SECURITÉ DES EQUIPEMENTS NUCLÉAIRES | - |
| **JPNM** | - | JOINT PROGRAMME ON NUCLEAR MATERIALS |
| **INNUMAT** | - | INNOVATIVE STRUCTURAL MATERIALS FOR FISSION AND FUSION (PROJET EURATOM) |
| **KTA** | - | GERMAN NUCLEAR SAFETY STANDARDS COMMISSION (KERNTECHNISCHER AUSSCHUSS - KTA) |
| **LFR** | - | LEAD FAST REACTOR |
| **MCG** | MÉCANISME COMMANDE DE GRAPPE | CONTROL ROD DRIVE MECHANISM |
| **MNE** | - | MASTER OF NUCLEAR ENERGY |
| **MOU** | - | MEMORENDUM OF UNDERSTANDING |
| **NB** | NORMES CHINOISES NATIONALES | - |
| **NEA** | - | NUCLEAR ENERGY ADMINISTRATION (IN PRC) |
| **NFPA** | - | NUCLEAR FIRE PROTECTION ASSOCIATION |
| **NUCOBAM** | - | NUCLEAR COMPONENTS BASED ON ADDITIVE MANUFACTURING (PROJET EUROPÉEN H2020) |
| **OCDE** | ORGANISATION DE COOPÉRATION ET DE DÉVELOPPEMENT ÉCONOMIQUE | - |
| **ONR** | - | OFFICE FOR NUCLEAR REGULATION |
| **PG** | - | PROSPECTIVE GROUP |
| **PG** | - | PROJECT GROUPS |
| **PTAN** | PUBLICATION TECHNIQUE DE L'AFCEN | - |
| **R&D** | RECHERCHE ET DÉVELOPPEMENT | - |
| **SDO** | - | STANDARD DEVELOPMENT ORGANIZATION |
| **SG** | SECRÉTARIAT GÉNÉRAL | - |
| **SWOT/** | - | STANDARD DEVELOPMENT ORGANIZATION |
| **MOFF** | MENACES OPPORTUNITÉS FORCES FAIBLESSES | STRENGTHS, WEAKNESSES, OPPORTUNITIES, THREADS |
| **TBM** | - | TEST BLANKET MODULE |
| **TOFD** | - | TIME OF FLIGHT DIFFRACTION |
| **TS** | - | TECHNICAL SECRETARY |
| **TSO** | - | TECHNICAL SAFETY ORGANIZATION |
| **UT** | - | ULTRASONIC TEST |
| **WS** | - | WORKSHOP |

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