

## Adoption of the RCC-M Code by the UK Supply Chain for New Build EPR Reactors

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### Abstract

The UK's new build EPR reactors at Hinkley Point C and Sizewell C are specified to meet the requirements of the RCC-M code for the Design and Conception of Mechanical Components of PWR Nuclear Islands. RCC-M has been developed through the organisation of AFCEN<sup>1</sup>, and has been extensively applied in France and China. However, knowledge and experience of applying the code by companies involved in the manufacture and installation of nuclear island components in other countries is relatively limited. Some upper tier UK companies have successfully applied the code, but there is a need to build knowledge and experience through the whole supply chain.

This paper will describe the formation and operation of the RCC-M UK User Group, which aims to fill this gap. It will highlight some of the technical issues and practices of the code that UK companies are facing. The paper will also consider the approach that companies need to follow to qualify new technology that may not currently be within the scope of the code.

Finally, the paper will describe the co-operation that has been generated between the UK supply chain and the AFCEN code committees. The UK User Group is leading to an exchange of ideas and technology that will drive development of the code in future. The aim is for the RCC-M code to be capable of practical application in other countries seeking to build new nuclear power plant.

### INTRODUCTION

The UK's new build European Pressurised Reactors (EPRs) at Hinkley Point C and Sizewell C are specified to meet the requirements of the RCC-M code, AFCEN (2012), for the Design and Conception of Mechanical Components of PWR Nuclear Islands. RCC-M has been developed through the organisation of AFCEN<sup>1</sup> and has been extensively applied in France and China, Malouines (2012, 2014, 2015). However, knowledge and experience of applying the code by UK supply chain companies who will be involved in the manufacture and installation of nuclear island components is relatively limited.

Recognising a need for greater understanding of the code in the UK, AFCEN approached TWI in 2012 with the suggestion of setting up a RCC-M UK User Group for UK supply chain companies. This has led to the establishment of the RCC-M UK User Group under the Chairmanship of TWI. This paper will describe the formation and operation of the RCC-M UK User Group and some of the issues that have arisen during its meetings. It will also highlight the relationship between the code and its implementation within a UK project and regulatory context.

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<sup>1</sup> AFCEN – French Association for Design, Construction and In-service Inspection Rules for Nuclear Islands

## **DEVELOPMENT OF AFCEN AND THE RCC-M CODE**

When the French government decided to launch a large nuclear programme, in the context of the first petroleum crises in the 1970's, the decision was taken to follow American rules (ASME III) for the design of nuclear island components. Procurement, manufacturing and examination of components would meet the relevant French and European standards. The first three loop and four loop (P4) plants were built according to this approach, with many adaptations for practical reasons to agree on practices consistent with those approved by the French Safety Authority and utility EdF.

The leading companies to set the new code rules were the main contractors to the French nuclear programme (Framatome and Novatome, both since integrated in Areva), and the utility EdF. Component manufacturers were associated to provide inputs or advice but were not involved in the decision-making process at this time. The first RCC-M code was produced in 1979 and formed the contractual basis of the second set of four loops plants (called P4)

At the same time it was recognised that codes would be necessary to cover other areas of nuclear construction, such as civil and electrical engineering, and the design of high temperature fast reactors, and in-service inspection and repair of existing reactors. When all the conditions were met for creating new codes, it was decided to create a specific organization to manage and develop codes for nuclear power plant that was not involved in contractual relationships. Thus AFCEN was created on 19 October, 1980.

The founders of AFCEN worked together on many applications of the code. The development of EPR needed special agreement, for which a specific partnership was established with German nuclear companies and the French/German Authority for the safety assessment of the EPR, Grandemange (1997).

In 1997 the European Pressure Equipment Directive (PED) n° 97/23/EC came into force, EU (1997). Due to the exclusion of nuclear pressure equipment from the scope of the PED, French Nuclear Regulators enacted the PED in France, by a specific Order dated December 12<sup>th</sup>, 2005 called "ESPN Order", (2006). It was important for AFCEN to demonstrate compliance with the new regulatory framework and to propose rules so that any utility or supplier could meet the requirements with full transparency. AFCEN now has the status, and internal regulations of an open association of legal entities ("Members" under French law). The Members are companies and other entities that have an interest in developing or applying the AFCEN codes. Representatives of Members sit on various AFCEN committees.

The status of AFCEN and its internal rules were recognized under French Law 1901 concerning Associations in February 2010. In February 2011, quality management based on NF EN ISO 9001: 1995 was replaced with the requirements of NF EN ISO 9001:2008 and some requirements of Nuclear Management System of IAEA GS-R-3:2006, IAEA (2006). AFCEN has obtained NF EN ISO 9001 2008 certification in December 2013 from Bureau-Veritas Consulting.

Since its conception, the AFCEN organisation has evolved. Each major code has a Subcommittee reporting to a main Board of Governors. AFCEN has Editing and Training Committees to ensure consistency of standards across the codes. Each Subcommittee has Working Groups dealing with maintenance, development and drafting of specific parts of each code. For example, the RCC-M code has Working Groups concerned with Generalities, Design, Materials, Fabrication Technology (including welding), Inspection Methods, Qualification and Surface Technology.

## **ESTABLISHMENT OF USER GROUPS**

AFCEN has Framework Agreements with different entities to co-ordinate interactions with Users of the codes who may choose not to become Members. Within **Europe** by 2014 AFCEN has established three

Framework Agreements, including one on RCC-M, as well as those signed 4 years ago on RCC-MRx. It is called CEN Working Agreement (CWA) 064 Phase 2, and RCC-M Group is PG1. The Chairperson of PG1 is from French Technical Support of French Nuclear Authority (IRSN), and the Secretariat is delegated by CEN to French Standardization Association AFNOR.

In **UK**, AFCEN has a Framework Agreement with The Welding Institute (TWI). TWI convenes a meeting of UK suppliers using the RCC-M code and prepares and communicates to the RCC-M Subcommittee Requests for Modification and Interpretation in adequate form. This facilitates the work of assessment of the RCC-M Subcommittee. In **China**, AFCEN has signed a Memorandum of Understanding with the China National Nuclear Cooperation and the China Guangdong Nuclear Power Holding Corporation. These companies organize meetings with RCC-M Users in China, with AFCEN experts delegated to transfer to the Sub Committee Modification and Interpretation Requests in French or English, and to ensure that the Sub Committee deals with these in a timely fashion.

### **PURPOSES AND OPERATION OF THE RCC-M UK USER GROUP**

The general purpose of the RCC-M UK User Group is to assist UK nuclear supply chain businesses to understand and use the RCC-M code. Specific purposes include but are not restricted to those listed in Table 1. The Group focuses on industrial, practical and technical matters associated with use of the RCC-M code. It does not enter into any discussions of an overtly commercial nature.

The Group has a Host Organisation (TWI) charged with the responsibility of providing a Chairman and a Secretariat to enable the Group to undertake its business. TWI is an independent UK based technology company with appropriate technical breadth and expertise to have knowledge of all relevant aspects of the code. It is a member of AFCEN and attend the AFCEN RCC-M Sub-committee and its relevant Working Groups on behalf of the User Group.

Membership of the User Group (the Members) is open to individual representatives of UK based industrial companies and other UK based organisations using or intending to use the RCC-M code for the supply of nuclear components or technical services. By becoming a Member of the User Group, the company representative will agree to comply with Terms of Reference and Confidentiality Undertakings. A list of Members of the User Group is maintained.

The Nuclear Advanced Nuclear Manufacturing Research Centre (NAMRC) assists TWI in the operation of User Group and will represent the interests of small and medium sized enterprises at meetings. EdF NNB Genco is invited to attend User Group meetings as the project manager of UK EPR new build projects and potential licensee. Their presence is entirely voluntary and their role is to provide such information and guidance to the User Group as they judge appropriate.

Meetings are held at least twice per year or more frequently depending on the volume of business. Members can raise items for the agenda with TWI before each meeting. TWI issues the agenda, minutes the discussions and actions, and distributes to User Group Members and other participants of each meeting. The User Group is planning to use the UK Energy Generation and Supply Knowledge Transfer Network as a means for communication within a restricted area.

TWI operates the User Group and interacts with AFCEN under the terms of a Framework Agreement. This defines confidentiality undertakings on the Host Organisation and Members of the User Group and intellectual property rights. A Steering Committee of AFCEN UK User Groups, chaired by a representative from EdF NNB Genco and including the User Group chairmen and representatives from AFCEN, has been established to guide the User Group with regard to project industrial challenges.

Table 1 – Purposes of the RCC-M UK User Group

***Technical***

- To ask questions about the meaning or interpretation of code requirements
- To identify aspects not covered or adequately specified by the code
- To understand the background/origins/purpose of code requirements
- To raise requests for interpretations and modifications
- To identify any difficulties of UK suppliers to comply with the code requirements
- To identify where UK regulatory requirements may exceed the code specification
- To discuss alternatives/concessions to code requirements that may be acceptable
- To propose additions to the code
- To clarify issues of translation and language
- To identify issues of common interest or concern

***Communication***

- To inform AFCEN of issues requiring high priority resolution
- To be a focal point for contact with AFCEN RCC-M Sub-committee and Work Groups for UK Users
- To enable AFCEN to know who is using the code in the UK and how they are using it
- To feedback discussions taking place in AFCEN RCC-M Sub-committee and Work Groups
- To disseminate responses from AFCEN on requests for interpretations, modifications or additions
- To enable UK Users find out who are the experts in understanding and using the code

***Learning***

- To share knowledge with other users and learn from them
- To identify requirements for training in the code
- To promote appropriate training courses
- To learn from AFCEN experiences from previous and current projects using RCC-M code

***Wider ambitions***

- To demonstrate knowledge and expertise in applying the code to the worldwide nuclear market
- To confirm the acceptability of the code within UK engineering practice and regulation

Representatives of the AFCEN RCC-M Sub-committee and Working Groups will be expected to support the User Group and to participate in User Group meetings. TWI as a Member of AFCEN sends representatives to RCC-M Subcommittee meetings. These meetings are an opportunity to report and put the views of the UK nuclear manufacturing supply chain direct to the Subcommittee. TWI reports matters of interest discussed at the Subcommittee back to the User Group at its next meeting.

The RCC-M UK User Group is the collective voice of the UK nuclear industry supply chain in representations to AFCEN on all matters concerning the RCC-M code. Through TWI the User Group can formulate, justify and forward requests for interpretations and propose modifications or additions to the code for AFCEN to consider and respond through the relevant Working Group. The User Group does not give interpretations of the code for its Members without validation from AFCEN. Membership does not preclude individual companies from being members of AFCEN and representing their own interests at AFCEN Sub-committee and Working Group meetings.

The User Group facilitates and promotes the provision of training and exchange knowledge of the RCC-M code in the UK. Members of the User Group are expected to share their knowledge and experience of the code and to contribute to discussion. A key role is to determine and inform AFCEN of the general and specific training needs of its Members' companies and suppliers and to co-operate with AFCEN and recognised training providers in promoting training courses, workshops and other knowledge exchange events. The User Group feeds back to AFCEN any questions or issues arising from such training.

All Members of the Group participate at their own expense, time and risk. While one of the purposes of the User Group is to exchange knowledge and experience between Members, neither the User Group as a whole nor TWI can take any ultimate responsibility for the quality or accuracy of the knowledge or experience exchanged. The User Group and TWI try to ensure as far as possible good practice and accurate understanding of the code.

## **USER GROUP TOPICS**

The User Group has held a number of meetings since its launch in 2013. These have discussed a variety of topics connected with the RCC-M code. The Chairmen of AFCEN Working Groups on Design, Materials, Welding, Inspection, Quality Assurance and Surface Technology have attended the meetings to present the key aspects and issues affecting their section of the code. Members have taken the opportunity to share their experience and insights and to raise issues of concern.

An early and on-going issue is the procurement of RCC-M compliant materials in small quantities. The RCC-M code specifies materials for particular applications with specifications that are different to comparable American and other standards. UK manufacturers have pointed out that because only a single plant is being built at present material stockists do not stock all the RCC-M grades and product forms.

In response AFCEN drew attention to Section M 2000 which allows other specifications to be used providing equivalence with RCC-M can be demonstrated for the particular application. However, this process can be time consuming and costly. The need for sufficient materials of the correct specification to be available to build the plant has been recognised as an important issue within the project.

The Generic Design Review of the Hinkley Point C plant was made on the assumption that it would be constructed to the 2007 edition of the RCC-M code with amendments up to the 2010 addenda. A recurring issue for the User Group is whether developments in the code since 2010 will be taken into account, particularly where these represent improved practice. The RCC-M code refers extensively to European and ISO standards, some of which have been updated, withdrawn and replaced since 2010. This issue is a primarily matter for the licensee to resolve in the relevant procurement specifications.

A related issue concerns that of the admissibility of new technology such as new manufacturing methods such as HIPING, and advanced ultrasonic NDT techniques. In many respects AFCEN adopts a conservative position preferring to wait until the technology is proven in other industry sectors before introducing it into the code. The UK manufacturing supply chain is keen to use modern technologies, particularly where these give technical advantage.

In this respect the UK position may be more flexible. The licensee has the responsibility to decide on the particular options available within a procurement specification. AFCEN are actively developing the RCC-M code in areas such as the use of phased array ultrasonic testing as a replacement for radiography for inspection in certain applications, and the use of HIPING technology for manufacturing particular types of vessels. These developments will be introduced progressively and expanded in future.

AFCEN has consulted the UK User Group with regard to the introduction of welding quality assurance standard ISO EN 3834. This is replacing NF EN 287-3 and adopts a different approach to assuring welding quality areas such as technical review, personnel qualification, the definition of welding co-ordinators, equipment maintenance and the storage of parent materials. UK upper tier manufacturers are starting to adopt the new standard within their businesses.

The UK manufacturers pointed out that it would be difficult and costly to use two welding quality standards at the same time. They also drew attention to the requirements for welding subcontractors who might be slower to adopt the new standard. Since ISO EN 3834 was introduced since 2010 questions remain about what welding quality standard will be specified for Hinkley Point C and later plants.

## **TRAINING**

Discussions held at the UK User Group meetings have highlighted that the level of knowledge and readiness to use the RCC-M code for future projects are different for different levels of the UK manufacturing supply chain. Upper tier suppliers show a good level of readiness. This has been demonstrated by their involvement in the User Group and the RCC-M Subcommittee, the level of exchange during User Group meetings, and investment in general training on the code.

However, the level of investment and readiness appears to be much lower for lower tier suppliers. This has been observed by training organisations and identified as a concern from the licensee and upper tier manufacturers which have the responsibility to ensure that their subcontractors have a good knowledge of the code. The reasons suggested were the uncertainty of the UK EPR project and the requirement for more tailored training. The User Group is working with training providers to facilitate opportunities to increase the awareness of the code through the supply chain.

AFCEN's position on training is clear. AFCEN requires that training delivered on the code is certified to ensure high level of service quality and hence allow users to gain clear knowledge, insight and competences in the requirements and practices for using the code. In order to become certified AFCEN assess and approve a training organisation's ability to implement the training course and training aids.

Several training organisations already certified in France have extended their range of operation to the UK. It can be noted that third party inspection companies (notify bodies) are in a strong position to deliver training. Their role is important as these companies ensure that the manufacturing supply chain is ready to apply correct required practice and are at the front line to ensure correct practice along the whole supply chain. Training providers in the UK are also linked to organisations such as the National Skills Academy Nuclear. In this context, the User Group is in a strong position to facilitate and promote the provision of training and exchange knowledge of the RCC-M code in the UK. It determines and informs

AFCEN of the general and specific training needs of its Members' companies and assists and co-operates with AFCEN and recognised training providers in promoting training courses, workshops and other knowledge exchange events. The key question for the Members of the User Group is how much the upper supply chain can support the knowledge and competences of their subcontractors. In addition the question of Suitable Qualified and Experienced Personnel in relation to knowledge and practice of the RCC-M code is being raised in particular on the level of demonstration required.

Finally it is worth noting that AFCEN has published in English and French an extensive document giving the background and criteria used by the code, AFCEN (2015). Jean Marie Grandemange, prepared this document and TWI checked the English translation on behalf of the User Group. This document should be very helpful to users wishing to gain a good understanding of the code.

## **CONCLUSION**

The RCC-M UK User Group has been in existence for nearly three years. During this time it has established a strong and committed Membership and is proving to be of value to the UK nuclear manufacturing supply chain. The User Group has received good input from AFCEN on a number of topics it has discussed.

The key issue for UK manufacturers is the admissibility of developments in technology and the code and related standards since 2010. The RCC-M code is continuing to evolve, and much will depend on the timescales relative to the UK projects. Training and the level of readiness of the UK nuclear manufacturing supply chain is another key issue and here there User Group is working with AFCEN, training providers and its Members to identify the requirements and ensure suitable training is provided.

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