



RCC-MRx 2015

Context, Overview and on-going developments

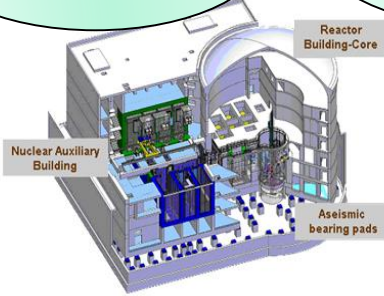
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IGORR 2017, Sydney
3-7 December 2017

- ✓ **RCC-MRx**
- ✓ **Evolution process and main evolutions**
- ✓ **2014-2018 CEN Workshop**
- ✓ **Next editions / on-going developpments**

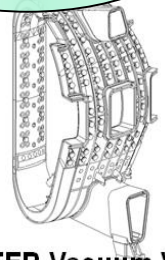
- ✓ **Design and Construction Rules for mechanical component of Fast breeders and Research Reactors**
- ✓ **Issued from the merge of RCC-Mx (JHR) into RCC-MR:**
 - **RCC-Mx 2008 in use for the JHR**
 - **RCC-MR 2007 in use for ITER Vacuum Vessel**
 - **2 editions : 2012 and 2015**
- ✓ **Remarquable features for reseach reactors (Igorr 2014)**
 - **Nuclear design and construction set of rules addressing:**
 - **Use of Aluminium and zirconium alloy**
 - **Irradiation and creep dammmages**

RCC-MX
2008



Jules Horowitz Reactor

RCC-MR
2007

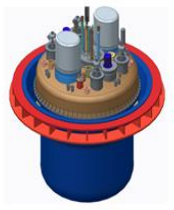


ITER Vacuum Vessel

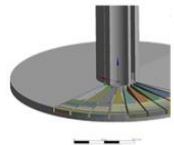
RCC-MR
2002



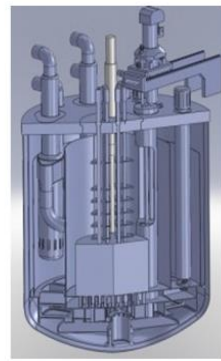
Indian PFBR



MYRRHA primary system



European Spallation Source target



ASTRID

RCC-MRx
2012

RCC-MRx
2012

RCC-MRx
2012

✓ RCC-MRx Sub-commission:

- 21 members
- 70 contributing experts

Section I (RDG)

- General provisions
- Entrance Keys – Applicable sets of rules
- Equipment specification
- Management system

Section II (REC)

Additional requirements

For class 3 components

- application of Standard NF EN 13445
- application of Standard NF EN 13480
- Eurocode 3

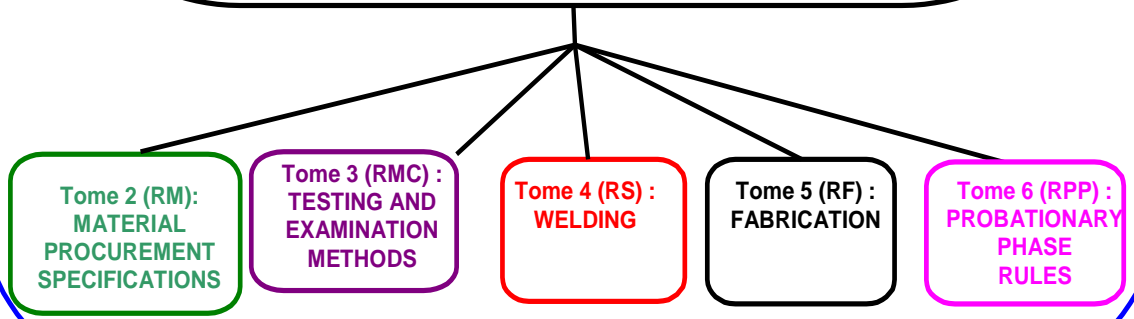
Special requirements

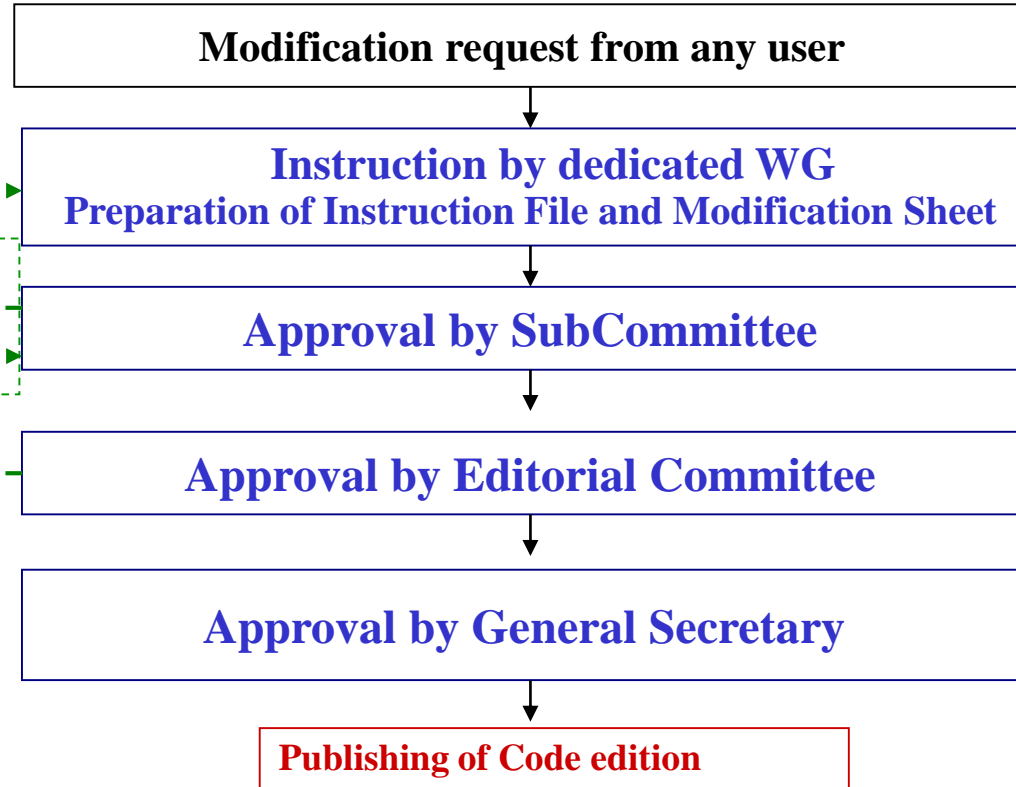
- French regulation ESP/ESPN
- European regulation REACH

Section III

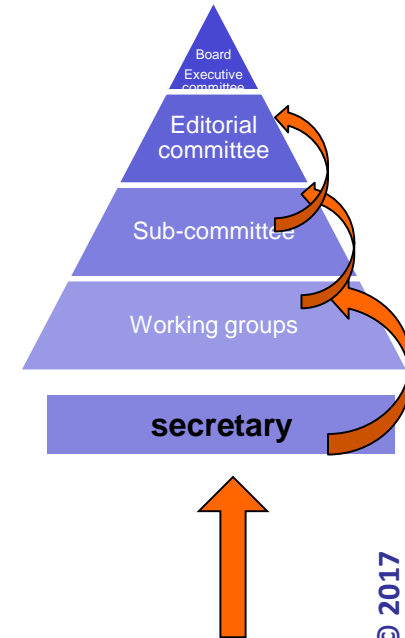
Tome 1 : DESIGN

- Subsection A (RA): general provisions and entrance keys
- Subsection B (RB): class N1_{Rx} components and supports
- Subsection C (RC): class N2_{Rx} components and supports
- Subsection D (RD): class N3_{Rx} components and supports
- Subsection K (RK): Examination and handling mechanisms
- Subsection L (RL) : Irradiation device equipment
- Subsection Z (Ai) : Appendixes (properties of materials etc.)

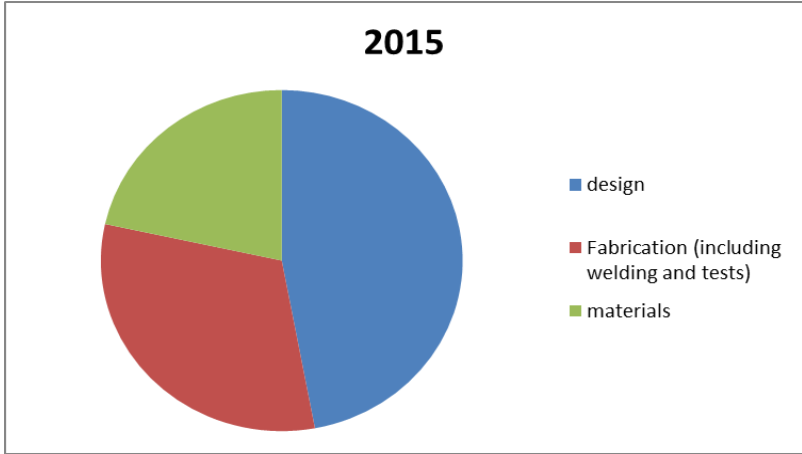
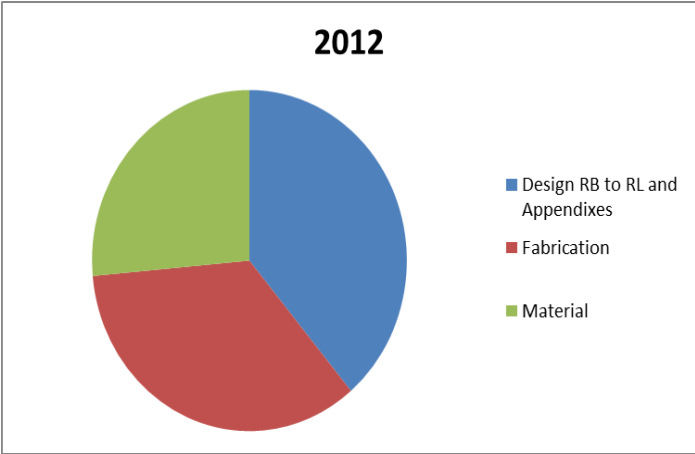
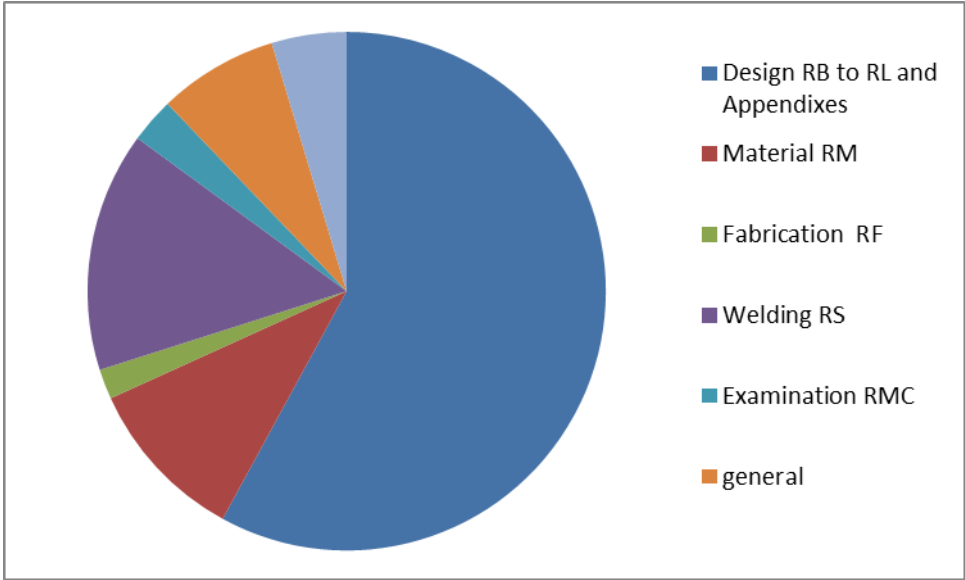




Possible request
for complementary
instruction



- ✓ **2012-2015: 110 Modifications**
- ✓ **Essential element of the code evolution:**
 - **users feedbacks.**
 - **Harmonization actions**



JHR

- Lessons learnt from manufacturing
- Eg. Reactor block components, primary heat exchangers

ASTRID

- Outcomes from Astrid Project to cover needs
- Eg. Materials, probational rules, creep data

Fusion project

- Introduction of Eurofer

CEN Workshop

- Topics for code improvement to address GEN III and GEN IV NPPs and long-term operation/lifetime extension for GEN II NPPs

➤ RPP : Probationary Phase Rules

PPR	Title	Paragraph(s)	Purpose	Status
RPP1-2012-RA5000	Management system	RA 5000	Establishment and use of a quality management system	Renewal 2012-2015
RPP2-2012-9%Cr	Properties of chrome alloy steels from Annex A3.18AS	A3.18AS	Properties of chrome alloy steels from Annex A3.18AS – cyclic behaviour and creep	Renewal 2012-2015
RPP3-2012-RM 243-2	RM 243-2 thick plates	RM 243-2 and A3.18AS	Extension of application of RM 243-2 to thick sheets (up to 250 mm)	Renewal 2012-2015
RPP4-2012-Eurofer	Eurofer	RM 242-6, 243-3 and 244-3, appendix A3.19S	Introduction of Eurofer	Renewal 2012-2015
RPP5-2012-STR-S Casing 6061-T6	RM 522-7 casing 6061-T6	RM 522-7, appendix A3.GEN and A3.2A	S-RPS: Type 6061 T652 Al-Si-Mg alloy forged blanks for the core casing and additional information in associated Appendices A3.GEN and A3.2A	Renewal 2012-2015
RPP6-2012 aluminium welds	US inspection of welds on aluminium alloys	RS 7714.4 RS 7724.4	Introduction of measures for US inspection of welds on aluminium alloys	Renewal 2012-2015
RPP7-2012-A16	A16 – Locating defects	A16.2122	Definition of a general procedure for locating defects	Renewal 2012-2015
RPP8-2013-SMC2	Use of the SMC2 method for prevention of type S damages	RB 3645.82 RB 3661.1 RB 3661.24	Extension of the method of Seismic Moments Classification SMC2 to type S damages	Renewal 2013-2015
RPP9-2013-800H	800H Alloy	RM 412-4 RM 414-3 A3.6SA	Introduction of bars and tubes RPS in alloy 800H and the associated appendix A3	Renewal 2013-2015
RPP10-2015-A3.2A.69	6061-T6 swelling	A3.2A.69	New swelling law for 6061-T6	Introduction 2015

✓ Harmonization actions

➤ actions performed to maintain the consistency of the RCC-MRx with other sets of rules : references to other systems (more than 200)

- Regulations texts,
- ISO standards,
- European standards,
- ASME/ASTM/AWS texts,
- technical publications.

Modified part	Topic
RS 7433	Update of the requirements on the check of instruments used for measuring welding parameters accordingly with RCC-M and EN ISO 17662 evolutions.
RS 3242.12	Modification of steels grouping, accordingly with RCC-M.
RS 2120	Procurement of filler materials others than RCC-MRx
RS 7700	Ensuring consistency for acceptance criteria for radiographic examination.
RB, RD, RM	Consistency between procurements according RCC-MRx, RCC-MR and RCC-M.
RB 3700	Bellows design rules harmonisation.
RA 1300	Update of the standards references listed in the tome 3 and consequences on synthesis table RA 1300.
RMC	Update of the standards references listed in the tome 2 and consequences on synthesis table RA 1300.
RA 1300	
RM	Consistency between Jr and Sr, St values.
A9.J3S	
RDG 4000	Clarification of the possibility to use EN 13445/13480 alternatively to N3Rx and anchors movement consideration.
RD 3650	
RMC 2000	Consideration of the RCCM evolution for RMC 2000 chapter.
RDG 3310	Homogeneisation with RCC-M : correction corrective action /preventive action
RB 5240	Homogeneisation with RCC-M: consideration of the supports during hydraulic test.
RA 1300 RF	Update of the standards references listed in the tome 5 and consequences on synthesis table RA 1300.
RM RMC	Homogeneisation with RCC-M (2013, 2014 and 2015) for tomes 2 and 3.
REC	Integration of the 2005/12/12 order modification.
RS	Update of the standards references listed in the tome 4.
RS 4000	Integration NF EN ISO 9606-1 standard.
Tomes 4 , 5	Consideration of the RCC-M modifications since 2012.
A14.2450	Precision added consistent with RCC-M evolution.
REC 3200	Put in conformity of the welding and fabrication disposition with the COLEN interpretation sheets validated by ASN
REC 3200	Put in consistency of Section II with ESP order modification.
Tome 1	Update of the standards references listed in the tome 1.

- ✓ **Voluntary mechanism under CEN Umbrella**
- ✓ **Requirements for long term evolutions of codes**
- ✓ **Identification of prenormative research**

- ✓ **Some outcomes already integrated in the RCC-MRx evolution process**
 - **Use of code in innovative coolant environment**
 - **Negligible creep curve**
 - **Extension of temperature range of mechanical properties of specific materials**
 - **Extension of creep strain and rupture data range**

- ✓ **Current status of validated modification request:**
 - **67 DMRx are already validated**

	General parts	T1 Design	T2 and T3 Material Testing and examination	T4 and T5 Welding Fabrication	RPP
Number of validated DMRx	4	24	15	9	2

- ✓ **Some topics are still on-going dealing with complex technical issues, requiring research and development or needed to collect participation of different experts such as:**
 - **improvement of ratcheting rules: evaluation of rule in significant creep and alternative rule to efficiency diagram for materials others than stainless steels,**
 - **design of the bellows for an operating in high temperature, nuclear environment,**
 - **work on irradiation rules: scope of the rules – domain, curves, extension of the available rules for all the materials, development of new rules,**
 - **Reorganization of fast fracture parts of the code**
- ✓ **Development of Criteria of the code**
 - **Design rules (Creep design rules, Bolt design rules, Ratcheting rules, Irradiation rules,...).**
- ✓ **Integration of the CEN Workshop 64 Results**
- ✓ **Harmonization as regards ESPN (French Nuclear Pressure Equipment Regulation).**

Next edition -> 2018

- ✓ **RCC-MRx is continuously improved with:**
 - **Feedback for users: on-going projects**
 - **R&D outcomes**
 - **Harmonization with other set of rules**
- ✓ **RCC-MRx provides to research reactor community up-to-date rules suitable to address the specific issues design and construction of**
 - **Reactor block component**
 - **Irradiation devices issues**

Thank you for your attention

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