

Task Group 7 – Fitness for Service & Risk Based Inspection

Claude Faidy

EPERC TG7 Chairman

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Minutes of the 1st web-meeting of TG7

Thursday September 2nd, 2021 14,00 – 17,00 CST

1 General introduction

1.1 Participants

Participants	e-mail address	EPERC Member	Country
Andrea Tonti	a.tonti@inail.it	YES-BOD	Italy
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Jader Furtado	jader.furtado@airliquide.com	NO	France

1.2 Chairman General EPERC Introduction

1.2.1 EPERC Major Objectives

Develop and manage R&D to support, improve and enlarge the scope of Pressure Equipment Construction and Operation Codes & Standards, with International harmonization challenge, if possible...

EPERC Action plan

- Detailed comparison of existing International C & S
- Analysis with Industry and Standard Development Organisations (SDO's): gaps and needs
- Proposals of "Recommended Practices" with justification
- R&D programs
- Benchmarking and Examples
- Proposals of "Recommended Practices" with justification
- Code Case proposals
- Knowledge Transfer: Conferences, Workshops, International cooperation, Training

1.2.2 EPERC "connected" Countries

- All European Countries are "basic members" with registration fees
- UK, Switzerland, Russia, China after BOD agreement
- USA (ASME ST-LLC) Japan (JPVRC), Korea (KEPIC) through dedicated agreement

1.2.3 Technical General Introduction

- 4 steps for major degradations:
 - cracks
 - thinning - pitting
 - excessive deformation - buckling
 - loss of material properties

with different environment, inside and outside the pressure boundary

- 4 steps analyses
 - Understand root causes and mechanisms
 - Degradation rate
 - Maximum allowable degradation / leak before break
 - Repair technologies and consequences

2 Review of TG7 Technical Program

2.1 Chairman Introduction

- After the International Code review, we will identified Gaps and Needs:
 - 2.1.1 in term of Procedure, Material data, Criteria and available justification
 - 2.1.2 assure that existing rules covers "innovation" in Pressure Equipment Industries, as:
 - operating conditions, loads and new material ...
 - 2.1.3 remain consistent with industrial field experience

2.2 WP1: International Codes & Standards comparison

- Development of detailed comparisons for Nuclear, Oil & Gas and other non-nuclear Codes
- Gaps and Needs identification, including innovation in different industries:
 - new operating conditions (temperature, pressure, environments...)
- Main lines of R&D program

2.3 WP2: R&D program

2.3.1 Crack analyses

- handbooks, crack growth, critical crack size, cladding, defect interaction, creep..

2.3.2 Residual stresses

- from Manufacturing, Welding, Repairs

2.3.3 Leak before Break procedure:

- crack growth rate and shape, through wall crack, crack opening area and flow rate

2.3.4 Thinning and pitting

- rate and maximum allowable values

2.3.5 Loss of material properties:

- thermal ageing (loss of toughness rate) and consequences

2.3.6 All needed material properties for all previous WP's

- $da/dN = f(\Delta K \text{ or } \Delta J)$
- J- Δa curves
- $da/dt = g(C^*)$
- Thinning rate
- Stress-strain curves
- Thermal aging versus material chemical composition and consequences

2.3.7 Overload and Buckling

2.4 WP3: Surveillance program and In-Service Inspection (ISI)

- Techniques of surveillance of key parameters: monitoring programs
- ISI optimisation
- Techniques / Performance / Inspection frequency
- Risk Based Inspection (RBI): development of a dedicated Guide with associated validations

2.5 WP4: Benchmarks on practical cases

- Definition
- Performance
- Synthesis

2.6 WP5: TG's Synthesis

2.6.1 Later

2.7 WP6: Knowledge transfer

2.7.1 Later

2.8 WP7: Road map development and management

2.8.1 1st version for next TG4 meeting using TG4 questionnaires from each participant

2.8.2 Managed by TG4 Chairman

3 Major remarks during the meeting

- 3.1.1 Consider very old plant working under creep conditions
- 3.1.2 Consider all consequences of Hydrogen environment
- 3.1.3 Consider very high temperature conditions, up to 950 °C
- 3.1.4 Consider specific ITER components
- 3.1.5 Consider component reliability and system reliability
- 3.1.6 Consider welds in Natural Gas pipelines

4 Action List for each potential participant and TG4 members

- 4.1 Remarks on any Task of the Technical program attached to this minutes from each TG7 member and Potential members
 - 4.2 Fill up attached Questionnaire for each TG7 member and Potential members
 - 4.3 List of proposed contributions to open the Road Map by each TG7 member and Potential members
 - 4.4 First edition of TG7 Road Map by TG7 Chairman
 - 4.5 TG7 next meeting: beginning of December (to be confirmed later by EPRC TG7 Chairman and EPERC BOD (Board of Directors))
 - 4.6 1st TG7 Workshop beginning of 2022: program and final date to be defined at next TG7 meeting; potential topic: FFS in Hydrogen Industries
 - 4.7 Continue to invite international experts and universities in the domain
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EPERC TG7 Questionnaire on Potential Participation

Name	Company	Country	e-mail
1. I'm EPERC member	Yes	No	Potentially: Yes or No
2. I'm interested to be TG7 member	Yes	No	Comments
3. I'm interested to contribute to different reports	Yes	No	Topic
4. I'm interested to develop an Experimental Validation	Yes	No	Topic
5. I'm interested in Benchmark on Practical Cases	Yes	No	Topic
6. I'm interested in a Code Case contribution	Yes	No	Topic
7. I'm interested in other aspects of the program	If Yes Define it:		
8. Other remarks on the proposed program			

Next TG7 web-meeting : December, 2021 (to be finalized soon)
Potential participants have to register on EPERC website for Teams-Link
SEND YOUR ANSWERS to:
Claude FAIDY EPERC-BOD-TG7 Chairman
info@eperc-aisbl.eu


TG7 - FITNESS for SERVICE (FFS) - Risk based Inspection (RBI)

EPERC TG7 Potential Technical Program

(to be associated with TG7 1st meeting minutes on EPERC website)

General Introduction

General introduction				
4 major degradations:	cracks	thinning-pitting	excessive deformation/buckling	loss of material properties (ageing)
4 major steps	understanding root causes and mechanisms	degradation rate	- maximum allowable degradation - leak before break	repair technologies and consequences
WP 1: Existing International Codes & Standards	review/comparison of International Codes and Rules	gaps & needs, including new needs associated to innovative industries		
WP2: R&D program	Crack analyses	- K, J, C* handbook	Step by step Procedure	
		- crack growth / plasticity effects / mean stress / threshold / environment effects		
		- critical crack size		
		- cladding consequences		
		- defect interaction		
		- creep consequences		
	Residual stresses	- manufacturing - welding - repairs		
Leak Before Break		- Crack growth rate/shape - TWC critical size - Crack Opening Area		
Thinning - Pitting analyses		- thinning rate - allowable thinning rules		
Loss of material properties		- rate - consequences	- due to environment - thermal ageing consequences - other types of ageing	
	All needed material properties		- da/dN - ΔK or DJ - JΔa curves - da/dt - C* - thinning rate - stress-strain curves - thermal ageing consequences	
	Overload and Buckling			
WP3:Surveillance program and ISI	techniques for surveillance of key parameters		ISI optimisation	techniques, performance, frequency
	Risk Based Inpection development and Final Validated Guide			
WP4: Benchmarks on practical cases		definition	performances	synthesis
WP5: TG7 Synthesis	All task and WP synthesis		Final Best Practices Report	Code Case proposal to European Standards
WP6: Large Knowledge Transfert	Workshop - Training - International Conferences			
WP7: Road Map management	Regularly up-dated with all TG7 actions			
FFS International Codes & Standards		ASME BPVC Section XI, RSEM/RCC-MRx, R5-R6,		
		API-ASME, FITNET, BS 7910, JSME, KEPIC, VERLIFE...		
RBI International Codes & Standards		ASME BPVC Sec XI Code Cases/Division 2 RIM, API 581,		
		RIMAP, ENIQ, TWI, JSME, EN16991 ...		


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Status of EPERC Development

"European Pressure Equipment Research Council"

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EPERC Major Objectives:
Develop and manage R&D to support, improve and enlarge the scope of Pressure Equipment Construction and Operation Codes & Standards, with International harmonization challenge if possible...

EPERC Action plan::


- Regular comparison of existing International C & S
- Analysis with Industry and SDOs: gaps and needs
- Proposals of "Best Practices" with justification
- R&D programs
- Benchmarking and Examples
- Code Case proposals
- Knowledge Transfer: Conferences, Workshops, International cooperation, Training

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EPERC "connected" Countries:
All European Countries (basic members)
UK, Switzerland, Russia, China
USA (ASME ST-LLC) Japan (JPVRC),
Korea (KEPIC)

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Status on August 2021

Around 20 topics are planned to be considered
Many different Industry C&S are covered
from Nuclear to Oil & Gas or New Energy Plants...


- TG1 Fatigue
- TG2 Alternative to hydro proof tests
- TG3 Bolted Flange
- TG4 Nonlinear Design Rules
- TG5 Additive Manufacturing
- TG6 Creep Design Rules
- TG7 Fitness for Service and Risk Based Decision making
- TG8 Nuclear-Non nuclear bridge
- TG9 EN13445 Background
- TG10 Piping design rules

- TG11 Hydrogen PE
- TG12 Pressure Equipment re-certification
- TG13 Cryogenic Pressure Equipment
- TG14 New Materials /Non Steel Materials
- TG15 New NDE Techniques
- TG16 New Welding Procedure
- TG17 HDPE Piping Rules
- TG18 In-series Pressure Equipment
- TG19 Ultra Super-Critique Power Plants
- TG20 Specific needs for high safety application

• Any other TG can be proposed by any group of volunteers to EPERC BOD

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Status on August 2021 – Active TGs (1/3)

TG1: Fatigue
(draft program available, composition of the Group on-going)

- Detailed Comparison of **last Editions**
 - ASME III and VIII
 - EN 13445 and ASME VIII
 - EN 13480 and ASME B 31
- Fatigue objectives: "small cracks" or "through wall cracks" ?
- Elastic versus **Inelastic rules, including K_e**
- **Fatigue curves** (mean and design) and **cyclic stress-strain curves**
- Fatigue reduction factors and **uncertainties**
- Particular cases of **cycle combination**, including large seismic event
- **Crack like defects and notches**: comparison of existing methods
- **Environmental Effects**: different types as steams, waters... hydrogen...
- **Negligible creep rules**
- Review of **Exemption of fatigue analysis** rules
- **R&D program**: set of tests (standards and specimen) for validation
- Benchmarks
- **Best Practice with validation**
- Knowledge transfer

Next web-meeting : TG1 on September 22, 2021
 Open to all participants (members or potential members)
 by registration on the website for the [meeting Agenda and Teams-Link](#)

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Status on August 2021 – Active TGs (2/3)

TG4: Non-linear Design Rules
(program available, Group under finalization)


- Detailed Comparison of International Codes (lot of modification in last Editions)
ASME (III and VIII) – RCCM – EN – API
- **Background, Validation, Best Practices on:**
Plastic collapse, Plastic Instability, Buckling, Tri-axiality limits, Elastic Follow-up, Strain based criteria, Fracture, Fatigue, Plastic Shakedown, Seismic loads...
- **R&D program**: new validation tests on specimen and components, Material Constitutive Equation for Cyclic Analysis ...
- **First draft of "Best practices and Validation Report"** available and under review

TG7: Fitness for Service - RBI
(draft program available, Group under constitution)

- Detailed Review of International Codes, Standards and Rules on:
 - Excessive def. & Buckling (design)
 - Thinning and pitting
 - Cracks
 - Loss of material properties: ageing
- **List of Degradation Mechanisms**
- **Degradation Rate and Allowable max value**
- **R&D program** for Validation and Material Prop.
- **Leak Before Break**
- **FFS** : ASME XI, RSEM/RCC-MRx, R5/R6 / BS7910, API, FITNET, JSME, KEPIC, VERLIFE...
- **RBI** : RIMAP, ENIQ, API, ASME-RIM & Risk-Informed, TWI...

Next web-meetings :
TG4 on September 2, 2021
TG7 on September 1, 2021
 Open to all participants (members or potential members)
 by registration on the website for the [meeting Agenda and Teams-Link](#)

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Status on February 2021 – Active TGs (3/3)

TG2: Alternative to Pressure Test
(program available, Group is running)

- Detailed Comparison of European Practices
- Proposal of alternatives based on CND, as Acoustic Emission tests...

TG12: PE Re-certification
(old versus new PE regulation consequences)


- Comparison of European practices
- Best practice proposal

TG3: Bolted Flanges
(draft program under development and Group under constitution)

- Comparison of Codes & Standards
- Standardization of Metallic seal Technology
- Fugitive Emission consideration
- R&D program: leak tests

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Status on August 2021 – Other TGs under Preparation

Nuclear and Non-Nuclear

TG5: Additive Manufacturing

TG6: Creep Design Rules

TG10: Piping Design Rules New Needs

TG14: New Material-Non Steel Mats

TG15: New NDE Techniques

TG16: New Welding Procedures

Non-Nuclear

TG9: EN 13445 Background- Validation

TG11: Hydrogen & High Pressure PE

TG13: Cryogenic PE

TG17: HDPE

TG18 In-Series PE

TG19: Ultra-Sup.Critiq. Power Plants

TG8 Nuclear – Non-nuclear C& S Bridge

Comparison of Nuclear versus Non-Nuclear Codes & Standards

Analyses of Differences (except irradiation outside of the comparison)

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Welcome to all of you...

Through EPERC website : www.eperc-aisbl.eu

For existing TG's or TG's under development !

For any question or suggestion:

info@eperc-aisbl.eu