EPERC
European Pressure Equipment Research Council

# EPERC Newsletter

European Pressure Equipment Research Council

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## EPERC and detailed Task Group programs!

In 2019 EPERC has launched a large "reconstruction" and an important event take place in INAIL-Roma on April 2019, with a large success of the 1st International Conference on "**Pressure Equipment Innovation and Safety",** Abstracts and Proceedings are available on the new EPERC website, continuously in progress…
In January 2020, an EPERC Task Groups Conference has been held in INAIL, Milan. The Minutes of the meetings are available on the EPERC website
The major objectives of EPERC is to develop and manage R&D to cover different needs, as: innovation, new operating conditions, new materials and new technology to support associated Codes & Standards development of Pressure Equipment.
The next step for EPERC is the development of "**Task Group programs"** and preparation of proposal for EC support. 6 of them are drafted, ready to be detailed with volunteers and potential members and 3 more will be available soon. Any topic can be added by any group of volunteers…
The major orientation is to work with the key actors at the European level, in one hand with Industry and in the other hand with CEN Standards Pressure Equipment Technical Committees, all supplemented by International Cooperation (with USA, Japan, Korea, China, Russia, India, and many other countries…).
All Companies concerned by Pressure Equipment interesting by innovation, to share knowledge and to manage R&D projects, are Welcome in EPERC! EPERC will be in the same time directly involved on knowledge transfer, training of users, development of benchmarks and practical case examples on different innovative option of Codes & Standards.
**If you have any needs, any initiative, any ideas or any suggestions on "Codes & Standards" and "R&D needs for support" around Pressure Equipment (PE), please join the EPERC Operating Agent or EPERC BOD (Board Of Directors)!**

*Claude FAIDY EPERC Chairman*

## Remember EPERC Objectives

Identify the needs for research and innovation to make pressure vessel industry safer, innovative and competitive through the exchange of industry experience and dedicated Thematic Technical Task Groups; establish priorities, timescales, scope and funding requirements to launch joint research and collaborative programs and activities based on needs identified and partially or totally support by European Community and CEN Technical Committees; manage the implementation of the joint projects, collaborative programs and activities; disseminate research results and industry experience in order to improve existing Codes & Standards.

## EPERC proposed tools

The major EPERC activities are attached to:
- **Thematic Task Groups** with a dedicated technical program (charter), form by a group of voluntary active members to express needs and to propose Technical Reports and Define and Manage different R&D programs
- **Regular Thematic Technical Seminars**, 1 to 3 days, open to members and visitors, to make a status on Gaps, Needs and recent program Results on a dedicated technical topic in order to check R&D needs
- **International Conference**, 3 to 5 days, to exchange at the International level on State of the Art in Pressure Equipment Technology, to promote European Pressure Equipment Industry, to compare existing International Codes & Standards
- **Training courses, master classes, summer school** proposals on different aspects of Pressure Equipment
- **Communication**: major exchanges will be done through EPERC website (regularly updated):

www.eperc-aisbl.eu

The number of face to face meetings will be limited using in priority phone call conference or web-seminars as alternatives
- **Reports and Documentation**:
All the historical (since 1995) and new EPERC Reports are downloaded on the website; all other free reports from any member could be also downloaded on the website, after BOD agreement.

## EPERC Organization

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|---|---|
| **Board of Directors (BOD)** | Communication, Documentation and website |
| **Members** | |
| **Thematic Task Group** (TG) 1 to 19… with a TG Chairman in charge of TG management, a group of members, a charter and a list of potential R&D projects | |
| **Periodic Thematic Seminars** : around existing active TG or New Topics, to develop State of the Art achievement and discuss potential needs for new programs | |
| **International EPERC Conference** on present and future Pressure Equipment Technical Activities status and associated needs to support: **Safe, Competitive and Innovative Pressure Equipment and Renewable Industries** | |

## EPERC Task groups running or recently open

- **TG1 Fatigue**: in connection with EN13445 for Vessel first, and later with EN13480 for Piping systems; what's the detail background of existing rules, how to compare them with other Codes (non-nuclear and nuclear), how to consider different environments (as water or hydrogen) in fatigue analyses, what's the level of margins and conservatisms attached to different rules, what kind of complementary R&D is needed, as all type of weld join fatigue reduction factors or how to consider plasticity and cyclic nonlinear material constitutive equations (in connection with EPERC TG4 on Nonlinear Design Rules)…
- **TG2 Non Destructive Testing as alternative to hydro proof tests**: after analyses of a large questionnaire reviewing the different practices at the EU level, some practical proposals will be done for operating plants alternatives
- **TG3 Bolted Flange**: a task group will start during the Milan TG Conf. by an example of innovative bolted flange (lightweight, leak tightness assure by metallic seal, large case by case experience in many different industry..), and move to leak tightness criteria, gasket properties and design rules for EN 13445, EN13480, EN1591… in accordance with corresponding CEN TC 74, 54 & 267. Potential new topic: "fugitive emission"
- **TG4 Nonlinear Design Rules**: after a large comparison of existing rules in International Codes, a task group has been launched during the Milan TG Conf. to develop limit load and elastic-plastic analyses rules for monotonic loads (plastic collapse, plastic instability, fatigue plasticity amplification factor, local failure and rupture analysis) and cyclic loads (plastic shakedown and fatigue). 2 methods are proposed for failure mode with material properties, criteria and margins: limit load analysis and direct elastic-plastic analyses, including cyclic constitutive equations of key materials…

Many new partners have join us recently with 2 major requirements:

- a slight enlargement of the scope to nonlinear fracture mechanic and bolted flange nonlinear analysis
- a dedicated experimental program to support different methods and material constitutive equations is under definition following the Milan TG Conf.

- **TG5 Additive Manufacturing**: new task group has been started during the Milan TG Conf. to define how to use this technology for Pressure Equipment in connection with CEN TC 438 and what are the major R&D needs.
- **TG6 Creep Design Rules**: in connection with EN13445 and EN13480, consequences on design, construction or operation of PE due to creep condition for all type of PE in different steels (including negligible creep criteria) and interaction with other damages as fatigue, plastic shakedown or buckling

**TG7 Fitness for Service and Risk Based Decision making**: First step: after comparison of existing international rules (ASME XI, RSEM/RCCMRx, R5/R6/BS7910, API, FITNET, JSME, KEPIC, VERLIFE…) toward a Harmonized European Procedure for flaw evaluation, for no-creep and creep conditions, including **Defect evaluation rules,** as cracks, thinning areas, leak before break…

Second step, review of existing Procedures on Risk Based Inspection, like RIMAP, API, ENIQ, ASME-RIM, TWI… for no-creep and creep conditions.

**TG12 Pressure Equipment re-certification:** rules for the re-certification of old pressure equipment, originally designed according to the National rules of the single member States and/or rules for the certification after relevant modifications of CE pressure equipment

**Recently, the EPERC programs of 3 major TGs have been mention to be included in the 'European Strategic ¨Plan for Hydrogen"** (https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12407-A-EU-hydrogen-strategy ):

- **TG11-1 Hydrogen PE** and specific aspects of interaction of the pressure boundary with hydrogen
- **TG 11-2 High pressure PE**: specific rules for pressure greater than 500 bar (50 MPa) and consequences on design, construction or operation of these PE
- **TG13 Cryogenic Pressure Equipment** for temperature less than 0 °C and consequences on design, material and construction or operation of these PE

**Corresponding deliverables of each Task Group**: different International Code comparisons, review background of existing rules and proposal to improve these rules with CEN TC's, gaps and needs

identification for new innovative use, recommended practices associated to R&D programs and Standard Code Cases proposals in accordance with EN PE Technical Committees.

The technical activities include Benchmarks, Practical Cases, Recommended practice and Knowledge transfer…

## EPERC Potential other Task Groups

*(Generally in connection with corresponding CEN Pressure Equipment Technical Committees)*

- **TG8 Nuclear-Non nuclear bridge**: new task group will be defined soon with 2 major objectives:
  - how to consider seismic event for non-nuclear plants
  - how to use non-nuclear pressure equipment Codes & Standards for Safety application as valves, pumps and heat exchangers
- **TG9 EN13445 Background**: Updated version for Vessel design rules in connection with TC 54
- **TG10 Piping design rules** in connection with TC 267 in order to enlarge the scope for innovation and renewable energy applications; for example piping system design rules under high level dynamic loads and strain criteria…
- **TG14 New Materials /Non Steel Materials**
  - for new innovative PE application, as high pressure, high temperature…
  - aluminum, copper, titanium, nickel… to be defined with end users, and material and manufacturer companies of corresponding PE
- **TG15 New NDE Techniques** and associated requirements in accordance with to-day State of the Art, including potential use of drone and robot to perform ISI
- **TG16 New Welding Procedures**
  - Heat Treatment and Repair technology for PE in operation, for Construction and Repair Technology as Excavation or different Repair constraints, in accordance with to-day State of the Art
- **TG17 HDPE Piping Rules**
  - started by High Density Polyethylene Pipe to develop a dedicated appendix to EN 13480 (in connection with TC 267 & 155) for design, material, fabrication, installation, tests and operation guidelines
- **TG18 In-series Pressure Equipment**

Particular needs of design, fabrication, inspection when the production of PE is associated to a large series.

- **TG19 Ultra Super-critique Power Plants**
  - From the smallest, most compact USC technologies to the most Advanced Ultra-Super-Critical (AUSC) technologies available, companies have efficient solutions for steam power plant—all supported with the latest digital capabilities to deliver better performance, greater efficiencies and improved reliability, all at a lower cost.
  - When it comes to the efficiency of a coal power plant, it all comes down to the pressure and temperature of the steam entering the turbine: The higher the pressure and temperature, the higher the efficiency and the lower the CO2 emissions. GE Steam Power has been continuing to push the limits of our steam technologies to make them even more efficient.
  - Available to-day: 330 bar/650-670°C
  - Most efficient in operation: 275 bar/600-620°C
- **TG20 Specific needs for high safety application** on design, manufacturing and operation of PE, as Nuclear, Aeronautic, Space, Car, Petro-chemistry, Rail, Medical or other specific industries, as Leak Before Break or Incredibility Of Failure or Reliability approach of Pressure Systems for Design, high reliability component, with associated specific requirements for Manufacture, Operation and Ageing Management…
- **Any other TG can be proposed by any group of volunteers to EPERC BOD**

## EPERC Recent Events

✓ **EPERC and ASME – ST LLC meeting**
- Bolted flange and Sealing, Hydrogen, Creep, Ratcheting, Codes and Standards status and on-going development…
- The program of the February and May 2020 Code Week and the EPERC presentation will be downloaded soon on EPERC website

✓ **EPERC participation to UIA Conference**
- Union of International Associations: 13th Round Table Europe on November 4, 2019 in Brussels
- The Minutes of the meeting has been downloaded on EPERC website

✓ **EPERC TGs Conference in Milan**
- INAIL, Milan
- The Minutes of the meetings have been downloaded on EPERC website

✓ **EPERC TGs programs draft proposals and openings**
- 6 EPERC TG programs are download on EPERC website
- 3 more will be downloaded soon: creep, additive manufacturing, hydrogen/high pressure PE
- Any other can be proposed by volunteers

## EPERC Future Events

✓ **EPERC TG program finalization**
- Review of draft download programs
- Web-meeting with interesting parties to one or more EPERC TG **Before end of June 2020**
- Revised version of each EPERC program
- Dedicated proposal for EC support

✓ **Typical EPERC TG Programs**

1. Introduction, Scope and Definition

2. Existing International Codes & Standards Review and Comparison
3. Gaps and Needs identification for innovation
4. R&D program:
   - set of key Reports for synthesis of existing R&D to justify or improve existing rules
   - Experimental Program: definition, performance, pre- and post-test analyses, including Material Properties evaluation
5. Benchmarking
6. Recommended Practices and Code Case proposal
7. Practical Examples
8. Knowledge Transfer
9. Program Synthesis and Conclusion

✓ **EPERC TG1 program on "Fatigue Design rules"**

- Objectives: no cracks or no leaks associated to all potential cyclic loads
- Overview and comparison of existing international Codes and Standards
- Gaps and needs identification, in particular for innovative PE with particular operating condition, as environment, pressure, temperature…
- Material properties: fatigue curves (standards, mean and design, low cycle and high cycle, environment, surface finish, mean stress, cold work, stress or strain control tests…); cyclic stress-strain curves; data for use of new material…
- Analysis engineering methods: Equivalent stress (Tresca/ Von Mises/ Rankine…), Cycle combination and counting; principal stress turning along a transient; Plasticity consideration ($K_e$, $K_n$, $K_\upsilon$ …)
- Specific cases: stress concentration, welds, bolts, crack like defects, bellows…
- Piping systems and support
- Revised existing "Fatigue Rules" with recommended practices in European Standards

✓ **EPERC TG2 program on "Alternative to Pressure Tests"**

- Objectives: operation alternative to pressure test in Europe
- Regulation background in Europe
- Analysis of NDT techniques
- In-service Inspection Guidelines and Best Practices for "normal" and "special" PE
- Introduction of recommended practice in European Standard

✓ **EPERC TG3 program on "Bolted Flange and sealing"**

- Objectives: bolted flange and sealing design rules with leak tightness for Boilers, Vessels and Piping systems, including innovation and fugitive emission
- Overview and comparison of existing international Codes and Standards
- Gaps and needs identification, in particular for innovative PE bolting flange with

particular operating condition, as environment, pressure, temperature…
- Non-metallic and metallic sealing comparison
- R&D leak tightness test program and seal design analysis
- Specific case of compact flange and piping clamp
- Revised existing "Bolted Flange Rules" with recommended practices in European Standards

✓ **EPERC TG4 program on "Nonlinear Design Rules"**
- Objectives: material nonlinear analysis for design of Pressure Equipment or Part of PE; to evaluate margins and analyze some PE
- Revision of existing Codes & Standards comparison with Gaps and Needs definition
- Analysis of Failure Modes: plastic collapse, plastic instability, local failure, buckling, creep…
- Analysis of Degradation Mechanisms: Fatigue, Ratcheting, Creep-fatigue…
- Flaw Tolerance Analysis, including Leak Before Break and Master Curve Approach
- Specific cases, as: reinforcement rules, elastic follow-up, sealing, cyclic dynamic loads…
- Base materials and Welds material properties: stress-strain curve for monotonic loads, cyclic constitutive equation for cyclic loads (fatigue and ratcheting) for all the PE materials used in European Standards; Thermal Ageing and Environmental degradations
- Revised existing "Nonlinear Design Rules" with recommended practices in European Standards

✓ **EPERC TG7 program on "Fitness for Service and Risk Based Inspection"**
- Objectives: support to PED Risk Analysis and Instruction notice requirement, Ageing management and surveillance of PE in operation, acceptable degradation and repair-replacement criteria proposal
- Overview and comparison of existing international standards with Gaps and Needs definition
- Fracture mechanic methods: K handbook, J and C* estimation scheme, stress-strain curves and toughness properties (brittle, ductile, transition with thermal ageing consideration…)
- Fatigue/Creep crack growth methods, including multi-defect interaction, crack growth rate of major PE material, R ratio correction, threshold, plasticity, combine cycles, small cracks, environmental… Pre-analyze defect propagation curves…
- Critical crack size under monotonic and cyclic loads, no-creep and creep conditions
- Leak Before Break
- Thinning rate and acceptable criteria
- Recommended practices report
- Benchmarks and Practical case examples
- Introduction of recommended practice in European Standards

✓ **EPERC TG12 program on "Pressure Equipment recertification"**
- Objectives: Boilers, Vessels and Piping PED requirement fulfillment and original design with past National Codes & Standards
- Identification of major differences between international Codes used and new PED requirements: conformity assessment, ageing of material, embrittlement of part of PE, sigma phase precipitate, high temperature embrittlement, NDE performance and results, welding procedure qualification, welders qualification, Pressure tests, Overpressure protection….
- Recommended practice report for operating plants
- Introduction of recommended practice in European Standard

✓ **EPERC TG5 program on "Additive Manufacturing", TG6 on "Creep design rules" and TG11-13 on "Hydrogen PE" will be defined and released soon on EPERC website**

## Next steps for EPERC

- an identification of potential members (companies or individual experts or R&D centers…) for each Task Group in order to:
  - ° define the details of each Work Package and Tasks for each TG program
  - ° propose availability dates for a web-conference TG by TG to confirm your interest and finalize the different WP and Tasks of each EPERC TG programs **BEFORE END OF JUNE 2020**; the webconference will be organized by each TG Chairman with all the volunteers
- URGENT preparation of proposals to be supported totally or partially by European Union and in particular CEN working products available.

## EPERC Board of Directors

- Update regularly the website (on-going action)
- Assure success of the 6 running TG's and the 2 new one;
- Be prepared to launch other TGs
- develop a large group of interesting EPERC members or potential members from many EU countries Develop a dedicated action toward "Universities"
- Develop cooperation with corresponding CEN Technical Committees

- Develop cooperation with corresponding international similar organizations: ASME STLLC, KEPIC, JPVRC, IMechE…
- Prepare a "chart" for each task groups

## EC Potential Support

- "How to Link Standardization with EU research projects" can be found on www.cencenelec.eu/research .
- "Horizon 2020" December 2019 on https://ec.europa.eu/programmes/horizon2020/en/background-material
- "Strategic Plan" December 2019 on https://ec.europa.eu/info/files/strategic-planning-process-and-strategic-plan_en
- "Different CEN cooperation working products": ES, TS, TR, GU, CWA https://www.cen.eu/work/products/cwa/pages/default.aspx

## EPERC Action Plan

- Define an R&D road map in each TG with some project definition in order to have some proposal for EU budget support requests (Reports or Experimental Programs)
- Define Web-seminars, date and program, for EPERC TG finalization and release dedicated minutes using EPERC website…
- Develop regular update information on EPERC website on Task Groups and Seminars
- Continue to develop EPERC international cooperation

## Announcement

**2020 EPERC General Assembly**
**on June 25, 2020 through Visio-conference**
**Open to members and potential members**
**On Registration on EPERC website with dedicated Agenda**

If you have any needs, any initiatives,
any ideas or any suggestions
on "PE Codes & Standards" or "PE R&D topics"
around Innovation and Safety of Pressure Equipment (PE):

# Welcome and Please Join Us!

# How to contact us?

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