EPERC - aisbl
European Pressure Equipment Research Council

www.eperc-aisbl.eu

EPERC

TG1 : FATIGUE

Meeting Report

Guy Baylac
EPERC TG1 Chairman
Guy.baylac114@gmail.com
Phone: +33 6 17 36 15 26

Presented by: Claude FAIDY
EPERC Chairman
Claude.faidy@gmail.com
Phone: +33 6 1410 11 19

TG1 FATIGUE

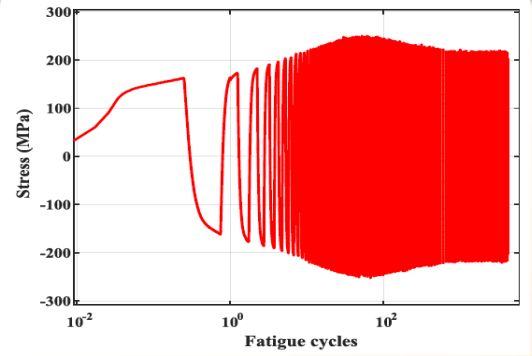
- **Fatigue Design Rules for regulated PE (PED)**
  - **For vessels** (on going)
  - **For Piping, Pumps, Valves and their support** (to be developed)
- **Overview of existing Codes & Standards, with associated background and validation**
- **Gaps and Needs identification, including innovative PE**
- **Some Open Points on Fatigue:**
  - **Objectives of Design Rules: protection Crack Initiation / Through wall crack ???**
  - **Collection of (S, N) mean curve:**
    - **standards for test** (push-pull test on small test specimen),
    - **stress or strain control tests;**
    - **list of material and operating conditions** (temperature, environment…)
  - **Transferability from mean ➔ design curve with different reduction factors**
  - **Base metal / welds / bolts / bellows….**
  - **Practical application:**
    - **Selection of an S,N curve**
    - **$\Delta\varepsilon_{tot}$ evaluation:** with plasticity and K_e and cyclic stress-strain curves,
    - **Rotation of principal stresses**
    - **Environmental effects: water, steam, hydrogen…..**
    - **Non-linear analyses: K_e and cyclic constitutive equation**

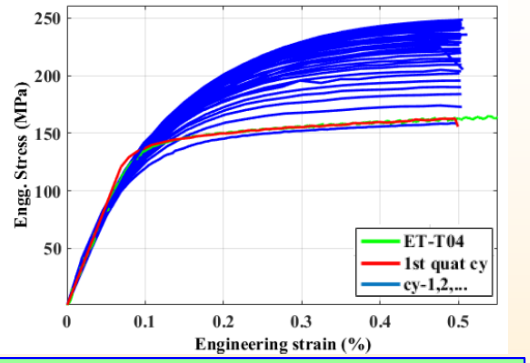
TG1 FATIGUE – GERMAN PROGRAM

- **CEN Report to justify EN13445 Clause 18 Modifications**
  Design curve = Mean divide by 10 on Cycles and 1.3 on Stress
  Comparison with German ADM : 10 x 1.5.
  CF Rmk: Not "Safety Factor" but "Transferability Factor"
- **Report on Fatigue curves improvements**
- **Continuation and comparison of German results (IWM, Darmstadt, Munich) with tests performed in other countries :**
  low and high cycle fatigue tests
- **Improvement of alternative method of new Clause 18**
- **Environmental Effects, in particular Hydrogen environment**
- **New issues from EPERC TG1 meeting in Milan**

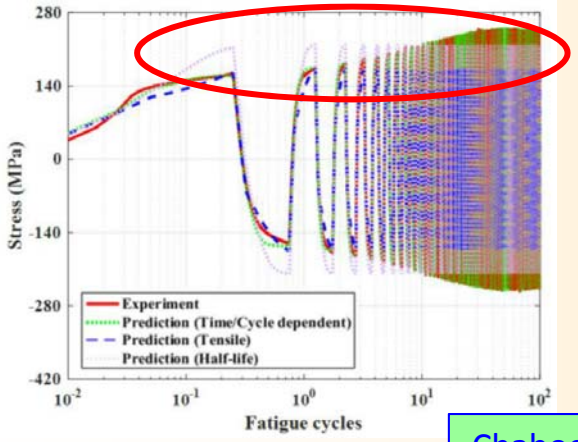
TG1 – TG4 Connections

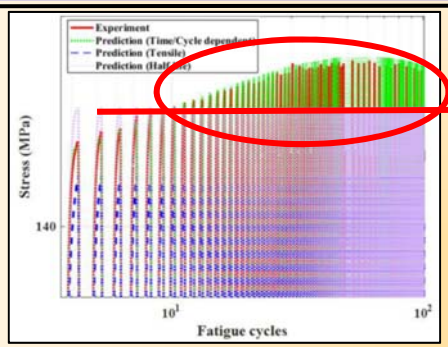
ANL Project





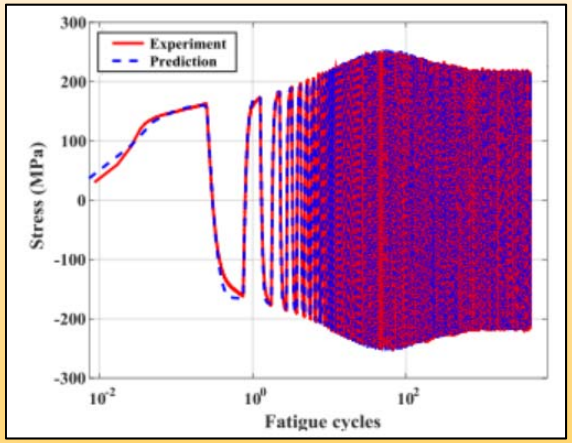
Fatigue Standard Test measurements





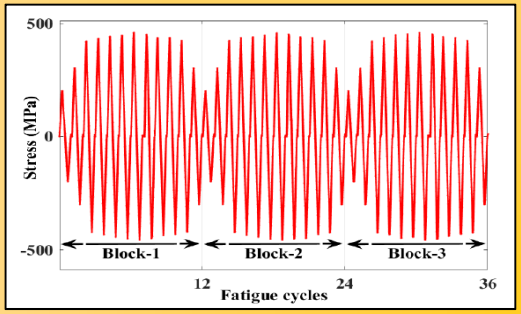
Chaboche model compared with test results

ANL "Evolutionary Fatigue Cyclic Plasticity" used and comparison with test

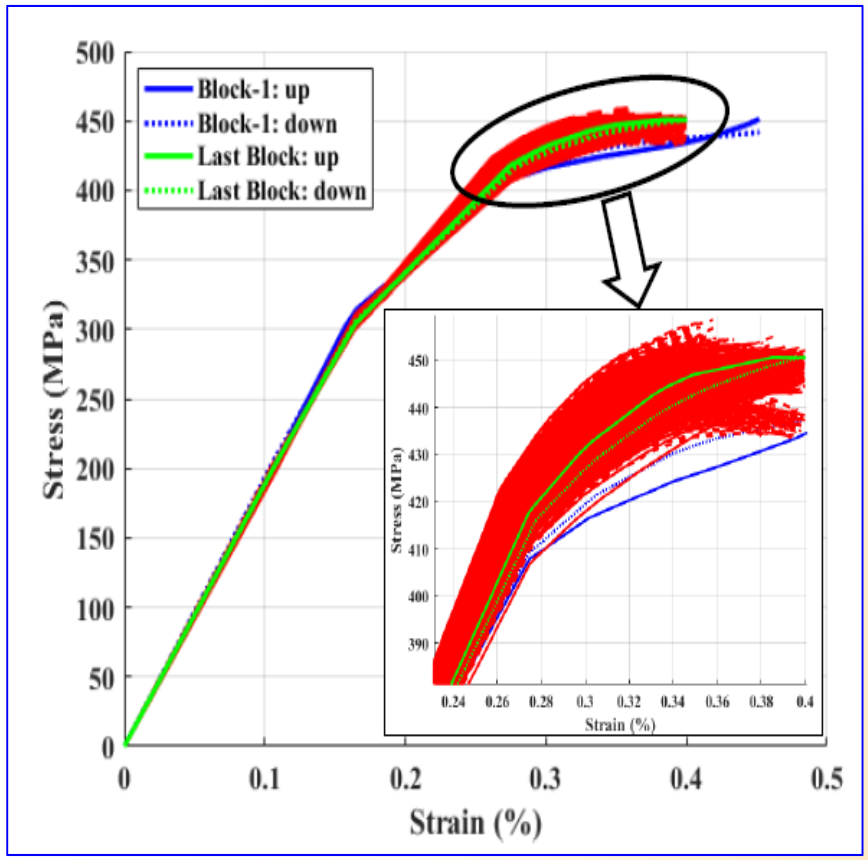


Cyclic Plasticity validation program before modelisation:

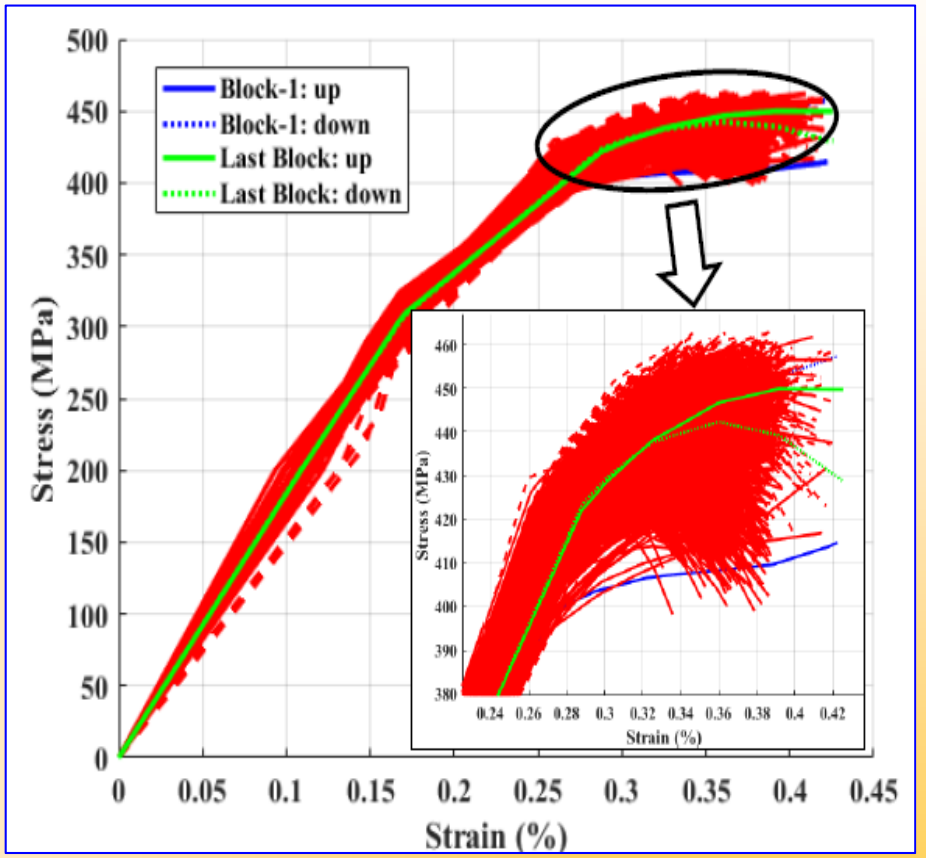
- Variable amplitude fatigue tests
- Bi-axial loads; multi-axial loads fatigue tests
- non-proportional loads fatigue tests
- Finally: real practical loads fatigue tests on industrial structures



TG1 – TG4 Connections



300°C Air Stress-Strain Curves



300°C PWR Water Stress-Strain Curves

$\neq$?

TG1 CONCLUSIONS – ACTION LIST

- **Develop an official list of Members**
- **Clarify the EPERC TG1 scope**
  - **Components, major materials, T_{max} / T_{min}, P_{max}, Environments…**
- **Review and compare similar International Codes**
  - **for Vessels:** EN13445, ASME VIII, API, Japan, Korea, Russia, China…
  - **For Piping:** EN13480, ASME B31, API, Japan, Korea, Russia, China…
  - **For other Pressure Equipment:** Pumps, Valves, Bolts, Bellows... and Supports
- **Independent review of EN13445-2019 Clause 18 with associated validations** (with new TG1 experts…)
  The Chairman has to release last Clause 18 Edition to each member volunteer to do the "Review", to start the work shortly
- **Develop a General Technical Report on Fatigue Design Rules Recommendations:** Validated Methods, Data, Criteria
- **TG1 – TG4: common new needs**
  - **K_e formulae and need of cyclic stress-strain curves** (a dedicated program is needed)
  - **Material cyclic plasticity models and validation**
  - **Fatigue and Ratcheting rules consistency**