Summary of Discoveries and Developments by Charles Becht IV, PhD, PE

The following highlights some of the discoveries and other work product of Dr. Becht in some technology areas. Some publications of Dr. Becht on the subjects are referenced; full details of the reference can be found in Dr. Becht's resume.

- Bellows Expansion Joints
    - Discovered in-plane squirm was a plastic collapse mechanism caused by the formation of plastic hinges in the bellows wall (*Root Bulge of Bellows,* 1981).
    - Discovered why widely used closed form solutions differ from some calculated stresses from finite element analysis (*An Evaluation of EJMA Stress Calculations for Unreinforced Bellows,* 2002 and WRC Bulletin 466*, Behavior of Bellows,* 2001).
    - Discovered the effect of plastic strain concentration on the relative performance of deep versus shallow convolutions, and reinforced versus unreinforced bellows in fatigue (*The Effect of Bellows Convolution Profile on Stress Distribution and Plastic Strain Concentration,* 2000; *Fatigue of Bellows,* 2000; and WRC Bulletin 466, *Behavior of Bellows,* 2001).
    - Created the bellows fatigue curve in ASME B31.3, Appendix X, as well as developed the other design rules within that Appendix.
    - Wrote 13 peer reviewed technical papers, a PhD dissertation, a WRC Bulleting and a Chapter in the 1984 ASME Decade of Progress on the subject of metallic bellows expansion joints.
- ASME B31 Piping Codes
    - Created, and introduced into ASME B31.3, weld joint strength reduction factors for elevated temperature piping, a practical solution to a long term problem that established the approach to handling this safety concern. The approach has been further refined and introduced into ASME B31.1 and BPVC Section I.
    - Created alternative flexibility analysis rules and introduced them into ASME B31.3 as Appendix P.
    - Created bellows expansion joint rules, including development of the fatigue curve, included in Appendix X of ASME B31.3.
    - Created alternate rules for short term occasional loads at elevated temperature based on yield strength of the materials and introduced them into ASME B31.3.
    - Developed a simplified approach to calculate creep deflection due to sustained loads for elevated temperature piping (*Span Limits for Elevated Temperature Piping,* JPVT, 2000)
    - Wrote the ASME book, *Process Piping, The Complete Guide to ASME B31.3* and Chapters on ASME B31.1 and B31.3 in the ASME book, *Criteria and Commentary on Select Aspects of ASME Boiler and pressure Vessel Code and Piping Codes.*
    - Wrote eight peer reviewed papers and was invited speaker in five panel sessions on the subject of piping.

    - Taught short courses on ASME B31.3 and Piping Vibration, as well as tutorials on ASME B31.3 as part of ASME Pressure Vessel and Piping Conferences (six times), the International Pipeline Conference, The MTI Second International Conference on the Mechanical Integrity of Process Piping, and Cape 2001; and tutorials on piping vibration as part of ASME Pressure Vessel and Piping Conferences and Cape 2001.
    - Chair, ASME B31.3; Member B31 Mechanical Design Committee; Member B31 Standards Committee.
- Elevated Temperature Design
    - Discovered that pressure induced bending stresses at discontinuities behave as primary stresses and identified the mechanism that results in this behavior (*Behavior of Pressure Induced Discontinuity Stresses at Elevated Temperature,* 1986).
    - Developed simplified elevated temperature design methods based on shakedown concepts (*A Simplified Approach for Evaluating Secondary stresses in Elevated Temperature Design,* 1983; *Elevated Temperature Shakedown Concepts,* 2008; *Extension of Fatigue Exemptions rules in Section VII, Div 2 slightly into the Creep Regime*, 2008).
    - Developed criteria in an ASME Research Project to extend Section VIII, Div 2 fatigue analysis exemption criteria into the creep range (*Extend Fatigue Exemption Rules for Low Cr Alloys Slightly into the Time-Dependent Range,* 2008).
    - Developed criteria in an ASME Research Project to provide time dependent stress limits for Section VIII, Div 1 construction (*Time Dependent Allowable Stresses in Section VIII, Div 1*, 2008).
    - Wrote 14 peer reviewed papers, presented in three panel sessions, and wrote two ASME Research reports on the subject of elevated temperature design.
    - Former Chair and current Member of the ASME Boiler and Pressure Vessel Code Subgroup on Elevated Temperature Design.
- Post Construction
    - Founded and Chair the ASME Post Construction Subcommittee on Repair and Testing, which created the new standard, *Repair of Pressure Equipment and Piping.*
    - Member and former Chair of the Post Construction Standards Committee and Post Construction Executive Committee.
    - Former member of Subcommittee on Flaw Evaluation.
    - Wrote six peer reviewed papers on post construction issues such as repair and fitness for service, presented in two panel sessions and taught a tutorial on the subject in the ASME Pressure Vessel and Piping Conference.
- Simplified Methods
    - Developed simplified methods for elevated temperature design and elastic plastic analysis.
    - Technical papers include:
        - Introduction of use of twice yield stress in elastic plastic analysis to calculate strain range for fatigue using monotonic loading (*Fatigue Analysis Using Simplified Elastic Plastic Analysis,* 1995),

- Use of secant modulus in elastic plastic analysis to predict creep buckling of thermoplastic pipe (*Evaluation of Creep Buckling of Thermoplastic Pipe*, 1998), and
- Use of secant modulus in elastic plastic analysis to estimate limit load (*Robust Limit Load Estimation Using Secant Modulus Techniques*, 1996).

The years in parenthesis are dates of publications on the subject.