

# **Eighth International Conference on Advances in Materials Technology for Fossil Power Plants 2016**

Albufeira, Portugal  
11 - 14 October 2016

Volume 1 of 2

**Editors:**

**J. Parker  
J. Shingledecker  
J. Siefert**

ISBN: 979-8-3313-0545-1

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2016) by ASM International  
All rights reserved.

Printed with permission by Curran Associates, Inc. (2025)

For permission requests, please contact ASM International  
at the address below.

ASM International  
9639 Kinsman Road  
Materials Park, Ohio 44073-0002  
USA

Phone: +1 440.338.5151

[memberservicecenter@asminternational.org](mailto:memberservicecenter@asminternational.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

## VOLUME 1

|                                                                                                                                                                                                                            |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| United States Advanced Ultra-Supercritical Component Test Facility with 760°C Superheater and Steam Turbine.....                                                                                                           | 1   |
| <i>Robert Romanosky, Vito Cedro, Robert Purgert, Jeffrey N. Phillips, Horst Hack, Paul Weitzel, James Pschirer, James Claeys</i>                                                                                           |     |
| 700°C A-USC Technology Development in Japan.....                                                                                                                                                                           | 12  |
| <i>M. Fukuda, T. Yoshida, A. Iseda, H. Semba, E. Saito, M. Kitamura, T. Dohi, H. Aoki, K. Muroki, H. Fukutomi, K. Sato, K. Takahashi, N. Saito, Y. Hirakawa, T. Nishii, T. Takahashi, T. Takano, Y. Matsubara, Y. Yagi</i> |     |
| Status of the Power Industry in China and Overall Progress for A-USC Technology.....                                                                                                                                       | 24  |
| <i>Zhengdong Liu</i>                                                                                                                                                                                                       |     |
| Next Generation Casting Materials for Fossil Power Plants .....                                                                                                                                                            | 35  |
| <i>S. Roberts, R. Leese, S. Birks</i>                                                                                                                                                                                      |     |
| Review of the European Developments of MarBN Steel for USC Power Plants.....                                                                                                                                               | 47  |
| <i>Bartosz Polomski, Rod Vanstone</i>                                                                                                                                                                                      |     |
| Materials Performance in the First U.S. Ultrasupercritical (USC) Power Plant.....                                                                                                                                          | 55  |
| <i>Michael Crichton, John Shingledecker</i>                                                                                                                                                                                |     |
| Some Problems in Metal Material Service of Fossil Power Units in Mainland China.....                                                                                                                                       | 66  |
| <i>Jianmin Jia, Hong Ma, Xionghua Cui, Junmin Wang</i>                                                                                                                                                                     |     |
| Component Relevant Creep Damage in Tempered Martensitic 9 to 12 %Cr Steels.....                                                                                                                                            | 74  |
| <i>Jonathan Parker</i>                                                                                                                                                                                                     |     |
| Material and Design Aspects for Modern Steam Power Plants .....                                                                                                                                                            | 90  |
| <i>Torsten-Ulf Kern, Henning Almstedt</i>                                                                                                                                                                                  |     |
| Alloy 740H: Development of Fittings Capability for A-USC Applications .....                                                                                                                                                | 101 |
| <i>John J. deBarbadillo, Brian A. Baker, Stephen A. McCoy</i>                                                                                                                                                              |     |
| Correlation of Microstructure and Properties of Alloy 617B and Alloy C-263 for A-USC Power Plants .....                                                                                                                    | 113 |
| <i>Nicole de Boer, Patrik Schraven</i>                                                                                                                                                                                     |     |
| Influence of Data Scattering on Estimation of 100,000 Hours Creep Rupture Strength of Alloy 617 and Alloy 740 by Larson-Miller Method.....                                                                                 | 125 |
| <i>Fujio Abe, Masaaki Tabuchi, Masao Hayakawa</i>                                                                                                                                                                          |     |
| Creep Degradation Assessment of Ni-Based Alloys by Hardness Method.....                                                                                                                                                    | 137 |
| <i>Fujimitsu Masuyama, Kazuki Ishiyama, Tomiko Yamaguchi</i>                                                                                                                                                               |     |
| Creep-Fatigue Life and Damage Evaluation of Ni-Based Alloy 617 and Alloy 740H.....                                                                                                                                         | 149 |
| <i>Shengde Zhang, Yukio Takahashi</i>                                                                                                                                                                                      |     |
| Application of Inconel 740H to Pipe Transition Joints in Advanced Power Plant .....                                                                                                                                        | 161 |
| <i>P. Moody, P. Barnard, T. Dauda, B.A. Baker, R.D. Gollihue</i>                                                                                                                                                           |     |

|                                                                                                                                                               |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Performance and Causes of Failure for Circumferential Welds and Welded Branch Connections for 23Cr-45Ni-7W Alloy Under Internal Pressure Conditions .....     | 169 |
| <i>Keiji Kubushiro, Kenji Tokuda, Kyohei Nomura</i>                                                                                                           |     |
| Effects of Trace Elements on Creep Properties of Nickel-Iron Base Superalloy.....                                                                             | 181 |
| <i>Yusaku Hasebe, Eiji Maeda, Koichi Takasawa</i>                                                                                                             |     |
| A Newly Designed Nickel-Based Superalloy GH750 For 700°C Advanced Ultra-Supercritical Power Plants .....                                                      | 190 |
| <i>Fusheng Lin, Shuangqun Zhao, Rui Fu, Yanfeng Wang, Xishan Xie, Chengyu Chi, Yaohe Hu, Maicang Zhang</i>                                                    |     |
| Design, Creep Performance and Deformation Behavior of an Eta-Phase Strengthened Nickel-Base Alloy for A-USC Power Plant Applications .....                    | 202 |
| <i>W.W. Milligan, P.G. Sanders, C.L. White, J.P. Shingledecker, D.F. Purdy</i>                                                                                |     |
| Precipitate Phase Stability and Compositional Dependence on Alloying Additions in Advanced Ni-Base Superalloys .....                                          | 213 |
| <i>S. Antonov, M. Detrois, S. Tin</i>                                                                                                                         |     |
| Development of Ni-Base Superalloy USC141 for 700°C Class A-USC Boiler Tubes.....                                                                              | 224 |
| <i>Toshihiro Uehara, Naoya Sato, Masaru Shimizu, Patrik Schraven</i>                                                                                          |     |
| Creep and Creep Rupture Behavior of Nickel-Base Alloys for Superheaters After Cold Working .....                                                              | 235 |
| <i>Falk Mueller, Matthias Oechsner</i>                                                                                                                        |     |
| Experimental Investigations and Numerical Simulation Accompanying the HWT Test Loop Operation.....                                                            | 247 |
| <i>Magdalena Speicher, Andreas Klenk, Heiner Oesterlin, Gerhard Maier, Michael Schwienheer, Yan Wang, Alfred Scholz, Matthias Oechsner</i>                    |     |
| Design, Operation, Numerical Simulation and Damage Assessment of a Header in the HWT Test Loop .....                                                          | 260 |
| <i>Magdalena Speicher, Andreas Klenk, Tobias Steck, Andreas Helmrich, Frank Kluger</i>                                                                        |     |
| Investigation of Long Term Creep Damage Behavior and Life Assessment of Ni Based Weldment .....                                                               | 271 |
| <i>T. Tokairin, M. Kitamura</i>                                                                                                                               |     |
| Research and Development of a New Austenitic Heat-Resisting Steel SP2215 for 600-620°C USC Boiler Superheater/Reheater Application .....                      | 283 |
| <i>Xishan Xie, Chengyu Chi, Hongyao Yu, Jianxin Dong, Maicang Zhang, Yaohe Hu, Hui Yang, Cheng Zhu, Jianxin Song, Qiuhua Zhu, Zhengqiang Cui, Fusheng Lin</i> |     |
| Creep Failure of a Gamma Prime-Strengthened Alumina-Forming Austenitic Stainless Steel .....                                                                  | 295 |
| <i>B. Hu, I. Baker, S.J. Kernion, Y. Yamamoto, M.P. Brady</i>                                                                                                 |     |
| Power Austenite- A Novel $\sigma$ -Phase Hardened High Temperature Alloy for 700 °C (1292 °F) Fired Boilers .....                                             | 304 |
| <i>Michael Spiegel, Patrik Schraven</i>                                                                                                                       |     |
| UNS S31035/1.4990 - A Newly Developed High Strength Heat Resistant Austenitic Stainless Steel for Advanced High Efficiency Coal Fired Power Plants .....      | 310 |
| <i>Urban Forsberg, Guocai Chai, Johan Hernblom, Timo Peltola, Glenn Darley</i>                                                                                |     |
| Development of High Cr Containing FeCrAl Alloys for Fossil Energy Structural Applications .....                                                               | 318 |
| <i>Yukinori Yamamoto, Bruce A. Pint, Benjamin Shassere, Sudarsanam Suresh Babu</i>                                                                            |     |

|                                                                                                                         |     |
|-------------------------------------------------------------------------------------------------------------------------|-----|
| Research on HR6W Manufactured Reheater Outlet Header of the Advanced USC Boiler.....                                    | 326 |
| <i>Tian Zhihao, Zhu Yufeng, Lu Xiaoli, Wang yu, Yang Kaiyin, Wang Chongbin</i>                                          |     |
| Investigation and Assessment of Stress Corrosion Cracking of Welded HR3C Superheater Pipes of the MPP3 Power Plant..... | 336 |
| <i>Hans Hoffmeister, Mirko Bader</i>                                                                                    |     |
| Creep Failure Analysis of Superheater Tubes in a Supercritical Boiler.....                                              | 347 |
| <i>Chang Che, Gong Qian, Linfeng Qian, Xinzhong Chen</i>                                                                |     |
| Neutral Zone Crack and Window Opening Failure in SA213 TP347H Bent Tube .....                                           | 356 |
| <i>Byeongook Kong, Kyongwoon Lee, Jungmin Han, Yunil Chol, Youngwha Ma, Dojin Cha, JhinIk Suk</i>                       |     |
| Creep Behavior and Microstructural Evolution of Super 304H .....                                                        | 365 |
| <i>Paul G. Sanders, Calvin L. White, Daniel J. Seguin, Sitarama Raju Kada, John P. Shingledecker</i>                    |     |
| Microstructure Impacts on Mechanical Properties in a High Temperature Austenitic Stainless Steel .....                  | 377 |
| <i>D. Purdy, P.J. Maziasz, J. Wharry, C. Dolph</i>                                                                      |     |
| Research on Magnetic Behavior of Austenitic Heat-Resistant Steel Boiler Tubes After Service.....                        | 388 |
| <i>Zhi-gang Shi, Hong Ma, Xiong-hua Cui, Hong-zhe Wang, Xiao-dong He</i>                                                |     |
| Thermal Fatigue Properties of Dissimilar Welded Part of SUPER304H Boiler Steel Tube .....                               | 400 |
| <i>Yasutaka Noguchi, Hiroyuki Hirata, Mitsuru Yoshizawa, Katsuki Tanaka</i>                                             |     |
| Creep Behavior and Microstructure Evolution in AISI 316LN + 0.1 Wt.% Nb Steel at 600 and 625°C.....                     | 407 |
| <i>Vlastimil Vodárek, Jakub Rehořek</i>                                                                                 |     |
| Long-Term Creep Rupture Properties and Microstructures in HR6W (44Ni-23Cr-7W) for A-USC Boilers .....                   | 418 |
| <i>Nobuhiko Saito, Nobuyoshi Komai, Keita Hashimoto, Masaki Kitamura</i>                                                |     |
| Influence of Holding Time During Tempering on the Long-Term Creep Rupture Strength of MOD.9Cr-1Mo Steel.....            | 429 |
| <i>Nobuyoshi Komai, Ko Arisue, Kimihiko Tominaga, Masaaki Fujita</i>                                                    |     |
| Steelmaking Challenges to Achieve Grade 91 with Ultra-Low Impurity Content .....                                        | 440 |
| <i>P. Mariani, A. Marinari, M. Donati, M. Arrigoni</i>                                                                  |     |
| Microstructure and Creep Strength of Grade 91 Steel Used in USC Plants .....                                            | 446 |
| <i>Masatsugu Yaguchi, Seiji Nagai, Kota Sawada, Kazuhiro Kimura</i>                                                     |     |
| Effect of Stress and Strain on Microstructural Changes During Long-Term Creep in T91 Steel.....                         | 458 |
| <i>Kota Sawada, Toru Hara, Hideaki Kushima, Kazuhiro Kimura, Masaaki Tabuchi</i>                                        |     |
| Evaluation of Long-Term Creep Rupture Life of Gr.91 Steel by Analysis of On-Going Creep Curves.....                     | 466 |
| <i>Kouichi Maruyama, Junya Nakamura, Kyosuke Yoshimi, Yuji Nagae</i>                                                    |     |
| Structural Changes in P92-Type Martensitic Steel During Creep at 600°C .....                                            | 478 |
| <i>A. Fedoseeva, I. Nikitin, V. Dudko, N. Dudova, R. Kaibyshev</i>                                                      |     |

|                                                                                                                                   |     |
|-----------------------------------------------------------------------------------------------------------------------------------|-----|
| Evaluation of Long Term Creep Strength of Mod. 9Cr Heat Resistant Ferritic Steel with the Aid of System Free Energy Concept ..... | 486 |
| <i>Yoshinori Murata, Naoya Watanabe, Yuji Nagae</i>                                                                               |     |
| Investigation and Post Service Creep Testing of a Mis-Heat Treated Seam Welded Grade 91 Hot Reheat Bend .....                     | 494 |
| <i>S J Brett, S Kimpton, A Clark</i>                                                                                              |     |
| Small Scale Impression Creep Testing of an Ex-Service Mis-Heat Treated Seam Welded Grade 91 Hot Reheat Bend .....                 | 506 |
| <i>S J Brett, T Lant, A Clark</i>                                                                                                 |     |
| Impression Creep Testing and Its Role in Power Plant Component Integrity Management.....                                          | 516 |
| <i>C. Dyson, W. Sun, S. J. Brett, T. H. Hyde, C. J. Hyde, J. Shingledecker, D. Purdy</i>                                          |     |
| Linking Performance of Parent Grade 91 Steel to the Cross-Weld Creep Performance Using Feature Type Tests .....                   | 530 |
| <i>John A. Siefert, Jonathan D. Parker, Rachel C. Thomson</i>                                                                     |     |
| Creep Damage Evaluation Method for Welded Joints of Grade 91 Steels .....                                                         | 544 |
| <i>Kimiaki Yoshida, Hideki Tsuruta, Masaaki Tabuchi, Ken-ichi Kobayashi</i>                                                       |     |
| Development and Application of T91 Cold Weld Repair Techniques .....                                                              | 556 |
| <i>K.C. Mitchell</i>                                                                                                              |     |
| The Effect of Pre-Service Treatments on the Long Term Properties of 9Cr Steels Strengthened by Boron and Nitrogen .....           | 568 |
| <i>A. Sammarco, R. C. Thomson, R. Vanstone</i>                                                                                    |     |
| Research on Test and Evaluation of High Depth-To-Width Ratio Longitudinal Defects of Boiler Tube Inner Wall .....                 | 581 |
| <i>Lei Zhang, Hong Ma, Jinwen Cui, Zhigang Shi, Xionghua Cui</i>                                                                  |     |
| Analysis on Effect of Piping Stress and Supports and Hangers on Cracking of Tee Welds .....                                       | 590 |
| <i>Bo Zhao, Hong Ma, Lei Dong, Junmin Wang, Bining Wang, Linghui Deng, Yongming Cheng</i>                                         |     |

## VOLUME 2

|                                                                                                                                                                                     |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Life Diagnosis and Extension of a High Temperature Heating Surface .....                                                                                                            | 600 |
| <i>Haitao Cao, Hong Ma, Lei Zhang, Zhigang Shi, Fangping Zheng, Xipeng He</i>                                                                                                       |     |
| The Influence of Prior Austenite Grain Size on Fatigue Crack Growth Threshold of welds in Cr-Mo-V Steel Components .....                                                            | 610 |
| <i>Xin Huo, Peng Wang, Mengjia Hu, Zhipeng Cai, Jiluan Pan</i>                                                                                                                      |     |
| Effect of Ductility on Load-Stress Conversion Factor of Small Punch Creep Test .....                                                                                                | 622 |
| <i>Shin-ichi Komazaki, Yuya Ohkawa, Mitsuharu Yonemura</i>                                                                                                                          |     |
| Alternate Analytical Methodology to ASME Section I Design for Membrane Walls with Bimetallic Tube for High Temperature Sections of Advanced Ultrasupercritical (AUSC) Boilers ..... | 632 |
| <i>Reddy Ganta</i>                                                                                                                                                                  |     |
| Qualification of UNS N07028 for Forged Steam Turbine Rotors .....                                                                                                                   | 644 |
| <i>Deepak Saha, Stephen Coryell, John deBarbadillo, Ian Dempster, Lee Barber</i>                                                                                                    |     |

|                                                                                                                                                    |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| New Material and Manufacturing Developments for USC and A-USC Steam Turbine Rotor Forgings.....                                                    | 656 |
| <i>B. Donth, N. Blaes, A. Diwo, D. Bokelmann</i>                                                                                                   |     |
| Creep Crack Behavior in Alloy C-263 Used for Thick-Walled Components .....                                                                         | 668 |
| <i>Falk Mueller, Matthias Oechsner, Nicole de Boer, Vida Knezevic</i>                                                                              |     |
| Development of Low Thermal Expansion Fe-Ni-Cr Austenitic Heat Resistant Steel for High Temperature Steam Turbine.....                              | 678 |
| <i>Shun Oinuma, Reki Takaku, Yujiro Nakatani, Kiyoshi Imai, Masayuki Yamada, Takahiro Kubo</i>                                                     |     |
| Development of Large Sand Casting of Haynes 282 for A-USC Turbine .....                                                                            | 690 |
| <i>Subrahmanyam Thangirala, James Myers</i>                                                                                                        |     |
| Tensile, Creep and Microstructural Behavior of Welded Cast Haynes 282 Alloy for A-USC Steam Turbine Casing Applications .....                      | 702 |
| <i>P.J. Maziasz, J. Moser, K. Unocic, Y. Yang, D. Purdy, P.D. Jablonski</i>                                                                        |     |
| Microstructural Changes in GX12CRMOWVNB10-1-1 Steel During Creep at 893 K .....                                                                    | 714 |
| <i>V. Dudko, J. Borisova, R. Kaibyshev, V. Skorobogatykh, I. Schenkova</i>                                                                         |     |
| Influence of Apparatus Design and Test Method on the High Temperature Solid Particle Erosion of Nimonic 80A .....                                  | 723 |
| <i>A.T. Fry, D. Gorman, L.E. Crocker, M.G. Gee, A. Gant, J. Nicholls, T. Rose, F. Cernuschi, L. Lorenzoni, C. Guardamagna</i>                      |     |
| Comparison of the Effects of Conventional Heat Treatments on Cast and Selective Laser Melted IN939 Alloy .....                                     | 735 |
| <i>W. Philpott, M. A. E. Jepson, R. C. Thomson</i>                                                                                                 |     |
| Analysis, Assessment and Processing of the Recirculation Pump Casing Damage in the Power Plant Staudinger Unit 5.....                              | 747 |
| <i>M. Bader, A. Bagaviev, E. Kaufhold, H.-W. Wolf</i>                                                                                              |     |
| Mechanical Analysis of a Boiler Water Circulation Pump .....                                                                                       | 759 |
| <i>Marcus Haßlöcher</i>                                                                                                                            |     |
| Robust Quantification of Phase Formation Potential Over a Wide Chemistry Space .....                                                               | 768 |
| <i>D. Purdy</i>                                                                                                                                    |     |
| 9-10% Cr Steel Forgings for USC Turbines - Experiences in Manufacturing and Development Status of MARBN Steels.....                                | 778 |
| <i>Guenther Zeiler, Stefan Paul, Ernst Plesiutchnig</i>                                                                                            |     |
| Development of 9Cr Steels for High Temperature Steam Turbine Rotors .....                                                                          | 790 |
| <i>Masato Mikami, Takayuki Miyata, Masaaki Tabuchi, Fujio Abe</i>                                                                                  |     |
| Property Analysis of Waspaloy Alloy As Bolts and Blades for 700°C Steam Turbines .....                                                             | 802 |
| <i>Yu Wang, Lingen Sun, Wenlong Yu</i>                                                                                                             |     |
| Field and Laboratory Observations on the Steam Oxidation Behavior of Creep Strength Enhanced Ferritic Steels and Austenitic Stainless Steels ..... | 813 |
| <i>B. A. Pint, I. G. Wright, S. Kung, J. P. Shingledecker</i>                                                                                      |     |
| Evaluating The Effect of Cold Work on Supercritical Oxidation of Boiler Tube Materials .....                                                       | 823 |
| <i>Sanni Yli-Olli, Satu Tuurna, Pertti Auerkari, Sami Penttilä</i>                                                                                 |     |

|                                                                                                                                                                           |      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| The Influence of Surface Quality of Grade 91 Tubing on Long-Term Oxidation in Steam .....                                                                                 | 832  |
| <i>David M. Gorman, Antony T. Fry</i>                                                                                                                                     |      |
| The Effect of Impurities on Supercritical CO <sub>2</sub> Compatibility of Structural Alloys .....                                                                        | 844  |
| <i>B. A. Pint, R. G. Brese, J. R. Keiser</i>                                                                                                                              |      |
| Oxidation Resistance of Shot Peened Austenitic Stainless Steel Superheater Tubes in Steam .....                                                                           | 855  |
| <i>Brett M. Tossey, Hassan Khan, Tom Andress</i>                                                                                                                          |      |
| High Temperature Oxidation of Austenitic Steels and Nickel-Based Alloys in Steam Environment.....                                                                         | 867  |
| <i>Zhiyuan Liang, Qinxin Zhao, Preet M. Singh</i>                                                                                                                         |      |
| Tenaris New High Steam Oxidation Resistant, Creep Strength Enhanced Ferritic Steel Thor 115 .....                                                                         | 877  |
| <i>Y. Minami, Y. Yamamoto, M. Ortolani, P. Mariani, B. Pint</i>                                                                                                           |      |
| Corrosion of Nickel-Base Alloys by Supercritical CO <sub>2</sub> .....                                                                                                    | 888  |
| <i>R.I Olivares, W. Stein, T.D. Nguyen, D.J. Young</i>                                                                                                                    |      |
| Steam Oxidation Resistance of Advanced Austenitic Steels with High Cr Content and Advanced Ni<br>Based Alloys at High Temperatures for A-USC Coal Fired Power Plants..... | 900  |
| <i>T. Dudziak, N. Sobczak, J. Sobczak, V. Deodeshmukh, M. Witkowska, W. Ratuszek, K.<br/>Chruściel</i>                                                                    |      |
| Fireside Corrosion and Steamside Oxidation Behavior of HAYNES 282 Alloy for A-USC<br>Applications.....                                                                    | 912  |
| <i>V. P. Deodeshmukh, B. A. Pint</i>                                                                                                                                      |      |
| Supercritical Water Oxidation and Creep Behaviour of Boiler Tube Materials.....                                                                                           | 924  |
| <i>Satu Tuurna, Rami Pohja, Sanni Yli-Olli, Sami Penttilä</i>                                                                                                             |      |
| Property of 9Cr-3W-3Co-Nd-B Heat-Resistant Steel SAVE12AD Welded Joint.....                                                                                               | 931  |
| <i>Shinnosuke Kurihara, Takahiro Osuki, Tomoaki Hamaguchi, Hiroyuki Semba, Hirokazu<br/>Okada, Hiroyuki Hirata, Mitsuru Yoshizawa</i>                                     |      |
| Development of Matching Welding Consumables for Boron/Cobalt Alloyed 9%Cr-Mo Steels and<br>the Weld Metal Properties .....                                                | 939  |
| <i>Zhuyao Zhang, Mark Golding, Claude Bouillot</i>                                                                                                                        |      |
| Creep Rupture Strength of Dissimilar CB2-P92 FCW Joint Welds.....                                                                                                         | 951  |
| <i>Susanne Baumgartner, Hannes Pahr, Ronald Schnitzer</i>                                                                                                                 |      |
| Microstructural Characterisation of Creep Tested 9Cr Welds for MarBN Steel.....                                                                                           | 962  |
| <i>J. Guo, M. A. E. Jepson, R. C. Thomson</i>                                                                                                                             |      |
| The Evolutionary Behavior of Laves Phase in Virgin FB2 Steel During Welding and Its Effect on<br>Weld Joints .....                                                        | 974  |
| <i>Kejian Li, Zhipeng Cai, Jiluan Pan</i>                                                                                                                                 |      |
| Inspection and Evaluation of Defects on the Welds of P92 Header.....                                                                                                      | 983  |
| <i>Xipeng He, Hong Ma, Fugui Wang, Baozhu Zhang, Jinwen Cui, Haitao Cao</i>                                                                                               |      |
| Experience with 9Cr3W3CoVNbBN Steel in Terms of Welding, Creep and Oxidation .....                                                                                        | 989  |
| <i>K. G. Abstoss, A. Nitsche, P. Mayr, C. Schlacher, V. Gonzalez, A. Agüero</i>                                                                                           |      |
| Secondary Hardening of T24 Steel Weld Joints Performed at Incorrect Interpass Temperature and<br>Low Temperature Heat Treatment .....                                     | 1001 |
| <i>Martin Sondel, Jaroslav Koukal, David Schwarz, Petr Mohyla</i>                                                                                                         |      |



|                                                                                                                                                    |      |
|----------------------------------------------------------------------------------------------------------------------------------------------------|------|
| G115 Steel and Its Application for 600+°C A-USC-Power Plants .....                                                                                 | 1010 |
| <i>Zhengdong Liu, Hansheng Bao, Zhengzong Chen, Songqian Xu, Haiping Zhao, Peng Yan, Qijiang Wang</i>                                              |      |
| Development Status of High Performance Ferritic (HiperFer) Steels .....                                                                            | 1018 |
| <i>B. Kuhn, M. Talik, J. Lopez Barrilao, L. Singheiser, Y. Yamamoto</i>                                                                            |      |
| Microstructure and Intermetallic Particle Evolution in Fully Ferritic Steels.....                                                                  | 1027 |
| <i>Jennifer Lopez Barrilao, Bernd Kuhn, Egbert Wessel</i>                                                                                          |      |
| Manufacturing Experience of Thor 115 Components.....                                                                                               | 1036 |
| <i>P. Mariani, L. Fullin, A. Marinari, M. Ortolani, S. Baietta</i>                                                                                 |      |
| Thor115 Welding Experience .....                                                                                                                   | 1046 |
| <i>D. Jones, M. Ortolani, P. Mariani, S. Baietta, Y. Yamamoto</i>                                                                                  |      |
| Tantalum and Niobium Based Z-Phase in A Z-Phase Strengthened 12% Cr Steel.....                                                                     | 1058 |
| <i>Masoud Rashidi, Robert Lawitzki, Hans-Olof Andren, Fang Liu</i>                                                                                 |      |
| Long-Term Microstructural Evolution in a 10%Cr High Creep Resistant Martensitic Steel at 650°C .....                                               | 1067 |
| <i>Roman Mishnev, Nadezhda Dudova, Rustam Kaibyshev</i>                                                                                            |      |
| Evaluation of Hardness Levels of T24 Boiler Tube Butt Welds Regarding SCC Susceptibility in High Temperature Water.....                            | 1075 |
| <i>Fabian Unterumsberger, Dietrich Bernds, Michael Pohl</i>                                                                                        |      |
| Environmental Assisted Cracking of Alloy T24 in Oxygenated High-Temperature Water .....                                                            | 1086 |
| <i>Bastian Devrient, Renate Kilian, Fabian Unterumsberger, Dietrich Bernds</i>                                                                     |      |
| Investigation of the Observed Stress Corrosion Cracking of T24 Material.....                                                                       | 1098 |
| <i>C. Ullrich, H.-G. Rademacher, W. Tillmann, R. Zielke, P. Körner</i>                                                                             |      |
| Influence of Aluminum Diffusion Layer on T/P92 Steam Oxidation Resistance - A Laboratory and Field Study .....                                     | 1113 |
| <i>J. Allenou, J. Pirón-Abellán, E. Hugon, C. Landier, Th. Le Guevel</i>                                                                           |      |
| Long-Term Material Tests in Liquid Molten Salts.....                                                                                               | 1126 |
| <i>J. Preußner, W. Pfeiffer, E. Piedra, S. Oeser, M. Tandler, P. von Hartrott, G. Maier</i>                                                        |      |
| Corrosion Products Development on Haynes282 Gamma - Prime ( $\gamma'$ ) Strengthened Alloy at 550 °C Under Salt Mist Conditions for 500 Hours..... | 1138 |
| <i>T. Dudziak, N. Sobczak, J. Sobczak, A. Siewiorek, R. M. Purgert</i>                                                                             |      |
| Long-Term Creep Rupture Strength and Microstructural Evolution of Weldments in Mod.9Cr-1Mo Steels .....                                            | 1149 |
| <i>Ko Arisue, Nobuyoshi Komai, Kimihiko Tominaga, Masaaki Fujita</i>                                                                               |      |
| Microstructural Evolution and Mechanical Properties in Simulated Heat Affected Zone Regions of Grade 91 Welds .....                                | 1160 |
| <i>Kyle Stritch, Boian T. Alexandrov</i>                                                                                                           |      |
| Effect of Aging on Creep Strength of Grade 91 Steel Weld Metal .....                                                                               | 1170 |
| <i>Sosuke Nakahashi, Masatsugu Yaguchi, Koji Tamura, Yusuke Minami</i>                                                                             |      |
| Investigating Effects of Variations in Heat Treatment Parameters on Performance of CSEF Welds.....                                                 | 1182 |
| <i>P Doubell, M E J Bezuidenhout, R D Knutsen, J Westraadt</i>                                                                                     |      |

|                                                                                                                                        |      |
|----------------------------------------------------------------------------------------------------------------------------------------|------|
| Experimental Study of the Creep Performance of Creep Strength Enhanced Ferritic Steel<br>Weldments .....                               | 1194 |
| <i>Xinghua Yu, Zhili Feng</i>                                                                                                          |      |
| Dissimilar Metal Welds in Grade 91 Steel.....                                                                                          | 1199 |
| <i>Michael W. Kuper, Boian T. Alexandrov, Michael J. Mills, D. Joshua Burgess</i>                                                      |      |
| Influence of Fusion Ratio on Carbon Migration Phenomenon in the Narrow Gap Welding of<br>Dissimilar Metals in 9% Chromium Steels ..... | 1207 |
| <i>Yuming Ding, Xiaojin Xu, Yunwei Zheng, Zhipeng Cai, Jiluan Pan</i>                                                                  |      |

## **Author Index**