The Ux Consulting Company, LLC ("UxC") shall have title to, ownership of, and all proprietary rights in this Report. Under United States federal copyright law (17 USC 101 et seq.) it is illegal to reproduce this Report by any means without written permission from UxC.

The information contained in this Report is obtained from sources that UxC believes to be reliable. UxC makes no warranty or representation, express or implied, with respect to the accuracy, completeness or usefulness of the information contained in this Report and UxC, to the maximum extent permitted by law, assumes no liability for the use or effects of any of the information or data contained in this Report.

It is UxC’s strict policy not to endorse, promote, or recommend any particular securities, currencies, or other financial products or instruments. Nothing contained in this Report is intended to constitute investment, legal, tax, accounting or other professional advice and the reader should not rely on the information provided in this Report for making financial decisions.

The Ux U3O8 Price® and other Ux Price indicators are developed by The Ux Consulting Company, LLC (UxC) and are proprietary and exclusive intellectual property of UxC. These price indicators are provided to UxC’s customers through the Ux Weekly® publication and are made available on UxC’s public website solely at UxC’s discretion. They may not be reproduced or otherwise used without UxC’s express permission.

UxC®, Ux Weekly®, Ux U3O8 Price®, Ux®, and Ux Consulting®, U-PRICE™, and SWU-PRICE® are trademarks of The Ux Consulting Company, LLC.
# Table of Contents

**Introduction & Overview** ................................................. 6  
  Comprehensive Coverage of the Global Nuclear Zirconium Industry ......................................................... 7  
  Availability of Data ................................................................. 7  
  What’s New in the 2015 Report? ................................................... 8  
  Structure of the Report ............................................................... 9  

1 – General Zirconium Overview ............................................... 11  
  Occurrence ................................................................................. 11  
  • Primary Producing Countries .................................................. 12  
  • Hafnium Occurrence ............................................................... 13  
  General Uses .............................................................................. 14  
  • Zirconium Metal .................................................................... 17  
  Nuclear Applications ................................................................... 17  
  • New Nuclear Zirconium Alloys Under Development .................. 18  
  Zircon Resources and Production .................................................. 21  
  • Reserves and Resources .......................................................... 21  
  • Notes on USGS Data ............................................................... 21  
  • Zircon Mining ......................................................................... 22  
  • Zircon Production ................................................................. 24  
  Zircon Consumption and Prices ................................................. 31  
  • Summary ................................................................................. 31  
  • Consumption of Zircon .......................................................... 31  
  • Market Dynamics ................................................................. 34  
  • Zircon Prices .......................................................................... 37  
  The Influence of China ............................................................... 39  
  Conclusions ............................................................................... 40  

2 – Manufacturing Processes for Nuclear Fuel Cladding ................. 41  
  Production of Zirconium Sponge .................................................. 41  
  • The Importance of Hafnium Separation .................................. 42  
  • Zircon Sand Processing .......................................................... 43  
  • Hafnium Removal ................................................................. 43  
  • Final Sponge Production ....................................................... 43  
  Manufacture of Zirconium Alloy Ingots ........................................ 45  
  Manufacture of Zirconium Alloy Plate, Sheet, Bar Stock, and Tube-Reduced Extrusions (TREX) .......... 46  
  Production of Nuclear Fuel Tubing .............................................. 48  

3 – Nuclear Zirconium Alloy Materials & Product Suppliers ........ 51  
  Zirconium Sponge Producers .................................................... 52  
  • China ..................................................................................... 53  
  • France .................................................................................... 55  
  • India ...................................................................................... 57  
  • Russia ................................................................................... 58  
  • Ukraine .................................................................................. 59  
  • United States ....................................................................... 61  
  Producers of Zirconium Alloy Plate, Sheet, Bar Stock, and TREX ................................................. 63  
  • Argentina ............................................................................. 64  
  • China ..................................................................................... 64  
  • France .................................................................................... 66  
  • India ...................................................................................... 67  
  • South Korea ......................................................................... 68  
  • Russia ................................................................................... 68  
  • Sweden .................................................................................. 69  
  • United States ....................................................................... 69  
  Zirconium Alloy Scrap Recycle .................................................... 70  
  Manufacturers of Nuclear Fuel Tubing ...................................... 71  
  • Argentina ............................................................................. 72  
  • Canada .................................................................................. 72
Table of Contents

- China................................................................................................................................. 73
- France ................................................................................................................................. 75
- Germany .............................................................................................................................. 75
- India ................................................................................................................................. 76
- Japan ................................................................................................................................. 76
- South Korea ...................................................................................................................... 78
- Russia .............................................................................................................................. 79
- Sweden ............................................................................................................................. 79
- United Kingdom............................................................................................................... 80
- United States................................................................................................................... 81

Possible Future Developments ........................................................................................... 83

4 – Nuclear Fuel Fabricators & Zirconium Components Supply ........................................ 84

Fabrication Market Overview............................................................................................. 84

Key Players ............................................................................................................................ 85

- AREVA .............................................................................................................................. 85
- Global Nuclear Fuel .......................................................................................................... 85
- Westinghouse Electric Company...................................................................................... 85
- TVEL Fuel Company ......................................................................................................... 86
- KEPCO Nuclear Fuel......................................................................................................... 86
- National and Regional Fuel Suppliers............................................................................. 87

Fabrication Supply & Demand ............................................................................................ 87

Fabrication Market Dynamics............................................................................................ 91

Zirconium Alloy Components and the Fuel Fabrication Process ......................................... 92

- Fuel Cladding .................................................................................................................. 93
- End Plugs or Caps ............................................................................................................. 93
- Fuel Rods ......................................................................................................................... 93
- Spacer Grids ..................................................................................................................... 94
- BWR Water Rods/Channels .......................................................................................... 94
- BWR Fuel Channels ........................................................................................................ 94
- PWR Guide Tubes/Thimbles and Instrument Tubes ....................................................... 95
- End Fittings ...................................................................................................................... 95
- Construction of the Assembly ......................................................................................... 95

Zirconium Tubing & BWR Channel Supply to Fabricators .................................................. 97

- Argentina ......................................................................................................................... 97
- Belgium ............................................................................................................................. 97
- Brazil ............................................................................................................................... 97
- Canada ............................................................................................................................. 97
- China ............................................................................................................................... 97
- France ............................................................................................................................. 98
- Germany .......................................................................................................................... 98
- India ................................................................................................................................. 98
- Japan ............................................................................................................................... 98
- South Korea .................................................................................................................... 98
- Romania ........................................................................................................................... 99
- Russia .............................................................................................................................. 99
- Spain ............................................................................................................................... 99
- Sweden ............................................................................................................................ 99
- United States.................................................................................................................. 99

5 – Nuclear Zirconium Supply & Demand Analysis ............................................................ 100

UxC Nuclear Zirconium Demand Modeling ....................................................................... 100

- Unaccounted for Zirconium Demand .............................................................................. 101

UxC Nuclear Zirconium Supply Forecasting ....................................................................... 102

Global Supply and Demand for Nuclear-Grade Zirconium Sponge ................................... 103

- Zirconium Sponge Demand Forecasts ........................................................................... 103
- Zirconium Sponge Supply Forecast .............................................................................. 104

Global Supply and Demand for Nuclear-Grade Zirconium Alloys ..................................... 106

- Zirconium Alloy Demand Forecasts .............................................................................. 106
- Zirconium Alloy Supply Forecast .................................................................................. 107

© 2015 UxC
Table of Contents

- Global Supply and Demand for Zirconium Tubing ................................................................. 108
  - Zirconium Tubing Demand Forecasts .............................................................................. 108
  - Zirconium Tubing Supply Forecast ................................................................................ 109
- Regional Demand and Supply Considerations ..................................................................... 111
  - Regional Demand Distributions ..................................................................................... 112
  - Analysis of Regional Supply .......................................................................................... 114
- Reactor Type Demand and Supply Considerations ............................................................... 116
  - Reactor Type Demand Distributions .............................................................................. 116
  - Analysis of Reactor Type Zirconium Supply and Demand ............................................. 118
- Overall Conclusions and Market Analysis ......................................................................... 119
  - The Zircon Roller Coaster Ride ...................................................................................... 119
  - The Nuclear Zirconium Alloy Market in the Post-Fukushima World .............................. 121
  - Nuclear Zirconium Alloy Market Supply and Demand Trends ........................................ 123
  - Nuclear-Grade Zirconium Prices ...................................................................................... 124
- Appendix A: Zirconium Weight Calculations for Fuel Assemblies ..................................... 126
- Appendix B: UxC Nuclear Power Forecasts ......................................................................... 127
  - UxC Base Case Reactor Forecast .................................................................................. 127
  - Alternative UxC Reactor Forecast Cases ........................................................................ 129
  - Post-Fukushima Changes to UxC Nuclear Power Forecasts ........................................... 130
- Appendix C: UxC Nuclear Power Regions ......................................................................... 131
- Appendix D: Statistics on Reactor Technologies and Vendors ........................................... 132
List of Figures

Figure 1. Nuclear Zirconium Manufacturing Overview ................................................................. 7
Figure 2. Zircon Sand ....................................................................................................................... 12
Figure 3. Microphotograph of Zircon Sand .................................................................................... 12
Figure 4. Countries with Major Zirconium Resources ................................................................. 13
Figure 5. Applications for Zirconium Materials ........................................................................... 14
Figure 6. Manufacture of Zirconium Products .............................................................................. 15
Figure 7. Historical Demand for Zircon by End Use (1970-2010) ............................................... 16
Figure 8. Zircon Utilization in 2013 ............................................................................................... 16
Figure 9. Zircon Mining Process ................................................................................................... 22
Figure 10. Zircon Mining Pond ....................................................................................................... 22
Figure 11. Zircon Mining Dredging Operations ............................................................................. 23
Figure 12. World Zirconium Reserves Distribution, 2014 ............................................................. 25
Figure 13. World Zirconium Mine Production Distribution, 2014 ............................................... 26
Figure 14. Zirconium Mineral Concentrates Production, 2000-2014 ......................................... 26
Figure 15. World Zirconium Mine Production from Industry Sources ......................................... 27
Figure 16. Zirconium Mineral Concentrates Production by Supplier in 2012 ............................... 28
Figure 17. Global Zircon Consumption, Actual and Forecast, Circa 2012 ................................. 32
Figure 18. Zircon Supply vs. Demand Forecast, 1990-2020, Circa 2010 ..................................... 34
Figure 19. Zircon Supply and Demand (including induced projects), Circa 2011 .......................... 35
Figure 20. Zircon Prices Q1-2010 – Q1-2012 ............................................................................. 37
Figure 21. Zircon Price Trends, 1980-2013 .................................................................................. 38
Figure 22. Typical Zirconium Sponge Production Process .......................................................... 41
Figure 23. Examples of Nuclear-Grade Zirconium Sponge .......................................................... 44
Figure 24. Nuclear Zirconium Alloy Manufacturing Process ....................................................... 45
Figure 25. Nuclear Zirconium Alloy Ingot Production ................................................................. 46
Figure 26. Typical Zirconium Alloy Sheet ..................................................................................... 46
Figure 27. Typical BWR Fuel Assembly Spacer Grid ................................................................. 47
Figure 28. Typical Zirconium Alloy Bar Stock ............................................................................. 47
Figure 29. Typical Zirconium Tube-Reduced Extrusions (TREX) .................................................. 48
Figure 30. Pilgering Process ........................................................................................................ 49
Figure 31. Schematic of the Pilgering Process .............................................................................. 49
Figure 32. Zirconium Alloy Nuclear Fuel Cladding ................................................................. 50
Figure 33. Typical BWR (left) and PWR (right) Fuel Assemblies ............................................... 50
Figure 34. Nuclear Zirconium Sponge Producer Capacity Shares ............................................... 52
Figure 35. First Nuclear-Grade Zirconium Sponge Production at SNWZH Plant ...................... 53
Figure 36. AREVA Zirconium Division ...................................................................................... 56
Figure 37. Nuclear Zirconium Alloy Producer Capacity Shares ............................................... 64
Figure 38. Nuclear Zirconium Alloy Tubing Manufacturer Capacity Shares ............................. 72
Figure 39. Worker Inspecting Zirconium Tubes at CAST Plant ............................................... 74
Figure 40. Worldwide LWR Fabrication Supply and Demand, 2008-2030 ............................... 89
Figure 41. Typical BWR Fuel Assemblies ................................................................................... 92
Figure 42. Typical PWR Fuel Assembly .................................................................................... 93
Figure 43. Typical Fuel Rod ........................................................................................................ 94
Figure 44. Typical BWR (right) and PWR (left) Skeletons/Cages ............................................... 96
Figure 45. UxC Projection of Global Zirconium Sponge Demand, 2008-2030 ....................... 103
Figure 46. Nuclear Zirconium Sponge Supply vs. Demand, 2008-2030 ................................... 105
Figure 47. UxC Projection of Global Zirconium Alloy Demand, 2008-2030 ............................ 106
Figure 48. UxC Global Zirconium Alloy Supply vs. Demand, 2008-2030 ............................... 107
Figure 49. UxC Projection of Global Zirconium Tubing Demand, 2008-2030 ....................... 108
Figure 50. UxC Global Zirconium Tubing Supply vs. Demand, 2008-2030 ........................................................... 109
Figure 51. Regional Distribution of Zirconium Alloy Demand, 2008-2030 ............................................................ 112
Figure 52. Regional Distribution of Zirconium Tubing Demand, 2008-2030 .......................................................... 113
Figure 53. Regional Distribution of Zirconium Alloy Supply .......................................................... 114
Figure 54. Regional Distribution of Zirconium Tubing Supply ............................................................. 115
Figure 55. Reactor Type Distribution of Zirconium Alloy Demand, 2008-2030 ...................................................... 116
Figure 56. Reactor Type Distribution of Zirconium Tubing Demand, 2008-2030 ................................................... 117
Figure B-1. UxC Nuclear Generating Capacity Forecast, 2008-2030 ................................................................. 127
Figure B-2. UxC Base, High, and Low Case Nuclear Capacity Forecasts, 2008-2030 ................................................ 129
Figure B-3. UxC Nuclear Power Forecasts to 2030 – Before & After Fukushima .................................................. 130
Figure C-1. Map of NPO Countries by Region .................................................................................................. 131
Figure D-1. Percentages of Different Operating Reactor Types ........................................................................... 132
Figure D-2. Percentages of New Reactor Types, 2009-2020 .............................................................................. 133
Figure D-3. Percentages of New Reactor Vendors, 2009-2020 .......................................................................... 133

List of Tables

Table 1. Chemical Composition of Principal Zr Alloys (%) ....................................................................................... 18
Table 2. Chemical Composition of HANA™ Alloys ................................................................................................ 20
Table 3. World Zirconium Mine Production and Reserves .................................................................................... 25
Table 4. Comparison of USGS and Industry Zircon Production Data ................................................................. 27
Table 5. New Zircon Mining Projects .................................................................................................................. 30
Table 6. Global Zircon Demand Scenarios Compound Annual Growth Rate (CAGR) ............................................. 35
Table 7. World Nuclear Zirconium Sponge Producers ......................................................................................... 52
Table 8. World Zirconium Alloy, Plate, Sheet, Bar Stock & TREX Producers .......................................................... 63
Table 9. World Nuclear Zirconium Alloy Tubing Manufacturers ........................................................................... 71
Table 10. Worldwide LWR Fuel Fabrication Capacity in 2014 ................................................................................ 88
Table 11. UxC Projection of Global Zirconium Sponge Demand, 2014-2025 & 2030 ............................................... 104
Table 12. UxC Projection of Global Zirconium Alloy Demand, 2014-2025 & 2030 .................................................. 106
Table 13. UxC Projection of Global Zirconium Tubing Demand, 2014-2025 & 2030 ................................................. 108
Table 14. Regional Distribution of Zirconium Alloy Demand, 2014-2025 & 2030 .................................................... 112
Table 15. Regional Distribution of Zirconium Tubing Demand, 2014-2025 & 2030 .................................................. 113
Table A-1. Zirconium Alloy Weight and Tubing Calculations for Fuel Assembly Designs ........................................ 126
Table B-1. Reactor Units & Nuclear Capacities Anticipated by Country by 2030 ...................................................... 128
Table B-2. UxC Base, High & Low Case Nuclear Reactor and Capacity Forecasts, 2014-2025 & 2030 .................... 129
Table B-3. UxC’s Base Case Nuclear Power Forecast to 2030 – Before & After Fukushima ................................... 130
Table D-1. Operating Reactor Types .................................................................................................................... 132
Table D-2. New Reactor Types, 2009-2020 ....................................................................................................... 132
Table D-3. New Reactor Vendors, 2009-2020 ...................................................................................................... 133
Introduction & Overview

The Ux Consulting Company, LLC (UxC) is pleased to present the fifth edition in its special report series, *Nuclear Zirconium Alloy Market.*

The initial report, published in November 2008, was intended to be a one-of-a-kind snapshot of the then-contemporary zirconium alloy industry. However, the highly favorable response to that original report and subsequent report updates demonstrated to us that there is an ongoing need and desire for current information and analysis on this important topic. Thus, we have added the *Nuclear Zirconium Alloy Market* to our list of periodic reports, and our latest findings and conclusions are presented in this new and improved April 2015 edition.

Nuclear-grade zirconium alloys and components are employed in the fabrication of fuel assemblies used in the vast majority of nuclear reactors currently operating, under construction, and planned around the world. Even as the nuclear renaissance has been derailed in many countries by the Fukushima accident, many aspects of the international nuclear fuel supply chain continue to be of concern.

The supply of nuclear-grade zirconium alloys – from the mining of zircon mineral sand through the manufacture of cladding and other components used in finished nuclear fuel assemblies – has not escaped this scrutiny. Therefore, the primary objective of this report is to factually and analytically approach the current and expected future direction of the nuclear-grade zirconium alloy market with the aim of reaching some clear conclusions about how producers of fuel assemblies for nuclear reactors will obtain the necessary zirconium alloys for their finished products.

This up-to-date report, published in April 2015, offers UxC’s most recent analyses and opinions of the various sectors that make up the nuclear-grade zirconium sponge, alloy, materials, and tubing markets. Additional details are included on the interplay of the nuclear fuel fabrication and zirconium alloy supply markets, and of the fabrication process itself. We then assess major trends in this unique industry by analyzing the global and regional supply and demand balances for nuclear-grade zirconium sponge, alloy, and tubing as well as the supply and demand situation based on reactor fuel types. We conclude with some final observations on the global market as well as the current status and expectations for future price developments for the related zirconium alloy products.
Comprehensive Coverage of the Global Nuclear Zirconium Industry

This report encompasses every aspect of the global nuclear zirconium industry. As such, it provides detailed analysis and the associated market implications of the numerous steps that convert zircon mineral sand to end-product nuclear fuel components. Figure 1 below provides the reader with a brief introduction to the principal steps currently employed in the nuclear zirconium industry.

**Figure 1. Nuclear Zirconium Manufacturing Overview**

- **Mining**
- **Mineral Separation**
- **Zirconium Sponge Production**
- **Zirconium Alloy Ingot Production**
- **Zirconium Tube Production**

Source: Lundberg (Uppsala University)

Availability of Data

During the preparation of UxC’s original 2008 report, it became evident that many of the various processors and fabricators of nuclear-grade zirconium sponge, alloys, and fuel assembly components were reluctant to publish, or even discuss, the details of their businesses. Much of their data is considered proprietary, and thus restricted from inclusion in reports such as this. Consequently, in the first report in this series, there were some significant gaps in the data.

When developing the 2010, 2011, and 2013 reports, we were able to identify additional sources of information and to fill in a number of the blanks. But, the majority of the participants in the industry remain closed-mouthed, and some of them have actually reduced the amount of information presented on their web sites and in their public pronouncements since.

To supplement our own data collection process for this 2015 edition, we provided each of the principal processors and producers with a draft of the portion of the report that described its operations. If corrections were received, the appropriate changes
Introduction & Overview

were made in the text. If our data were confirmed, or if no response was forthcoming, the original language, based on the best information available from public and private sources, was used. Where possible, we confirmed data from one source with a second, independent source. We would like to express our sincere appreciation to all of those companies who responded to our inquiries.

We believe that the information contained herein is accurate or, at a minimum, representative of the operations, production levels, expansion plans, etc. of the companies discussed in the succeeding chapters of the report. However, the possibility still exists that there may be a few inaccuracies or that the information has changed since the data were obtained. In a couple of instances, there were no available non-proprietary data, and, therefore, the missing information is listed as “not available” in the affected data tables.

It should also be noted that all price and cost data is quoted in US dollars (US$) throughout this report.

What’s New in the 2015 Report?

In this April 2015 edition of the Nuclear Zirconium Alloy Market report, we have continued to employ the format and content of the previous documents, but have updated all of the relevant information to reflect current circumstances. Other improvements have been made as well.

Beginning about four or five years ago, the markets for zircon sand and some of the downstream zirconium products entered a period a great volatility. Shortages of zircon led to explosive increases in prices for raw materials and created substantial uncertainty as to the future performance of these markets. This was followed, during the latter half of 2012, by a collapse of demand, production, and prices, raising additional questions about the future of the zircon market. Despite optimistic pronouncements by zircon producers, the market has yet to recover, although some positive signs have emerged.

Consequently, we have substantially expanded our analysis of this market from that in the earlier reports and highlighted the role of China, both as the world’s largest importer of zircon sand and the largest exporter of processed zirconium products. The current discussions also contain a much more detailed description of the zircon mining and refining process as well as the processes employed for the manufacture of nuclear-grade zirconium sponge and downstream zirconium alloy products.

One conundrum in the industry at present is the significant divergence of the zircon reserve and production data published by the U.S. Geological Survey (USGS), the principal source of such information in the past, and those obtained from industry and other sources. This report addresses these differences and presents UxC’s opinion of which data are the most representative of conditions in today’s zircon markets.
The impact of the massive March 11, 2011 earthquake and tsunami in Japan, which devastated the Fukushima Daiichi Nuclear Power Plant, continues to cast its shadow on all aspects of the nuclear industry. All of the analyses in this report have taken account of the implications of the Fukushima accident and how they continue to influence the current status and future prospects of the nuclear industry.

Perhaps Fukushima’s greatest impact has been on the future growth of nuclear power around the world, and therefore the demand for nuclear fuel assemblies and the zirconium alloy components that comprise them. The updated demand projections for zirconium sponge, alloys, and tubing described in this report have taken specific account of the post-Fukushima world, in which projected nuclear capacity continues to shrink from earlier estimates.

The current demand projection incorporates detailed UxC calculations of the zirconium weight and tube content in all the major nuclear fuel assemblies in the world, including improved estimates of the quantities of material used in various assembly designs. Moreover, the forecasts make use of UxC’s recently refined UxC Requirements Model (URM) to forecast global reactor fuel loading requirements and the resulting demand for zirconium alloy materials and products. The URM projects demand on a reactor by reactor basis taking account of each plant’s refueling schedule (and/or construction schedule for new plants), the specific fuel assembly design used in that plant, the size of the reload batch (or initial core), and the zirconium alloy content of the individual fuel assemblies.

In the 2013 report, we first included a supply-demand analysis for nuclear-grade zirconium sponge, in addition to those for alloys and tubing. In this 2015 edition, we continue to include market analyses for every step in the zirconium cycle from zircon sand through nuclear fuel tubing.

We have also noted that many of the subscribers to the previous editions of this report represented organizations that did not participate directly in the nuclear fuel fabrication market. Thus, for those not familiar with the technical aspects of the fabrication industry, we have again included a discussion of the design of BWR and PWR fuel assemblies, the zirconium alloy components of which they are constructed, and the fuel fabrication process itself.

Structure of the Report

This report contains separate chapters for various aspects of the nuclear-grade zirconium alloy market, supply and demand, and other related areas. Following this Introduction & Overview, the report includes the following chapters:

Chapter 1 – General Zirconium Overview provides a broad exploration of the zirconium mineral occurrence, resource base and industrial applications, including the role of zirconium alloy production in the nuclear fuel industry. It describes the mining and refining of zircon sand, and most importantly, it addresses the current and
projected supply, demand, and price of zircon in the international marketplace with emphasis on China’s critical role.

The General Zirconium Overview discussion helps to put the specific nuclear-grade zirconium alloy market analysis in better perspective, as there are numerous applications for the zirconium mineral beyond nuclear reactor fuel. Additional discussion is provided on the broader global market for zircon and how this impacts the specific nuclear-grade zirconium alloy market.

Chapter 2 – Manufacturing Processes for Nuclear Fuel Cladding discusses the manufacturing process steps from zircon sand through zirconium sponge and alloy production to the manufacture of nuclear fuel components, i.e., the overall “nuclear zirconium cycle” for production of the materials and components used in nuclear fuel assemblies.

Chapter 3 – Nuclear Zirconium Alloy Materials & Product Suppliers presents a profile of each of the companies involved in nuclear-grade zirconium alloy materials and product supply. This includes all the companies in the world involved in nuclear-grade zirconium sponge and alloy production and processing through manufacture of sheet, plate, bar stock, and tube-reduced extrusions (TREX), as well as tubing and other component manufacture.

Chapter 4 – Nuclear Fuel Fabricators & Zirconium Components Supply provides a brief overview of the global nuclear fuel fabrication industry and indicates the source of each fabricator’s fuel assembly tubing and other components. It also includes a discussion of the individual components that make up fuel assemblies and describes the fuel fabrication process.

Chapter 5 – Nuclear Zirconium Supply & Demand Analysis offers UxC’s most recent analysis of the global supply and demand balance for nuclear fuel-related zirconium sponge and alloy products as well as zirconium tubing. In addition, this chapter includes analysis of the zirconium supply and demand on the basis of regional breakdowns as well as on the basis of the different reactor types installed around the world.

Chapter 6 – Overall Conclusions and Market Analysis summarizes our findings on the nuclear-grade zirconium market and offers some final thoughts on the current situation and forecast of future trends. This chapter also provides UxC’s analysis of the current nuclear-grade zirconium alloy prices and expectations for future price developments.

Finally, the Appendices include the data and assumptions used in many of the analyses discussed in the body of the report.