

THE NUCLEAR NEWS INTERVIEW

Clark, Geeson, and Hanrahan: The new *Plutonium Handbook*

An international editorial board defined topics and recommended authors, and eventually, 215 authors from 13 countries produced more than 3,700 pages in seven volumes.

In 2010, three scientists by the names of David Clark, David Geeson, and Robert Hanrahan got together at a plutonium conference and agreed that an update to the seminal *Plutonium Handbook: A Guide to the Technology* was long overdue. The original handbook, edited by O. J. Wick, was published by Gordon and Breach in 1967 and then republished by the American Nuclear Society in 1980.

The project to produce a second edition of the *Plutonium Handbook* soon got under way and was envisioned as a three-volume set to be published in the 2015 time frame. The handbook eventually grew to six volumes on topics such as materials science, chemistry, techniques, and applications, with a seventh volume as a complete index (each volume also has its own separate index). Topics covered include the history of the discovery of plutonium; properties of plutonium isotopes; chemistry and properties of plutonium metal and alloys; plutonium aging; thermodynamic trends of plutonium; plutonium in nuclear fuels; waste forms; the packaging, storage, and transportation of plutonium; nuclear security and safeguards; and techniques for working with plutonium.

Clark, Geeson, and Hanrahan served as technical editors for the handbook and led a project team that included a project manager and managing editor, among others.

Clark is a Los Alamos National Laboratory (LANL) fellow and director of the lab's National Security Education Center, as well as leader of the lab's Plutonium Sci-

ence and Research Strategy. He served as director of the Glenn T. Seaborg Institute for Transactinium Science (1997–2009) and as a technical advisor to the Department of Energy for high-level waste and for the cleanup and closure of the Rocky Flats Environmental Technology Site (1995–2005).

Geeson is currently a distinguished specialist in Materials and Analytical Science at the United Kingdom's Atomic Weapons Establishment (AWE). He joined AWE in 1989 in the Chemistry and Explosives Division, using surface science techniques to study the corrosion behavior of uranium, before becoming group leader for Actinide Materials and, later, Metal Chemistry. His work has focused on the corrosion chemistry of uranium and plutonium, as well as plutonium metallurgy.

Hanrahan is currently the senior technical advisor to the associate deputy administrator for the Office of Research, Development, Test, and Evaluation at the National Nuclear Security Administration. He served as the NNSA program manager for Primary Assessment, Dynamic Plutonium Experiments, Dynamic Materials Properties, and Advanced Certification and supervised the National Hydrotest Plan and subcritical experiments planning.

The interview was conducted by ANS Director of Publications and Standards Rick Michal. The *Plutonium Handbook* is currently available only from ANS at <www.ans.org/store>.



Photo: Michael Greenbank

The five key players in producing the *Plutonium Handbook* were (from left) technical editor David Geeson, of the United Kingdom's AWE; project manager Patrice Stevens, of LANL; technical editor Robert Hanrahan, of the NNSA; technical editor David Clark, of LANL; and managing editor Natanya Civjan, of LANL.

What is the history of the handbook, and how long did it take to prepare the update?

Clark: The first edition has been the standard reference text for anyone working in the field of plutonium science and technology. It was written only two and a half decades after the discovery of plutonium. The original book was commissioned by the U.S. Atomic Energy Commission, which recognized the need for a single reference to cover the diverse and multidisciplinary literature on plutonium and to provide a first reference to its technology. The project was funded by the AEC,

developed by Hanford, with significant input from AEC labs, including Los Alamos National Laboratory, and published in 1967. It became the authoritative reference in what was an entirely new field of study. The original handbook was in such high demand that the American Nuclear Society reprinted it in 1980. No one anticipated that it would take more than 50 years to prepare an update to this classic work.

Geeson: The concept of updating the handbook was introduced in 2010 by the Los Alamos plutonium science strategy, which called for modernizing classic ar-

chival reference materials for the education and training of a new generation of students and workers in the field. The effort to update the handbook began in the fall of 2010 at the conference Plutonium Futures—The Science, held in Keystone, Colo., which had assembled the international experts in the field. After much discussion at the conference, the team of Clark, Geeson, and Hanrahan agreed and committed as technical editors to producing a scholarly update with international participation to this classic reference. We three editors had high confidence at the time that we could produce an update to commemorate the 75th anniversary of the discovery of plutonium in 2015–2016. Little did we know that it would take us nine years to complete.

Can you describe the book, including its purpose and intended audience?

Hanrahan: In the 50 years since the first edition, the fundamental science of plutonium spread and deepened in areas that were barely explored at the time of the first edition. To document this additional half century of advances in the field, we chose to start over with a new outline of topics. We established an international editorial board to help us define topics and suggest authors, and we ultimately recruited a group of 215 authors from 13 countries that produced over 3,700 pages in 87 chapters and seven volumes. The growth in topical areas covered in the new



The *Plutonium Handbook*, second edition

handbook is not only a consequence of the natural increase in knowledge over 50 years, but also of the development of new scientific instrumentation, experimental techniques, computational tools and methods, and modern facilities.

Because the science and technology of plutonium requires an interdisciplinary approach, the need for a single reference is as important today as it was 50 years ago.

An innovative addition to the handbook is the introduction of an entire volume devoted to laboratory techniques for the safe handling of highly radioactive and toxic materials—such as encapsulation, micro samples, and remote handling—so that they can be studied by modern instrumentation. This is an entirely new construct that we included in order to provide practical guidance on methodologies for working with plutonium and other radioactive materials safely.

Geeson: Because the science and technology of plutonium requires an interdis-

ciplinary approach, the need for a single reference is as important today as it was 50 years ago. Our goal for the new handbook is to provide a modern comprehensive archival resource for anyone working with plutonium, whether students entering the

field, seasoned professionals conducting fundamental research, or managers with oversight of activities involving plutonium. It should also serve a broader scientific audience that is interested in new phenomena in physics, chemistry, and metallurgy into which the study of

plutonium provides important insights.

Who are the key players behind creating the handbook?

Clark: We assembled a project management team of five key players, and we managed the project out of Los Alamos. This included the technical editors—David, Robert, and me—along with project manager Patrice Stevens [LANL] and managing editor Natanya Civjan [LANL]. We received tremendous support from LANL, AWE, and NNSA managers, along with illustration, editorial, and project

management support from Los Alamos.

What were some highs and lows of putting the project together?

Hanrahan: The core team of five held monthly conference calls and in-person meetings over nine years. This project developed lasting professional relationships and personal friendships around the world. We took advantage of the Plutonium Futures Conferences as a means to meet face-to-face with our international cast of authors. The Plutonium Futures Conference series facilitated author meetings in Cambridge in 2012, Las Vegas in 2014, Karlsruhe in 2016, and San Diego in 2018. There were many challenges in keeping more than 200 authors on track, and in some cases we had to make late substitutions to get to a final product. Our greatest disappointment is the lack of authorship from Russia.

Will there be another edition down the line?

Geeson: We sincerely hope to see an electronic version of the handbook come to fruition in the future. There will always be opportunities to add new topics as our understanding of this exotic material continues to grow. We look forward to keeping this material up to date, perhaps through Web resources, but another complete revision may well be a job for the next generation. **N**