Summary

The idea for this publication grew out deliberations of the Task Group on Plasma of ASTM Committee C-26 on Nuclear Fuel Cycle at the 1985 winter meeting (Reno, January 1985) of Committee C-26. Members of the task group saw a need to inform the nuclear analytical community of the progress being made in developing enclosed plasma sources for the safe analysis of nuclear materials. It was recognized, however, that writing an ASTM standard method for this technology would be difficult; the physical environment and analytical needs of individual research laboratories are often unique, and a variety of different engineering strategies may be applicable at different sites. The task group finally decided to assemble a compendium of successful engineering techniques for enclosing plasma spectroscopic sources that could, hopefully, serve as a guide for those interested in pursuing such activities in the future.

Papers devoted to this subject were presented at a special symposium convened at the 1986 winter meeting of ASTM Committee C-26 (New Orleans, January 1986). The contributions included in this volume, with the exception of the paper by Bergey et al., were drawn from papers presented at the New Orleans meeting. Dr. Bergey was unable to attend the New Orleans meeting but graciously agreed to submit a paper for publication.

The papers presented in this volume have demonstrated that plasma emission spectroscopy, utilizing direct-current plasma (DCP) and inductively coupled plasma (ICP) sources, can be successfully applied to the analysis of hazardous samples. The instruments described here have safely analyzed samples containing uranium, plutonium, beryllium, and radioactive fission products, on a daily basis, throughout the world. DCP and ICP sources are ordinarily used to analyze solution samples and, if the original sample is a solid, it is usually dissolved in a suitable solvent prior to analysis. In fact, plasma excitation methods impact directly on a broad range of solids analysis, because often the dissolution of a solid and its subsequent analysis by emission spectroscopy ICP or DCP provide a faster, more comprehensive, and more reliable analytical method than any bulk solid-state analytical procedure available. ICP analysis in particular has become the method of choice for a broad range of materials in many general analytical laboratories.

One subject, discussed in detail by McMillan, merits special attention because of its importance to both successful plasma emission analysis and the protection of the analyst. McMillan distinguishes between the potential hazards to the public and those to the laboratory analyst associated with plasma spectroscopic analysis of radiological materials. He concludes that the total potential release to the general environment from a properly functioning enclosed plasma unit leads "to the release of insignificant amounts of activity to the atmosphere." However, he considers the potential exposure to an operator from an incompletely enclosed plasma unit to be significant. In the case of plasma sources used for the analysis of plutonium-containing solutions (plutonium-239 at concentrations >1 $\mu g/mL$), McMillan concludes that total containment of plasma sources is preferable to partial isolation of such sources within radiological hoods. This is so because the totally enclosed source can prevent operator exposure to alpha-particle-containing gases *even if the exhaust blower system fails,* whereas the radiological hood rapidly becomes unsafe in the event of exhaust blower malfunction. McMillan suggests that the operation of plasma sources installed in radiological hoods can be made safer by interlocking the nebulizer operation with the operation of the hood blowers so that, in the event of a blower failure, the generation of hazardous particulates is rapidly halted. A recent publication[1] describes a safety mechanism that can be applied to the

[1] Rimmer, E. and McGuigan, J., "Power Fluidics for Ventilation Control," *Analytical Proceedings,* Vol. 22, 1985, pp. 319–320.

exhaust system of enclosures to automatically increase the exhaust flow rate whenever the enclosure containment is breached (for example, by a glove puncture or window break).

In closing, the editors wish to acknowledge the support and encouragement they have received from the members of ASTM Committee C-26. Particular thanks are due to Roy Morrow (Martin Marietta Energy Systems), the chairman of the Plasma Emission Task Group, and to Nancy Trahey (U.S. Department of Energy—New Brunswick Laboratory), the chairman of Committee C-26.

Martin C. Edelson

Ames Laboratory, Iowa State University, Ames, IA 50011; symposium chairman and editor.

J. Leland Daniel

Pacific Northwest Laboratory, Richland, WA 99352; coeditor.