

THE SLOW BUT STEADY PACE OF TRANSITION TO SI UNITS

Transition to SI on a global scale appears to be an inevitability. The major obstacle to SI attaining a supreme position in the United States is the general public's unfamiliarity with it.

The overwhelming majority of the world's industrial nations uses the *Système Internationale* (SI) as their primary mode of scientific measurement, including the measurement of radioactivity. The United States, however, remains the only major economic power steadfastly resisting international pressure to convert to SI from the old standard English system.

The European Economic Community (EEC), which has long advocated a worldwide comprehensive conversion to the SI system, has proposed a resolution instructing member countries to utilize SI units exclusively in all domestic and foreign business and trade activities on a certain, prescribed date. Initially, the EEC had planned a wholesale conversion to take effect in 1992, but the measure has been postponed to the end of the century.

"The EEC moves very, very slowly," commented Bryan W. Baker, PhD, manager of environmental and safety regulatory affairs for the Amersham Corporation, a leading US manufacturer of radiopharmaceuticals. Dr. Baker chairs a subcommittee on conversion to SI units under the auspices of the United States Council for Energy Awareness (USCEA), a Washington-based trade group that represents many prominent US radiochemical firms, such as E.R. Squibb Sons, Inc., E.I. DuPont de Nemours & Co., and the Amersham Corpora-

tion. The USCEA is actively campaigning for a US conversion to SI units and plans to launch a national educational program designed to familiarize academic and commercial sectors with SI in order to facilitate a timely conversion that will coincide with Europe's expected implementation in 1999. The USCEA espouses the use of both SI and conventional units during a proposed transitional phase-in program to allow Americans time to thoroughly learn SI without hampering the smooth continuity of trade, business, and research. The organization holds that a successful transition to SI would be tantamount to the ultimate disposal of the old English system of measurement.

Government's Role

In accordance with the United States Omnibus Trade and Competitiveness Act of 1988, which established government policy to designate SI as the "preferred" convention of measurement for American trade and commerce, the USCEA has petitioned several federal agencies to consider a step-by-step transition to SI. The Act requires all government agencies to adopt SI units for business-related activities by 1992. The measure lacks teeth, however, since it specifies that conversion should not be implemented in cases where using SI units would prove to be impractical. Among the USCEA's main lobbying targets for conversion to SI are the Nuclear Regulatory Com-

mission (NRC), the Department of Energy (DOE), and the Food and Drug Administration (FDA).

A spokesperson for the DOE noted that, although the US scientific community is eager to embrace SI, "There is such a strong anti-metric sentiment in the general public that only a law could force people to accept SI." The DOE is itself moving gradually towards exclusive use of SI although the transition is far from complete.

The NRC still dispenses licenses to users of radioactive products in the old measuring system. In anticipation of a worldwide switch to metric in 1999, the USCEA is urging the Commission to start familiarizing users of radioactive materials with SI units, notes Dr. Baker. Nevertheless, the pervasive reluctance among the American populace to adopt SI contributes to the slow progress of dismantling the old system.

Despite a perceived resistance to SI among the public, the NRC has begun to stimulate serious discussion and debate over the conversion issue, as exemplified by a two-day workshop on SI it sponsored in Baltimore, Maryland in November of last year. The meeting was attended by representatives on both sides of the debate—from radiochemical firms, industry lobby groups, and nuclear power companies. Brian Richter, who sits on an NRC committee studying the SI conversion problem, comments that they "are now only in a fact-finding mode, gathering information and trying to gain a per-

Comparison of Common Radiation Terms in SI and English Units

| Measurement | Description | SI Unit | Conventional Unit | Relationship |
|-----------------|--|-------------------------------------|-------------------|---|
| Radioactivity | nuclear transformation (disintegrations per second) | Becquerel (Bq) | Curie (Ci) | 1 mCi = 37 MBq 1 Bq = 2.7027 × 10 ¹¹ Ci |
| Exposure | charge produced in air by gamma or x-rays | Coulombs per kilogram of air (C/kg) | Roentgen (R) | 1 C/kg = 3876 R 1 R = 2.58 × 10 ⁻⁴ C/kg |
| Exposure Rate | observed dose rate in air from a sealed source at a distance of 1m from source | C/kg/sec | R/sec | 1 R/sec = 2.58 × 10 ⁻⁴ C/kg/sec |
| Absorbed dose | amount of energy imparted to matter | Gray (Gy) | Rad | 1 Gy = 100 Rad 1 rad = .01 Gy |
| Dose Equivalent | absorbed dose multiplied by modifying factors | Sievert (Sv) | Rem | 1 Sv = 100 Rem 1 Rem = 0.01 Sv |

spective. Down the road we will establish a policy statement on SI." He added that the Commission currently adheres to the conventional system. While the workshop was not intended to form a consensus opinion on SI, its very existence inspires some optimism that the NRC will eventually hasten the halting pace to implement an overhaul to SI. "The workshop was a very encouraging thing for us," said Dr. Baker. "At least [NRC] is finally beginning to make a move on this issue."

Making SI Convenient

The particular relationships between SI and conventional units for radioactivity measurements present some challenging problems. For example, the NRC uses the standard Curie (Ci) units as the basic measurement of radioactivity and grants licenses in packages in quantities measured strictly in Curies. The SI unit for radioactivity, the Becquerel (Bq), is extremely small in comparison to the Curie; for example 1.00 millicurie (mCi) = 37 megabecquerels (MBq).

The USCEA suggests that during the "dual unit" phase of conversion to SI, the NRC should supply and license amounts that generate rounded units of Becquerels in order to acclimate users to the new system with ease. For example, they advise that the standard 1.00 mCi supply package should be upgraded to 1.08 mCi, which would be equivalent to a round figure of 40 MBq. The USCEA contends that users and suppliers will find it more convenient to reference multiples of 10, rather than use Curies as the standard unit and make cumbersome conversions to irregular Becquerel amounts. To facilitate knowledge and acceptance of Becquerels, the USCEA requested the NRC to round up package sizes by 8% across the board when issuing or renewing licenses. They propose that if a licensee requested the possession and use of 4 mCi (148 MBq), the NRC should allow the licensee permission to receive 4.32 mCi, which is equivalent to 160MBq.

Metric Language Barrier

From the perspective of US manu-

facturers and suppliers of radioactive materials, using dual units is both necessary and problematic. When selling products in the international market, they face a "scientific language barrier." In the absence of a universal measurement standard, radiopharmaceutical firms are compelled to use dual units on their export packages, which requires having two sets of labeling for every product and having to prepare two batches of each product. "We don't want to have to put out the same product in Curie packaging and Becquerel packaging," notes Dr. Baker. "It's an expensive and time-consuming process. A conversion to SI would solve the problem."

Manufacturers of dose calibrators and other radiological measuring instruments find they, too, must provide their machines with dual unit capability. A spokesperson for Capintec, Inc., a leading producer of radiological instruments, reports that his firm has used dual units on their dose calibrators since the mid 1970s. "We feel it's necessary to have both units on our calibrators because we

want to make a complete product and because we have a large market in Canada and overseas, where SI is the standard," said the Capintec representative. "Also, our models are expected to last 12-15 years, and by then everything will probably be measured only in SI units." He also specified that firms using only conventional units on their calibrators will find their products becoming obsolete in the near future. Furthermore, the solid state wiring necessary to insert the extra switch in the calibrator is not prohibitively high.

The Medical Viewpoint

There apparently exists no consensus on conversion to SI in the US medical community. William R. Hendee, PhD, vice president of science and technology for the American Medical Association (AMA), says that while many US physicians are not intimately acquainted with SI units, the majority of American medical journals have adopted SI in their publications. "As the medical literature becomes an SI medium," notes Dr. Hendee, "the medical community will gain a deeper familiarity with it. It's an ongoing adoption process." *The Journal of the American Medical Association* (JAMA) has used SI units since 1986.

The Editor of *The Journal of Nuclear Medicine* (JNM), H. William Strauss, MD, director of the nuclear medicine division, Massachusetts General Hospital and professor of

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radiology, Harvard University, anticipates that JNM will express radioactivity measurements in both conventional and SI units starting in June 1990. This dual reporting procedure will emphasize SI units but shall not discard the conventional system for several years because of an expected resistance from readers who remain unfamiliar with SI. "There is a real trend toward standardization of units," says Dr. Strauss. "However, the majority of nuclear medicine practitioners in the US still are not conversant with SI units."

The field of nuclear medicine, indicates Dr. Hendee, will be able to adapt to SI easily largely due to the intellectual nature of its study and practice. "This area of medicine is based strictly on science and data," states Dr. Hendee. "Other medical disciplines are more reticent to jump to metric because their approach is more clinical and practice-oriented." Furthermore,

Dr. Hendee emphasizes, conversion to SI in all facets of medicine should be expedited cautiously since errors in conversion could lead to dangerous consequences. For instance, the administration of an incorrect dosage to a patient because of inexact conversion could prove fatal. Thus, according to Dr. Hendee, it is imperative for US physicians not only to move to SI, but also to comprehend the "sense of scale" between the two measuring systems. Overall, the US medical community would be averse to compromising the quality assurance of diagnosis and treatment for the sake of a hasty conversion to SI.

Transition to SI on a global scale appears to be an inevitability. Supporters of the move cite the ease of exchange of business and scientific research that a universal measuring language would afford. The major obstacle to SI attaining a supreme position in the United States is the general public's unfamiliarity with it. Groups like the USCEA advocate a comfortable transition period, in which education gradually inserts SI into the national mindset, instead of a forcible, overnight switch. The old English measuring system, rendered archaic by the global village concept, is surely doomed to extinction but cannot be swiftly retired.

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Palash R. Ghosh