# Reflections on the Past and Future of INMM

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I attended the first INMM Annual Meeting in 1960 where I was one of the nine speakers on the entire program. My interest in INMM stemmed from the fact that I worked for Nuclear Fuel Services Inc. (NFS), a company that produced specialty nuclear materials, including uranium compounds, metal, and alloys at all levels of enrichment. NFS also processed uranium scrap, particularly 93 percent enriched material. In those days all uranium was owned by the U.S. government. You could *lease* it from the government but you had to pay a use charge amounting to about 4 percent of the value of the material/year, plus pay for what was lost or consumed. Thus, in our work our customers had to pay for any losses that we sustained when processing government-furnished uranium into the form desired by the customer. As part of the competitive process prevailing at the time, we had to quote both a fixed price and a guaranteed maximum loss associated with our processing. If we lost more than quoted, we had to pay. Moreover, the customer generally added the value of the guaranteed maximum loss to the processing price in evaluating bids—and competition was fierce (three to four companies provided similar services to those of NFS). The loss situation was even more complicated when we processed scrap for uranium recovery because the scrap uranium content was heterogeneous.

The customers were generally commercial fabricators of fuel for research, test, and naval reactors who worked on the assumption that the difference between the amount of highly enriched uranium contained in the feed material to the fabrication process, and the product of fabrication, was contained in the scrap. This "by difference" determination of the scrap's uranium content meant that the fabricator didn't experience any losses except for what it measured in waste material that might be produced. However, when the scrap processors commenced processing the scrap, they seldom found that the scrap uranium content was as high as that represented by the fabricator. Thus, the scrap processors would only accept a uranium content for the scrap based on measurements they made at the first dissolution stage of the recovery process. At one point Admiral Hyman G. Rickover ordered a cessation in the commercial processing of uranium scrap from the fabrication of navy fuel because the processor's values were less than the "by difference" values of the fabricators. He eventually succumbed to the pressure, and resumed commercial scrap processing and acceptance of the processors' measurements at first dissolution. Thereafter, the customer's inspectors were frequently present to witness the first dissolution measurements because these were the key as to whether or not we met our loss guarantee.

The measurements made had a profound impact on the profit/loss and competitiveness of both fabricators and scrap processors. Consider the facts that highly enriched uranium was valued at about $17,000/kilogram and that the cost of its recovery from scrap would range from $100-$500/kilogram. A one percent loss in excess of a competitive guaranteed maximum loss could mean a financial loss of $170/kilogram—a large percentage of the cost of the scrap processing. While the processing of low-enriched uranium did not involve as highly valuable material as highly enriched uranium, the volumes were much larger and the cost impact of losses were still material.

Therefore, measurement techniques, measurement errors, laboratory differences, accounting methods and reporting, and associated experiences were of profound interest to small private industry in those days. I found that the INMM meetings had papers and panel discussions that were of direct practical application to our business. When my company's president suggested that INMM meetings were only for "accountability people," I told him that the meeting offered information, ideas, and experience for improving our company's accountability systems, and thus, reduce our financial risk—and that it was vital that we have a presence at all of the meetings and be active in the organization. He never interfered, and subsequently became a convert himself.

Until about 1967, the United States had relied on the value of the uranium and plutonium to inspire its safekeeping from theft or diversion, as described previously. Before that, even natural uranium feed material was kept under close accountancy because the United States had little developed resources of uranium and had to obtain its needs through imports—which were both expensive and with significant restrictions. Thus, the strategic value of the natural uranium that we used in the 1950s, and the concern that foreign supplies could be interrupted at any time, motivated the control and protection of these materials. However, with 1967 came an increased awareness of the need for more effective measures to protect nuclear materials from theft or diversion to unauthorized uses in the United States and worldwide, including the need for improved physical protection and control and accounting of nuclear materials.

The INMM experienced rapid growth in the years following because of the need for better and more timely measurement systems, statistical techniques that allowed the quantification of the significance of inventory differences, and improvements in physical protection methods. Moreover, INMM became involved in international safeguards. This was manifested by INMM establishing its first chapter in Japan in 1976 and Vienna, Austria, in 1978. Since then, the chapters have grown to include four in the former Soviet Union, one in Korea, six U.S. regional chapters, and three student chapters.

In the late 1970s and early 1980s, technical working groups were organized to deal with the principal areas of interest of the Institute and these eventually evolved into the six Technical Divisions that we now have that cover the diverse subject interest that logically fall under the common description "nuclear materials management" (Material Control & Accountability, Physical Protection, International Safeguards, Nonproliferation and Arms Control, Packaging and Transportation, and Waste Management).

A particular highlight of my activities in INMM was when it fell to me to lead a People-to-People Delegation to China for INMM, in September 21-October 12, 1983. The delegation consisted of fourteen technical lecturers and nine spouses who documented the social and cultural activities of the delegation. The then-present INMM chair and two past chairs were among the lecturers. About half of the lectures dealt with physical protection, material control and accountability, measurements, etc. The other half dealt with spent fuel and high-level radioactive waste management and fuel cycle processes. Our hosts in China were the Chinese Association for Science and Technology (CAST), and the Chinese Nuclear Society (CNS). Lectures were given in Beijing (seven), Cheng-Du, Emei Shan, Leshan, and Shanghai (two), and each were attended by 100-500 Chinese participants. Most lectures were attended by the spouses of the delegation members. On several occasions the delegation was divided into two concurrent sessions—one on physical protection and safeguards, and the other on waste management and fuel cycle related discussions. We were able to establish a relationship with the Chinese audiences in which there was a free and open exchange of information on the subjects discussed and where we were able to convey details of practices followed in the United States for nuclear materials management, and where their thirst for such information was satisfied to a high degree. We also toured nuclear facilities (including a small nuclear power reactor, hot cells, and research facilities), other factories and utility installations, and many points of interest along the way.

It is interesting to note that in the 1970s, the United States of America Standards Institute asked INMM to be the secretariat for a committee on standards for nuclear material control, accounting, and protection. This work involved getting input from a large cross-section of processors of nuclear materials and forging it into a consensus standard that all would recognize. The process for this includes the resolution of all reasonable conflicts and objections, so that the product of the standards effort is one that is universally accepted. This work continues today as the American National Standards Institute (ANSI) Committee N15, with the Institute having the lead in the standards development effort. ANSI recognized the success INMM had with N15 and, as a result, later asked INMM to take the lead on Committee N14 on standards for packaging and transportation of radioactive materials.

From the very beginning the role of INMM has been to serve as a forum for the display and exchange of technical and programmatic information in the areas of nuclear materials management. This we have been doing for fifty years. So it was initially somewhat puzzling when the suggestion was made recently that the Institute might take the lead in initiating the development of best practices with respect to physical protection and material control and accountability. In one respect it was like some were oblivious to the past efforts and successes of the Institute. However, the suggestion implied that a more formalized structure was needed to develop, reach agreement, and voluntarily implement these best practices on an international basis. Accordingly, INMM developed the concept of the World Institute for Nuclear Security (WINS) along with a preliminary business plan therefore, which is now in the preliminary stages of implementation. WINS is being facilitated by the Nuclear Threat Initiative (NTI) and the precise organizational structure is yet to be decided. INMM's ultimate role in WINS has also yet to be decided, but it is clearly in a position to make major contributions to the realization and implementation of best practices on a worldwide basis. This should be a major area for the Institute's future activity.

Another area of future activity for the Institute is in educating decision-makers in the subject areas of expertise of the Institute's technical divisions. This includes the development of policy papers, information pieces, tutorials of a technical and programmatic nature, and the like. The Institute is a professional organization and while it may not be appropriate for it to act in the role of an advocate for nuclear power, it certainly has a professional obligation to correct any misconceptions on nuclear matters that may arise and/or prevail. This should be our goal in the future years along with contributing to the success of WINS, and continuation of the works in which we have been involved successfully for the past fifty years.