



Aligning US Navy Dosimetry with NIST

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The Need for Standards



- “The need for a Federal bureau of standards was talked about for almost 20 years before legislation for its establishment was introduced in 1900. By then the necessity had become imperative as science and industry, ready to take giant steps in the new century, looked for better measurements and more uniformity, precision, and control in the laboratory, factory, and plant. “ Cochrane 1966
- Today the needs continues and vigilance is needed to meet the challenge

NIST – 116 years of Excellence



- Founded as the National Bureau of Standards in 1901
 - Under the direction of Samuel W. Stratton, 1901-1922
 - Chartered by the U.S. Congress on March 3, 1901, it was the first physical science research laboratory of the federal government, established at about the same time as the nation's first commercial laboratory.
- 1903, renamed Bureau of Standards
- 1934, renamed to National Bureau of Standards, or NBS.
- 1988, it became the National Institute of Standards and Technology, or NIST
 - Under the direction of Patrick D. Gallagher (Director)
 - November 2009 to present



Focus of the Presentation



- How the US Navy collaborates with NIST and industry to provide the warfighter with equipment that measures ionizing radiation that is traceable and reliable to be effective in the battlefield.

Aligning US Navy with NIST



- The US Navy is aligned with NIST and recognizes its leadership in maintaining our nation's standards
 - The alignment and recognition is the founding principles of the our metrological system which we use to evaluate material and equipment through a rigorous process of testing the specifications
 - The initial goal of the US Navy metrology program is to ensure that the products and materials the US Navy purchases meet manufacture and/or military specifications at time of purchase or manufacturing through either a military standard or through commercial off the shelf (COTS) purchase?
- The long term goal is to maintain the equipment within operating standards initially established when purchased through a system of institutionalized calibration program (METCAL).

Does it Matter?



- Does it matter?
 - Our warfighters or peacekeepers deploy around the world into harm's way will depend and expect that their equipment and materiel will work as intended when designed and purchased?
 - Case and point was the deployment of Radiation Detection, Indication And Computation equipment during the Fukushima Daiichi Plant accident
 - Our expectation is that equipment and material work as originally intended and meeting the specifications that they were bought under?



Tomodachi Registry



- Department of Defense (DOD) began established the Operation Tomodachi Registry following the devastating March 11, 2011 earthquake and tsunami in Japan. These unfortunate events caused severe damage to the Fukushima Daiichi Nuclear Power Station, which resulted in the release of radiation into the environment. This Registry will include the names of nearly 70,000 DOD-affiliated individuals who were on or near the mainland of Japan during the period from March 12, 2011 to May 11, 2011 along with radiation exposure estimates for each of these individuals.
- Conservative estimates, in this case an adult who stayed for the entire period would have received a whole body dose of 0.030 rem and 0.4 rem dose to the thyroid.

Environmental Health Surveillance Registries
U.S. Department of Defense

Home About the Registries Newsroom Registry: Operation Tomodachi

Operation Tomodachi Registry

About this Registry Event DOD Response Dose Estimates FAQs References Links Contact Us

About this Registry

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The Operation Tomodachi Registry is being completed in phases. radiation exposure estimates for 13 different shore-based locations selected since most of the members of the DOD-affiliated population are located in Japan or in the cities represented.

Final radiation dose estimates are expected to be available by May 11, 2012. Estimates may include updates to dose estimates for shore-based locations. For U.S. Navy ships located off the mainland of Japan during the period from March 12, 2011 to May 11, 2011, radiation dose estimates will be available for upwards of 8,000 individuals who had their exposure directly.

OPERATION TOMODACHI



<https://registry.csd.disa.mil/registryWeb/Registry/OperationTomodachi/>

Procurement Process



- Commercial of the shelf purchases (COTS)
 - The device, material is readily available in the commercial market
 - Manufacture has established specifications, short process for purchasing which relies on the industry for the heavy lifting of establishing their specifications
 - US Government expectation is that the purchase will meet the specifications established by the industry
- Developmental Contracts (MILSPEC)
 - The US Government establishes a goal which is beyond commercially available technologies and pushes industry toward that goal.
 - US government expectation is that industry collaborates with industry toward a mutual goal.

Measurement



- “When you can measure what you are speaking about and express it in numbers, you know something about it; and when you cannot measure it, you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind. It may be the beginning of knowledge, but you are scarcely in your thought advanced to the stage of a science.”

William Thomson, 1st Baron Kelvin



Metrology



- “The science of measurement, embracing both experimental and theoretical determinations at any level of uncertainty in any field of science and technology”
 - International Bureau of Weights and Measures (BIPM)

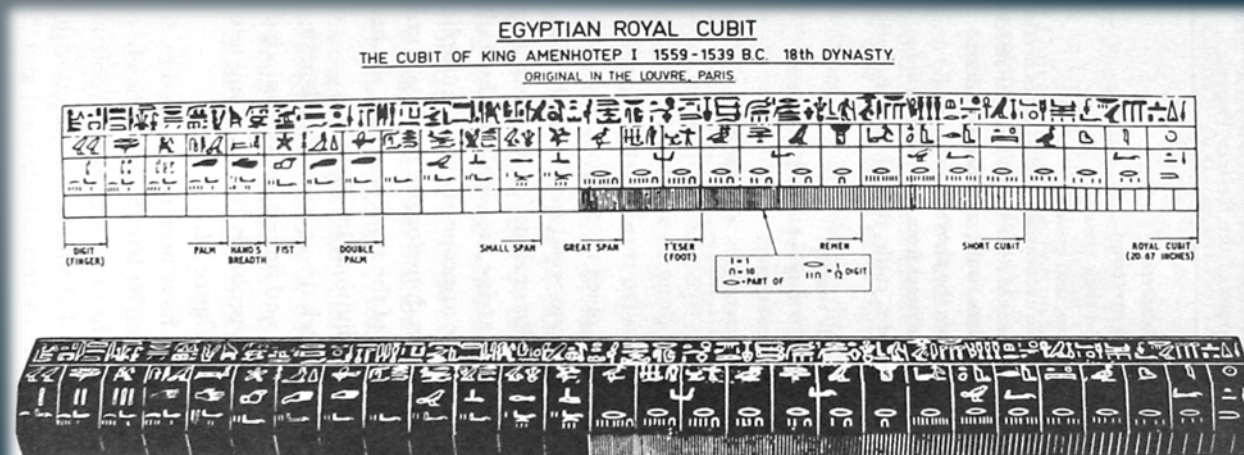


FIGURE 22.1

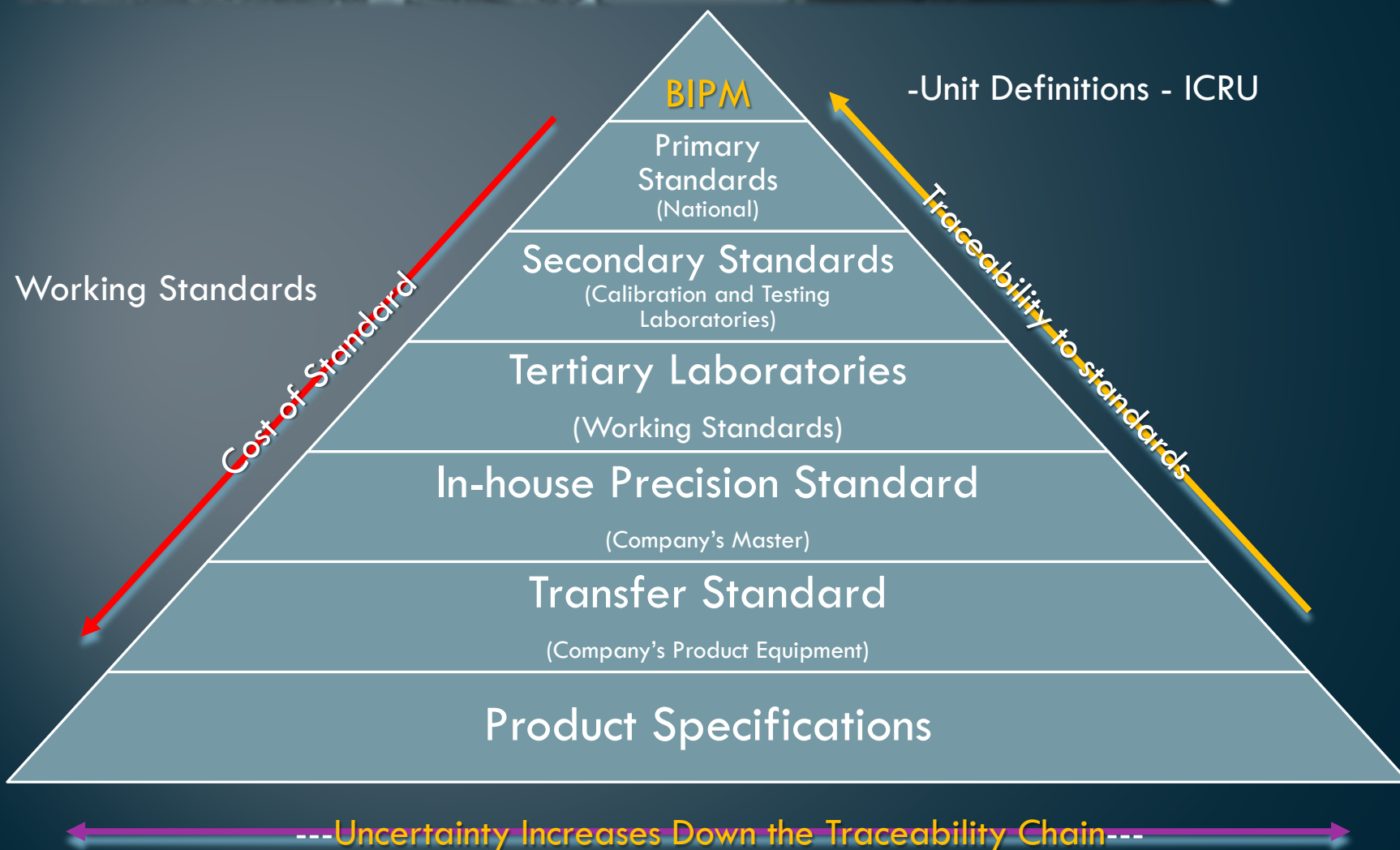
A possible division of an Egyptian measuring-rod. Courtesy M. J. Puttock B.Sc., National Standards Laboratory, C.S.I.R.O., Sydney, Australia.

Traceability



- The property of a result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties.

Traceability Pyramid



International Standards



- *Bureau international des poids et mesures (BIPM, International Bureau of Weights and Measures)* one of three organizations established to maintain the International System of Units (SI) under the terms of the Meter Convention (*Convention du Mètre*) of

- 1875, Signing of the Convention du Mètre (Meter Convention) and the foundation of the BIPM



Bureau
+ **International des**
+ **Poids et**
+ **Mesures**

ICRU (1925)



- The International Commission on Radiation Units and Measurements
 - ICRU, originally known as the International X-Ray Unit Committee and later as the International Committee for Radiological Units) was conceived at the First International Congress of Radiology (ICR) in London in 1925 and officially came into being at ICR-2 in Stockholm in 1928.
 - Since its inception, it has had as its principal objective the development of internationally acceptable recommendations concerning:
 - quantities and units of radiation and radioactivity;
 - procedures suitable for the measurement and application of these quantities in diagnostic radiology, radiation therapy, radiation biology, and industrial operations; and
 - physical data needed in the application of these procedures, the use of which tends to assure uniformity in reporting.



Links: BIPM and the ICRU

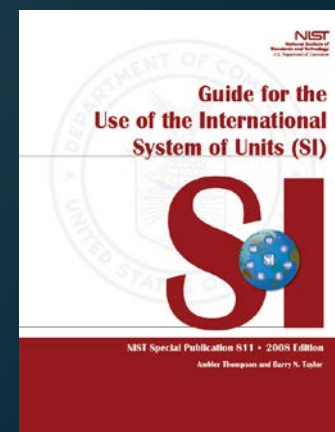
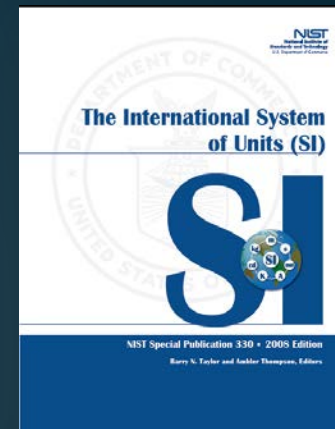


- The ICRU was an instigator of the Ionizing Radiation Department at the BIPM, as prior to this the ICRU had found it difficult to organize international comparisons of dosimetry without a centralized laboratory.
- The BIPM attends the annual meeting of the ICRU Main Commission.
- Dr D.T. Burns of the BIPM's Ionizing Radiation Department is also a member of the ICRU Standing Committee on Fundamental Quantities and Units and a member of two ICRU Report Committees, on Key Data for Dosimetry and on Operational Quantities for Radiation Protection. In 2012 he was elected a Commissioner of the ICRU.

BIPM and NIST



- NIST publishes Special Publications interpreting BIPM recommendations for the United States



International Organization for Standardization



- The International Organization for Standardization (ISO) is a worldwide federation of national standards bodies from more than 145 countries, one from each country.
- 1947 - ISO is a non-governmental organization that was established and based in Geneva, Switzerland.
- Promote the development of standardization and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity.
- ISO's work results in international agreements which are published as International Standards and other types of ISO documents
- ANSI is the sole U.S. representative and dues-paying member of the International Organization for Standardization (ISO), and as a founding member of the ISO, ANSI plays an active role in its governance.



American National Standards Institute (ANSI)



- The history of the ANSI and the U.S. voluntary standards system is dynamic and evocative of the market-driven spirit that continues today.
- In 1916, the American Institute of Electrical Engineers (now IEEE) invited the American Society of Mechanical Engineers (ASME), the American Society of Civil Engineers (ASCE), the American Institute of Mining and Metallurgical Engineers (AIME) and the American Society for Testing Materials (now ASTM International) to join in establishing an impartial national body to coordinate standards development, approve national consensus standards, and halt user confusion on acceptability.
 - These five organizations, who were themselves core members of the United Engineering Society (UES), subsequently invited the U.S. Departments of War, Navy and Commerce to join them as founders.
- ANSI was originally established as the American Engineering Standards Committee.

Accrediting Body



- National Voluntary Laboratory Accreditation Program (NVLAP)
 - The National Institute of Standards and Technology (NIST) administers the NVLAP.
 - The NVLAP provides third-party accreditation to testing and calibration laboratories in response to legislative actions or requests from government agencies or private-sector organizations.
 - NVLAP-accredited laboratories are assessed against the management and technical requirements published in the International Standard, ISO/IEC 17025:2005.
 - The national Dosimetry Standards in dosimetry are;
 - ANSI 13.11-2009, Whole Body Dosimeter
 - ANSI 13.32-2008, Extremity Dosimeter

Neutron Category

NVLAP LB-76-2013 – Case Study

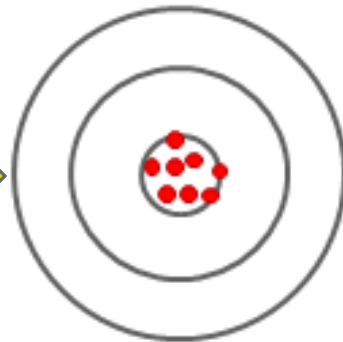


- The issues that resulted in suspension of NVLAP proficiency testing for neutron categories were resolved through a collaborative effort by the U.S. Naval Dosimetry Center, NIST, and Pacific Northwest National Laboratory (PNNL).
 - The efforts and outcome resulting from the collaboration were reported in PNNL-22353, Inter-Laboratory Comparison of PNNL and NIST Neutron Irradiation Capabilities using D2O-moderated 252-Cf and a Commercial Thermoluminescent Dosimeter Provided by the U.S. Naval Dosimetry Center.
 - A draft report was provided to NVLAP in April 2013, and a final report will be available through the PNNL Publications website at <http://www.pnl.gov/publications/>.

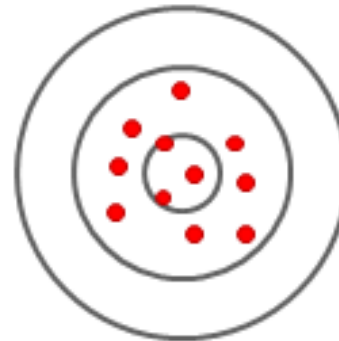
Goals of Metrology



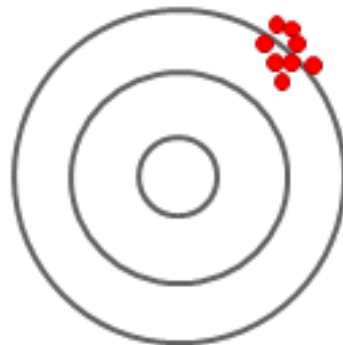
GOAL



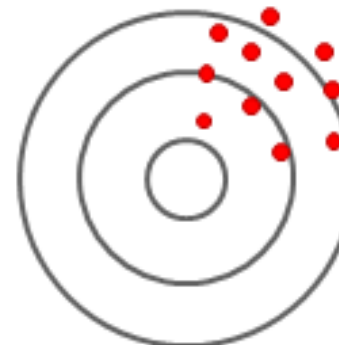
Accurate and Precise



Accurate but not Precise



Precise but not Accurate



Not Precise or Accurate

Military Metrology



- "To gauge the warfighting capability of ships and aircraft, from unit to battlegroup level, by assessing the suitability of design, the performance of equipment and weapons, and the adequacy of training." OPNAVNOTE 5450
- Ensuring equipment meets the warfighter needs through metrological traceability rigor!

US Navy Dosimetry Traceability



8800 Reader
Irradiator



Sr/Y-90

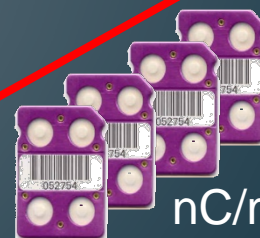
mrem/sec
(Cs₁₃₇-equiv)



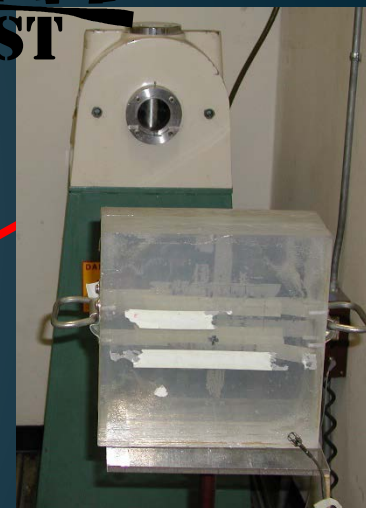
nC/sec



In-house 8800 Readers



nC/mrem



Cs-137

US Navy Dosimetry – Case Study



- DT-702/PD System is composed of a COTS purchase
 - First Adopted in 1998, containing over ~475,000 dosimeters with a circulating population of ~250,000
 - Dosimeter, Harshaw 8840/8841 consisting of Al card, Teflon, and LiF:Cu,Mg,P
 - Reader, Harshaw 8800 Reader which contains various parts and electronic components.
 - US Navy continues to accept materials from the manufacturer through a metrological approach by testing the new product against the performance of circulating population. Monitoring the system through operations.
 - After several performance issues, the US Navy in collaboration with the manufacture have developed methodologies and improvements

Summary



- Excellence through TESTING and VERIFICATION regardless of the source for the device and/or materiel
- Questioning specifications whether those be established by US Government or those established by industry
- **Ensuring equipment meets the warfighter needs through metrological traceability rigor!**