United States

Transuranium and Uranium Registries

Annual Meeting of the Scientific Advisory Committee (SAC)

Meeting Notes

April 13-14, 2007

Red Lion Hotel

Pasco, WA

Participants

Jennifer Christensen	DOE/RL
Marsha Lawn	DOE/HS-13
Barbara Brooks	DOE/HS-13, Retired
Bob Thomas	Advisory Committee Chairman – Scientific
Dennis Mahlum	Advisory Committee Member – Scientific
Herman Gibb	Advisory Committee Member – Scientific
Bill Hayes	Advisory Committee Member – Radiochemistry
Kathryn Meier	Advisory Committee Member – University & Ethics
Bob Bistline	Advisory Committee Member -- Scientific
Matt Lardy	STL – Retired, consultant
Steve Wheland	TA/STL – Primary Technical Contact
Erika Jordan	TA/STL – Project Manager Designate
Jodie Carnes	TA/STL – Technical Consultant, Data Review, QA Manager
Greg Jungclaus	STL – Richland Laboratory Director, Primary Client Contact
Tim Lynch	PNNL
Rich Brey	ISU – Professor/Director, Health Physics Program
Nino Chelidze	ISU – Graduate Student
Naz Fallahian	ISU – Graduate Student
Isabel Fisenne	USTUR – Radiochemistry Consultant
Dot Stuit	USTUR – Project Associate
James Kehrer	WSU – Dean of College of Pharmacy
Vicky Carwein	WSU – Chancellor, Tri-Cities campus
Barry Jacobson	USTUR – Adjunct Scientist
Stacey McCord	USTUR – Project Associate
Mishelle Bosted	USTUR – Secretary
Susan Ehrhart	USTUR – Program Administrative Manager
Sergei Tolmachev	USTUR – Laboratory Manager
Tony James	USTUR – Director

These notes highlight key points from the presentations and discussion during the Scientific Advisory Committee's review of the United States Transuranium and Uranium Registry's (USTUR) 2006 research program and operations, and USTUR's proposals for 2007/2008. The presentations and other supporting materials were included in meeting binders previously received by each of the meeting participants.

WSU/COP & USTUR — J. Kehrer

Dr. Kehrer (Dean, WSU College of Pharmacy) expressed his appreciation for the invitation to the meeting, and stated that the USTUR program is important to WSU and the College of Pharmacy (COP). Dean Kehrer is a free radical toxicologist who received his Ph.D. from the University of Iowa and had 25 years of research and teaching experience at the University of Texas. He distributed the program from the College's recent Evening of Excellence. This annual event highlights some of the College's research programs that deserve special recognition. The Dean looks forward to including the USTUR program in a future celebration, as it continues to develop new knowledge (and federal funding support).

Report from DOE/EH/RL — B. Brooks

Ms. Barbara Brooks, USTUR's recently retired U.S. Department of Energy (DOE) Program Manager, introduced the other DOE representatives. Barbara, a health physics regulatory specialist, had managed the USTUR research grant for DOE since its 1992 inception at WSU. Ms. Jennifer Christensen, Richland Operations Office, is the local DOE contract specialist for the WSU/USTUR. Ms. Marsha Lawn, is DOE Headquarter's 'interim' manager of USTUR's FY2007 research grant (from HS-13, the Office of Illness and Injury Prevention Programs). Marsha, and administration specialist, is currently looking for additional help at DOE, to try to replace Barbara Brook's special technical expertise in the work of USTUR. Barbara indicated that USTUR had met its program objectives this year, making especially good progress in increased visibility of USTUR research and contributions. Marsha stated that DOE expects to be able to meet its funding commitment to USTUR the current fiscal year.

Dr. Bob Thomas (SAC chair) encouraged USTUR to keeping Barbara Brooks involved with the USTUR research program, either as a consultant or as a member of the Scientific Advisory Committee. Ms Susan Ehrhart, USTUR's program administrative manager informed the SAC that the USTUR had already started discussing these possibilities with Ms. Brooks.

2006 SAC Recommendations and 2007 USTUR Issues — A. James

In their report following the 2006 Annual Meeting, the SAC provided USTUR with many specific recommendations and comments. This comprehensive advice,

supplemented by the quarterly telephone conferences, has proven extremely helpful. USTUR requested the SAC to make recommendations and comments for the remainder of FY2006, and for FY2008's proposal to DOE for continued grant funding.

Dr. James summarized the SAC's 2006 recommendations, and USTUR's actions in response to these recommendations, as follows.

Recommendation #1: Radiochemistry

"Continue negotiations to establish a contract with STL for analyzing USTUR samples … If initial work confirms the expectation of faster throughput at a reduced cost; expand the scope of work to be performed by STL … Dr. Isabel Fisenne should perform an overall evaluation of STL performance … Have STL run radiochemistry on one half of tissues from recent cases … Have USTUR's Ms. Dot Stuit run radiochemistry on other half … Case 0720 samples need to be finished by Ms. Stuit before the program is transferred … If STL needs more samples, return to the old samples in the freezer to supply them. Include 80 samples that need uranium in the initial STL contract."

There were some problems with the setup of subcontracts due to delays in DOE getting an approved FY 2007 budget from the U.S. Congress. USTUR is still in the process of evaluating the technical performance of STL. Dr. Isabel Fisenne is engaged as our consultant, and has visited USTUR and STL several times. She has provided interim progress reports.

Our initial vision was to have STL and USTUR's radiochemistry program carry out equal amounts of work. However, as previously recommended, in June 2006, USTUR had moved the 'in house' radiochemistry laboratory from WSU, Pullman's Nuclear Radiation Center Pullman (NRC) to the Center for Laboratory Sciences (CLS) located on the Pasco, WA campus of Columbia Basin College (CBC). Before the move, only 18 of 128 (14%) of the Case 0720 sample analyses had been completed at NRC/Pullman. Most of the remaining tissues and bones had therefore been dissolved and analyzed at STL. STL invested substantial effort in adapting procedures to meet the stringent demands of the USTUR, and has had a steep 'learning curve.' However, there has been a lack of effective technical communication, which had hampered the progress in completing the radiochemical analysis of Case 0720.

USTUR acknowledged that it's radiochemistry program lacked a technically advanced, innovative, and well organized research manager to lead both its 'in house' radiochemistry and the 'outsourced' components. The recruitment (in February, 2007) of Dr. Sergei Tolmachev, a research specialist in isotopic analysis of low-level environmental materials, had already proved to be a great benefit to the USTUR.

Recommendation #2: Data Analysis

"Continue to focus efforts on the utilization of USTUR data in evaluating and refining mathematical models that predict the behavior of transuranics in humans … This would include efforts to organize data relating to USTUR cases that facilitate their use and accessibility. Organization and presentation of all USTUR data in a consistent, more standardized fashion are very important aspects of the project."

There has been significant progress, including the recruitment of ISU graduate research students in the utilization of USTUR data. The March, 2007 recruitment of Ms. Stacey McCord shows great promise in helping USTUR improve the organization and accessibility of research data.

Recommendation #3: Personnel

"The Committee recognizes that USTUR would benefit from additional scientific personnel to examine data and prepare papers for publication. To this end, the Committee supports the Director's efforts to recruit a senior scientist and his collaborations with Health Physics Department at Idaho State University to obtain services of graduate students. These additional efforts are needed to accelerate the rate at which USTUR can analyze case data and publish technical reports … The possibility of approaching post-doc's at WSU to see if they would be interested in a 50% position at USTUR – with the thought of grooming them for a full time position – is also suggested."

Currently USTUR cannot afford to hire another senior scientist. Dr. James believes that USTUR needs research-oriented scientists at the *working level*. These have been recruited internally and externally. Currently the USTUR is working to get further along in fundamental biokinetic modeling research, so as to attract qualified 'post-docs' to the program.

Recommendation #4: Facilities

"Develop a shared lab at CLS/CBC. Build an agreement with CLS to house equipment for both USTUR and CLS to utilize. Relocate USTUR's laboratory from Pullman…"

An agreement between CLS/USTUR Directors was signed prior to the June 24th, 2006 laboratory move. However the envisioned mutual benefits have not materialized. It has become clear that even the 17-mile separation between the radiochemistry laboratory and Richland office facility is too far, and USTUR has begun to form a plan 'B'. This is to remodel the Richland National Human Radiobiology Repository (NHRTR) to include offices, radiochemistry, and repository. This appears to be practicable and has an October 2007 objective time-frame.

#5: Committee Membership

"Dr. Kathryn Meier was proposed to serve as both university liaison and fill Kathryn George's position, of ethics advisor … The fact that Dr. Fisenne likely would continue to serve as a consultant to USTUR, rather than serve on the SAC, led to discussion of the need to find a Radiochemist to serve on the Committee … The SAC should consist of at least 5 members, to ensure a variety of perspectives and independent input from pertinent disciplines."

Three SAC members, Dr. Kathryn Paxton George, Mr. Bruce Lawson, and Mr. Joe Aldrich, decided to leave the committee. Dr. Meier has been duly appointed to serve on the SAC as both the University and Ethics representative on. Mr. William Hayes, BWXT Pantex, will be contributing his current operational expertise in both radiochemistry and DOE health physics programs. Dr. Robert Bistline has been appointed as a scientific representative, in the field of occupational health. Dr. Herman Gibb from Sciences International, Inc. has also been appointed, as a scientific representative specializing in epidemiology.

Dr. James noted that the SAC no longer includes a labor or public member and wondered if this is advisable. The SAC unanimously agreed that this should not prove to be a problem, but if it does it can be remedied by appointing an additional representative.

#6: Policy and Procedures

"Review and update USTUR's policies and procedures and address tracking of samples. Review of radiochemistry procedures and protocols by Dr. Fisenne."

This is a highly pertinent comment. USTUR staff have worked on the policies and procedures revision, but the development of new radiochemistry procedures is stll 'in progress.'

#7: Suggestions for Potential Actions

"Isabel Fisenne should continue to provide counsel to the USTUR Director on radiochemical issues, and her recommendations should be given full consideration … Reevaluate Dr. Sayed Daoud's approach to determining the usefulness of stored tissues for molecular biology studies … Recruit a mid-level scientist, being sure to prepare a detailed description for this and any other new positions … For future SAC meetings, ensure that the audio/visual equipment works … Also, other USTUR staff should be asked to present their efforts."

Dr. Fisenne has continued to provide advice and counsel on radiochemical issues. We have determined that USTUR still cannot fund Dr. Sayed Daoud's approach to evaluating the integrity of our stored samples. New scientific faculty

members have been hired with detailed job descriptions. This year and in the future, more of the staff will present their work at the Annual SAC Meeting.

In Summary

Dr. James submitted that …. "USTUR has indeed heeded (and benefited from) the SAC's advice and guidance – received at, and frequently since, the last Annual Meeting. We now look forward to the fresh insights of our newly constituted SAC and to the continued guidance from our 'long-serving' SAC chair(s)."

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Overview of Program Goals, Organization, and Activities A. James

The purpose of the meeting is to introduce new SAC members, give external collaborators, and new hires a chance to introduce themselves and describe their progress, and what they bring to the USTUR. The new hires are: Dr. Sergei Tolmachev (February 10th, 2007), as Radiochemistry Laboratory Manager; Ms. Stacey McCord (March 1st, 2007), as Health Physicist; Mr. Florencio Martinez April 6th, 2007), as NHRTR Prosector.

In order to improve tissue sample and radiochemical solution tracking and inventory control in the National Human Radiobiology Tissue Repository (NHRTR), USTUR is purchasing (from RJ Lee Solutions, LLC) the specialized THEMIS software. This is widely used in the forensic pathology field to ensure evidence (sample specimen) integrity and traceability. It uses barcodes to track individual samples and has a built in chain of custody.

As summarized in USTUR's 2006 Annual Report, the main research goals are:

- to utilize all USTUR data to validate practical field methodologies for actinide bioassay and internal dose assessment;
- to contribute to the development of more realistic actinide dosimetry and chelation treatment models, and;
- to quantify the variability of actinide biokinetics among workers and the resulting variability of tissue doses.

Dr. James posed the question, "How do we insure that USTUR's case studies are relevant to improving and standardizing the *practice* of internal dosimetry?" It is important to apply USTUR case data to exercise current (and developing) field practices. The improved statistical analysis techniques incorporated in the IMBA Expert™ USDOE-Edition software (developed recently for DOE practical field use by Dr. James and the UK's National Radiological Protection Board) provides a direct bridge linking USTUR research to field application.

In October, 2006, Dr. James renewed contacts with European internal dosimetry specialists (IDEAS/CONRAD Project) at the Montpellier Workshop on *Internal Dosimetry of Radionuclides*. These scientists emphasized continued European interest in USTUR research results. Ms. McCord is testing the health physics database used by IDEAS as a template for a more functional database for USTUR. Mr. Tim Lynch (PNNL) is working in collaboration on the CONRAD calibration phantom project. The USTUR Case 0102 ^{241}Am human leg phantom will circle the globe. Dr. James is working privately (through ACJ & Associates, Inc.) to provide scientific support on a major litigation case, for which USTUR published results are providing crucial evidence.

USTUR's operational goals are to produce timely radiochemical analyses of all USTUR donor cases, broaden publication of (de-identified) USTUR case data, and expand USTUR's contribution to the academic and practical training of future internal dosimetrists and health physicists.

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Program Administration of the USTUR S. Ehrhart

Currently, USTUR's funding sources are two separate grants from the US Department of Energy. The main grant is from the Office of Health, Safety, and Security, for the "Management and Operations of the USTUR." A smaller, supporting grant is from the Office of Science, for the "Operation of the National Radiobiology Archives (NRA)." Also, USTUR has small contracts with Battelle's Pacific Northwest National Laboratory (PNNL), to provide dosimetry estimates for an experimental animal study on potential new actinide chelators, and to make technical contributions to the publication of other PNNL research project results. WSU/USTUR has placed subcontracts with Idaho State University (ISU), Severn Trent Laboratories (STL), and PNNL, and personal services contracts with Drs. Isabel Fisenne (Radiochemistry Consultant) and Chuck Watson (NRA Database Consultant).

The grant's proposed FY2006 operating budget was $1,362,505. However this budget was cut by $262,505. The substantial budget cut caused USTUR to restructure its staff, cut external subcontracts, and plan facility relocation. To date, funding for FY2006 has been provided by DOE in multiple allotments, occasioned by DOE's budget being caught in "continuing resolution" from the U.S. Congress. The initial allotment was $540. USTUR was authorized by DOE to carry forward the funds remaining from FY2005 ($184,123). The second (recent) allotment was $250,000, which enabled WSU to set up USTUR's subcontracts with external organizations. DOE's delayed funding caused a 6-month delay in USTUR's ability to let sub-contracts for FY2007.

Staff restructuring consisted of: (i) non-renewal of the appointments of Ms. Tanya Wood (NHRTR prosector), Mr. Robert Emmel (IT support), and Dr. Lyle Sasser

(retirement), and (ii) hiring Dr. Sergei Tolmachev (radiochemistry program manager), Ms. Stacey McCord (health physicist), Mr. Florencio Martinez (part-time NHRTR prosector), and Ms Heather Hamilton (part-time radiochemistry technician).

Operational activities since the last meeting include: (i) one Registrant decided not to renew their agreement to become a partial-body donor (non-response to USTUR invitation); (ii) one partial-body donor Registrant changed to a whole-body donor (at next-of-kin's request at the time of death – relaying known wish of the donor); (iii) registration of a new potential partial-body, and (iv) placement of two Registrants as 'inactive' (withdrawn autopsy permission). There were three Registrant deaths: two active donors (autopsies performed), and one inactive donor (no autopsy performed). Dosimetry (health physics) records were requested for four Registrants. Medical records were requested for two Registrants.

Radiochemistry Program at USTUR S. Tolmachev

It is proposed that subcontractors (commercial laboratories) will carry out the bulk of routine radiochemical analyses for USTUR. Overall QA/QC will be performed by USTUR 'in house,' and we are proceeding to establish a formal QA/QC program. The current methods of the Radiochemistry group need to be revised. The methods used for tissue digestion are USTUR procedure #100 (dry ashing) and USTUR procedure #110 (wet ashing). For Pu and Am chromatographic separation, the methods currently used are USTUR-150, USTUR-220, and USTUR-310. USTUR-150 has been revised to take only 1½ hours rather than the five to six hours that it previously required. USTUR Procedure-220 produces a lot of acid waste, and USTUR-310 has organic material that develops in the column during the final stages of the separation procedure. These methods are currently under review. For alpha-spectrometry, 'in house' radiochemistry utilizes USTUR-510 (electrodeposition) and USTUR-600.

In 2004, SAC recommended that "the radiochemistry group should search for funds to purchase or lease an ICP-MS." USTUR has adopted the "*try before you buy"* approach, and has utilized the prior contact between Dr. Tolmachev and Dr. Michael Ketterer, Northern Arizona University (NAU), a specialist of international repute in this field. NAU has a "high-resolution" ICP-MS. This has been used to perform about 10,000 routine Pu determinations in environmental geological samples. The instrument can analyze up to 100 samples per day. ICP-MS has sufficient sensitivity to determine ^{238}U in most samples without separation/pre-concentration. This method is called "*dilute and shoot*." It has the capability to measure minor isotopes (^{234}U, ^{235}U, ^{236}U) relative to ^{238}U in a column-purified U fraction. The method has sufficient sensitivity to determine Pu at "fallout" and elevated levels in a rapid, low cost analysis. Accurate determinations employ isotope dilution with ^{242}Pu addition. ICP-MS determination of Am is still relatively untested. ^{241}Am chemical separations are complex, have not been well-

developed for ICP-MS, and would require significant amounts of preliminary work. However, this is worth considering. NAU has promised to carry out 20 "test" sample analyses, at no cost to USTUR. Acid solutions from 9 bones and 11 soft tissues have been sent to NAU for this initial test.

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STL Progress Report G. Jungclaus

Severn Trent Laboratories have recently merged with TestAmerica LLC, and now trades under that name TA/STL (from January, 2007). Twenty-two TA laboratories have thus been added to STL's 32 laboratories, for a total of 54 U.S. service laboratories. The radiochemistry capability of TA/STL will remain the same (served by STL Richland and STL St. Louis). The affects of the merger are expected to be positive. The combined company has made a commitment to keep radiochemistry sample analyses 'in-house' and expect to increase technical resources for STL Richland. The Richland staff members that will be working with USTUR are Greg Jungclaus (Richland Laboratory Directory and primary client contact), Erika Jordan (project manager designate, Manager of Project Management), Steve Wheland (primary technical contact), Matt Lardy (has retired, but consults on the program on a part-time basis), Jodie Carnes (technical consultant, data reviewer, and Quality Assurance Manager), John Norton (sample preparation chemist), Cindy Black (Count Room Supervisor and initial data reviewer), and Ken Miller (Information Technology Manager and major contributor).

The following is the Lab Director's perspective on USTUR Program this past year. STL Richland is expert at preparing all types of human tissue samples. Some of the matrices like bone were challenging and required development of the final procedures. STL Richland has dedicated alpha spectrometry detectors to the USTUR program and can readily count, review and report sample results. STL Richland generated Am-241 data that was of high quality and readily met the usability needs for the program, but the measured Am-243 tracer yields showed a slightly high bias (over 100%). The yields were consistent with results published in the literature and with previous work at STL but did not meet the needs of USTUR. STL Richland has an ongoing investigation to evaluate the elevated Am-243 yields. In this investigation STL Richland has acquired new calibration standards, re-prepared co-precipitation calibration sources, purchased new electro-deposition calibration sources, performed new calibrations for the alpha detectors, included a pre-filter to the separation procedure, investigated comparison of manual vs. computer integration techniques, conferred with the vendors of the columns used for separation, evaluated alternative methods, and compared method performance with human tissue vs. other matrices.

USTUR has expressed the need to change the format of the STL analytical data reports. Several suggestions were offered. STL realized the value of more

reader-friendly reports, and STL's IT manager has spent a considerable amount of time programming to make the format changes. STL's Laboratory Director is absolutely committed to the success of this program and meeting client needs. STL has addressed all the client issues and worked to resolve them. Some of the work is ongoing, but STL expects to generate attractive reader-friendly reports with usable, as well as legally defensible, data.

STL Technical Milestones — S. Wheland

There is now a STL laboratory suite for Registries work – completely refurbished and now in use – and also *dedicated* alpha spectrometry detectors. Steve Wheland discussed the method of dissolution and analysis of samples received from USTUR. He also discussed some of the issues that have been resolved by practice, investigation, and consultation. One of the problems faced was calculated tracer yields routinely in excess of 100%. The investigations that took place included tracer composition, systemic contamination, detector geometry – diameter of diodes, summing effects – conversion electrons, etc, and calibration with new sources. The recalibration of diodes has brought the problem under control. Another issue was the data reduction and reporting. The decision was made to change the final report formal and content to have it be more inclusive of client information, more in line with client needs and requirements, more end-user friendly for data evaluators, and more concise.

Database and Website Innovations — S. McCord

The current database contains eight tabs including administrative, medical, radiochemistry, health physics, clinical, cause of death, NHRTR, and solutions. There is a need for a new database that is both more user friendly and includes actual USTUR data rather than generalized descriptions. A full database should include: the mode of intake (inhalation, wound, ingestion, mixed), chronic vs. acute intake; the date of suspected intake(s), and the specific radionuclides involved in the intake(s) – that can be inferred from radiochemistry and health physics data. The European IDEAS internal contamination database includes records of European incidents, urine data, and assessed doses. The strengths of the IDEAS database are that, at a glance, the user can quickly view the most important data from the primary database form – and the data that is displayed in a secondary form is summarized on the primary form. The IDEAS database also provides plots of the urine, fecal, whole body, lung, and/or thyroid external counting data. Modifications of the IDEAS database that would be necessary to make it useful for USTUR data would include: allowing for multiple intakes, showing the sequence of key "health physics" events, and listing all recorded 'possible' intakes. This would help the researcher determine which were significant intakes, and evaluate intake-dose estimates.

USTUR's new online database, still under construction, will provide four portals into the USTUR data that includes narrative searches by topic, radiochemistry,

health physics, and pathology. The pathology data can be searched by ICD-9-CM classifications; viewing observations by source of information, relation to death, and severity; viewing observations that lack a valid ICD-9-CM code; and using a customized website search engine. Future developments will include searchable radiochemistry and health physics case data. Ms. McCord gave a live demonstration of USTUR's 'beta' website and described the features that have recently been incorporated.

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Technical Support to the USTUR T. Lynch

Tim Lynch described PNNL's well established collaboration with USTUR in evaluating the accuracy of external counting of ^{241}Am in various parts of the body by comparing these results with known tissue contents determined by USTUR in whole-body donation cases. Mr. Lynch manages PNNL's *In Vivo* Monitoring Program. Calibration of PNNL's and other counting systems throughout the DOE complex are based on 'phantom' limbs, head and torso incorporating bones from USTUR Case 0102 (the Registries' first whole-body donation) with a substantial internal deposition of ^{241}Am. The distribution of ^{241}Am in those phantoms represent an elapsed time of 25 years after intake (by combined inhalation and skin wound) of $^{241}AmO_2$. It is important to determine how variable this distribution is for ^{241}Am produced in the body by radioactive decay of ^{241}Pu (in the majority of cases primarily involving intakes of $^{239+240}$Pu). PNNL also tests how well the LLNL torso phantom (developed in 1980s) represents the effect of overlying tissue thickness on measurements of lung and liver activity. USTUR whole-body cases include various body builds and a range elapsed time since intake and type of intake material (solubility and radioisotopic composition).

Recent cases counted postmortem are ## 0262, 0720, 0745, and 0990. It is planned to continue PNNL's and USTUR's *in vivo* follow-up of ^{241}Am inhalation Case 0855, last measured 6 years ago. This will extend the study of this case to 12 years post intake, by far the longest and most comprehensive *in vivo* follow-up of a single, acute, un-chelated, ^{241}Am inhalation ever carried out.

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The ISU Health Physics Program R. Brey

Students engaged in USTUR project in 2006 were Ms. Stacey McCord, Ms. Nino Chelidze, Ms. Maia Avtandilashvill, Ms. Naz Afarin Fallahian, Mr. Neba Robinson Neba, Mr. Dan Mecham, and Ms. Liesl Germann. Two Ph.D. thesis projects and ISU project objectives are focused on two important areas: (i) internal dosimetric analyses of many, as of yet unpublished, USTUR Registrant cases, and (ii) QA/QC of an electronic database which will be used to share the wealth of

USTUR data with researchers studying internal dosimetry of the transuranium elements and uranium throughout the world.

The ISU working group has focused on initial training in internal dosimetry and QA/QC. The group systematically analyzed previously published Cases 0023, 0262, and 0425. The goals of reviewing cases which have already been published is to make certain that the approaches used to assess the intake of radioactive materials by individual Registrants are internally consistent, and to compare these with past practice. A summary report of this effort was produced for review by USTUR staff. Starting in March, the working group began systematically assessing the intake of radioactive materials in previously unplublished USTUR cases, using current ICRP models. This is a necessary first step in the process of evaluating the possible ranges of biokinetic transfer coefficients between individual Registrants, a key goal of the USTUR research program.

"As a university we engage in scientific research. USTUR represents a wealth of potential research questions which are of substantial innate interest and engage student interest." The future efforts of ISU will be to systematically evaluate the intake(s) of each USTUR Registrant case, and identify trends and needs in the USTUR database which lead to improvement of the 'internal dosimetry system' and consistency among similar international efforts.

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Causes of Death and Longevity N. Fallahian

Ms. Fallahian presented the following description of her proposed study of causes of death and longevity among USTUR Registrants.

Epidemiological studies have played an important role in assessing the potential human health risks due to radiation. Large scale cohort studies can provide useful information with regard to the potential health effects of low levels of ionizing radiation. Several methods and designs have already been used for conducting studies on risk due to exposure to plutonium in nuclear facilities. The main challenges are to find a sufficiently large cohort, obtain accurate dose information, and find sufficiently long periods of follow-up to evaluate cancer risk. Considerable efforts have been made to increase cohort size by combining data from studies conducted in different countries and the establishment of registries and computer databases.

I intend to design a retrospective cohort study that compares the mortality rates of USTUR's plutonium-exposed Registrants with that of matched "non-plutonium exposed" nuclear workers drawn from DOE's Comprehensive Epidemiologic Data Resource (CEDR) database. 'Hypothesis I' is that the mortality rate among the plutonium-exposed people is less than that of non-plutonium workers.

'Hypothesis II' is that, based on the reports of body burdens and external exposures, the USTUR registrants have received low-levels of ionizing radiation. The total effective dose equivalents, including the internal dose equivalents to the critical organs of the USTUR registrants, need to be evaluated. 'Hypothesis III' is that there may be no association between the dose to critical organs and cancer mortality rates. The dose-response relationship studies for the USTUR registrants should be performed as part of a cohort study.

The first objective is to study the causes of death and mortality rates in USTUR donors, as representatives of the workers in the United States, who were involved for many years in different parts of the nuclear industry and were exposed to plutonium and its progeny. Another objective is to study whether or not there is any evidence of an association between the committed organ dose in workers of nuclear facilities in the United States, and the cancer mortality rates. The causes of death and mortality rate in about 320 deceased USTUR Registrants will be investigated, based on existing data in the USTUR database. The results will be compared with closely-matched cohorts such as workers who have not been exposed to plutonium, using data available in DOE's Comprehensive Epidemiologic and Data Resource (CEDR) research program. The dose-response relationship in USTUR donors will be studied based on external exposure reports and bioassay data such as urinalysis reports used for calculating internal exposures and doses received by the critical organs. We will assess the methods used in the study by considering different types of bias, and precision in the measurements; we will assemble literature and will conduct meta-analysis (a formal quantitative summarization of all data); and we will compare the results of this study with the results of the other similar radiation epidemiologic studies.

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Wound Modeling N. Chelidze

Ms. Chelidze described her project for validating models for exposures via wounds.

A biokinetic model for radionuclide-contaminated wounds was recently developed by the National Council on Radiation Protection (NCRP). Contaminated wounds are fundamentally different from inhalation and ingestion intakes. Radioactive foreign material at the wound site can definitely cause malignant tumors in both humans and animals. There is only a small amount of data from humans without surgical wound excision. It was necessary for NCRP to design and parameterize the wound model using experimental animal data. Initiall, data for 48 soluble radionuclides were found. Much less information was available for colloids and particulate materials.

Major compartments of the wound model represent soluble (SOL), colloid and intermediate state (CIS), particles, aggregates, and bound state (PABS), fragment, and trapped particles and aggregates (TPA). Additionally, *blood* and *lymph node* (LN) compartments receive radionuclides cleared from the wound site. The compartmental design is based on the physical and chemical properties of the deposited radioactive material. Transfer of material between compartments is characterized by first-order rate constants. There are four common compartments that radionuclides can enter directly. Initial portioning between SOL and CIS is strongly influenced by aqueous solution chemistry. The principal clearance pathway for soluble material is through blood. LN clearance is dependent on the hydrolytic tendency of the material; it tends to transform into particulates. There are four default categories of soluble materials defined in the NCRP model. Initially insoluble materials are fragments, particles and colloids. All are solid materials. Particles are smaller than fragments. Colloids are formed as hydrolysis products and also have particulate properties. These materials are introduced to the model by direct injection. Colloids enter the CIS compartment. Particles enter the PABS compartment. Fragments enter the fragment compartment.

Principal differences between soluble and insoluble materials are that initially insoluble materials have significant clearance from the wound site to LN; initially soluble materials typically clear through the blood. Wounds can contain materials that originate inflammatory reactions in the wound tissue. Capsule formation may occur which can lead to the creation of “TPA” compartment.

The aim of this ISU study is to examine USTUR ‘wound’ cases, both ‘non-chelated’ and ‘chelated,’ and to attempt to derive specific transfer coefficients applicable to the NCRP wound model system.

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