TEXAS WOMAN'S UNIVERSITY™

Radiation Safety Program

Radiation Producing Equipment Procedures

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Office of Environmental Health & Safety

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I. INTRODUCTION

The Radiation Safety Program at Texas Woman's University (TWU) exists to protect employees, students, and visitors as well as the public and the environment from the harmful effects of exposure to ionizing radiation. This manual describes the general procedures TWU has implemented to ensure a safe campus environment as it relates to X-ray generating equipment. For a Glossary of Terms, see Attachment A. Attachment D describes the specific operating and safety procedures for dual x-ray absorptiometry (DEXA) machines and Attachment E describes the specific operating and safety procedures for the Dental Hygiene Clinic. TWU is committed to meeting all applicable regulatory requirements and to keeping doses of radiation As Low As Reasonably Achievable (ALARA).

The Radiation Safety Officer (RSO) is responsible for managing the radiation safety program with support from the office of Environmental Health & Safety (EHS) and the Radiation Safety Committee. Additional programs containing specific radiation safety related procedures and protocols for users will be developed for specific authorized users (e.g. Dental Hygiene) as necessary. This manual is promulgated in accordance with TWU URP 04.430

II. PURPOSE AND SCOPE

The purpose of this manual is to ensure that all university activities, operations, and procedures involving the use of radiation producing equipment are performed in such a way as to protect the users, faculty, staff, students, and the general public from exposure. This manual applies to all faculty, staff and students responsible for the use of radiation producing equipment which includes but is not limited to:

- Human use medical/dental x-ray machines;
- Bone densitometers (DEXA);
- Diffraction x-ray machines;
- Atomic absorption;
- Fluorescence X-ray microscopes; and
- Other radiation producing equipment associated with research and education.

III. ORGANIZATION AND RESPONSIBILITIES

A. Radiation Safety Committee (RSC)

The RSC advises the TWU administration on matters related to radiation safety and recommends policies and procedures it deems appropriate to ensure an adequate radiation safety program.

The RSC should be comprised of at least 5 members, consisting of one Licensee of each type of radiation producing equipment, one Licensee from each department utilizing radioactive materials (when appropriate), as well as:

- The Radiation Safety Officer.
- The Executive Director of Public Safety.
- The Director of Environmental Health & Safety.
- A Purchasing Agent.
- The Chairperson of the RSC (which can be one of the other members).

The RSC shall meet as often as necessary to conduct business, but no less than 3 times a year. A quorum shall consist of a simple majority of the committee, including the chairman, RSO and a representative from management.

The RSC shall meet as often as needed to review:

- New or changing uses of radiation producing equipment;
- Changes in radiation safety staff and organizational structure;
- Changes in regulations;
- Radiation incidents and emergencies; and
- Procedural changes.

Specific responsibilities of the RSC include:

- Review and approve applications for possession and use of radiation producing equipment.
- Notify and advise the administration of any violation of federal or state regulations which might result in fines or penalties imposed on the University. Payment of fines or penalties will be the responsibility of the department whose non-compliance resulted in such action.
- Assist the RSO in reviewing or auditing radiation safety program operations as needed.

B. Radiation Safety Officer (RSO)

The responsibilities of the RSO include:

- Direct the radiation safety program.
- Oversee the purchase, receipt, storage, use, and disposal of radioactive or radiation producing equipment.
- Oversee the inventories of radiation producing machines on campus.
- Ensure the most current legal requirements are identified and evaluated for compliance.
- Ensure TWU's radiation producing equipment registration is maintained and kept up to date.
- Establish, coordinate, and adhere to the radiation safety procedures outlined in this manual and applicable regulatory requirements.
- Inspect university facilities, where radiation producing equipment are used for regulatory compliance and worker protection, or in response to a notice of a possible violation.
- Assist Licensees and Authorized Users with meeting radiation safety training requirements.
- Serve as the official university contact for federal and state regulatory agencies regarding radiation safety compliance and communicate compliance requirements to university officials.
- Write an Annual Report of the relevant operations per Academic Year.

C. Environmental Health & Safety (EHS) and Risk Management

The duties of the Environmental Health & Safety and Risk Management departments include:

- Assist the RSO in maintaining the overall radiation safety program.
- Arrange for proper disposal of radiation producing equipment.
- Inspect for radiation safety compliance during routine inspections.

D. College Deans, Chairs, and Directors

The duties of the college Deans, Chairs, and Directors include:

- Ensure the safe operations of all laboratories and other sites in the respective college or work area where radiation producing equipment are used.

- Ensure compliance with all applicable regulatory requirements, as well as the university policy and procedures described in this manual.
- Determine and assess fiscal responsibility in the departments resulting from fines and/or damages stemming from non-compliance.
- Provide safety equipment and engineering controls as deemed necessary by the RSO.
- Have enforcement authority, with consultation through the RSO and/or RSC, to close a laboratory for safety or regulatory violations.

E. Licensees

The duties of licensees, such as Principal Investigators (PI) or Supervisors in charge of registered radiation producing equipment, include:

- Comply with all license and registration requirements, regulations, programs, and procedures specified by the RSO/EHS.
- Complete all required radiation safety training courses and ensure all required protective equipment, engineering controls, and safety precautions described in this manual and any applicable owner's manuals are used by all members of their area.
- Handle all radiation producing equipment in accordance with this manual and applicable regulations.
- Periodically inspect their laboratory or work area to ensure compliance with this manual and applicable regulations.
- Notify the RSO/EHS of all incidents involving radiation producing equipment. Report non-compliance issues or concerns to the RSO or to the director of EHS.
- Have the primary responsibility for the health and safety of their faculty, staff, students, and visitors.

F. Authorized Users

Authorized users must:

- Comply with all license and registration requirements, regulations, programs, and procedures specified by the RSO, EHS, and their PI/ Supervisor (the Licensee).
- Report any condition which, in the individual's opinion, is unsafe or improper.
- Complete all required radiation safety training courses prior to working with radiation producing equipment.

IV. REGISTRATION AND REGULATORY REQUIREMENTS

TWU's current registration, R08296, issued by the Texas Department of State Health Services (TDSHS) includes specific conditions and regulations that apply to the use of equipment covered by the registration. A copy of the current TWU Registration and applicable state regulations are available upon request from the RSO.

Rules and procedures promulgated for use within the University shall comply with the regulations and requirements of the Texas Department of State Health Services Radiation Control Program detailed in the Texas Administrative Code 289, and the Texas Health and Safety Code Ch. 401 (Texas Radiation Control Act).

Any faculty or staff member at TWU who wishes to use radiation producing equipment must submit the application to use radiation producing equipment in Attachment C to the RSO. This person must be in a position of authority over laboratory personnel and operations.

Approval must be granted by the RSO prior to purchasing or using any radiation producing equipment at any TWU campus.

Only work that is authorized under the applicable registration may be performed. The RSO approval may include restrictions or limits on:

- Location of use and/or storage of the radiation producing device; and,
- Types of experiments authorized.

The RSO, RSC, or EHS may at any time place additional conditions or restrictions on an authorization for reasons of safety and/or compliance. Radiation producing equipment shall not be used in or on humans unless specifically authorized.

V. DOSE LIMITS AND EXPOSURE CONTROL

The effects of chronic low doses of radiation (in the range of 0 - 5 rem per year), as typically received by occupationally exposed persons, are not well known. Conversely, acute high doses of radiation (>100 rem in one exposure) are known to increase the risk of stochastic effects such as cancer in the exposed individual or genetic effects in the progeny of the individual. By extrapolating the dose-effect relationship from high doses to low doses using the linear non-threshold theory, increased risks for stochastic effects can be estimated even for very low radiation doses (Reference USNRC Regulatory Guide 8.29)

These data and models lead to the conclusion that there is no dose which is one hundred percent "safe", i.e., completely without risk. However, natural and man-made background radiation is ubiquitous, providing an average annual radiation dose of 0.360 rem to every U.S. citizen. Large fluctuations in background radiation, by geographical location, have not been shown to result in any measurable increase in risk of any health effect. Nevertheless, any radiation dose received occupationally will be in excess of the background radiation dose received and will be assumed to carry with it additive risk of deleterious effect.

State and federal regulations have established a system of dose limitation and minimization. Individual doses are limited to ensure that negative effects (such as cataracts) are avoided and that total lifetime risks of long-term effects (such as cancer and hereditary effects) do not exceed overall health risks for those persons working in safe industries. However, regulations also require that Authorized Users make every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as is practical with social, economic, and technological factors considered. This concept or philosophy is given the special name ALARA, which is an acronym for As Low As Reasonably Achievable.

A. Radiation Dose Limits

Occupational Dose Limits for Adults:

- Total Effective Dose Equivalent (TEDE) - 5 rem/y (5,000 mrem/y)
- Total Organ Dose Equivalent (TODE) - 50 rem/y (50,000 mrem/y)
- Shallow Dose Equivalent (SDE) -50 rem/y (50,000 mrem/y)
- Extremity Dose Equivalent -50 rem/y (50,000 mrem/y)
- Lens (of Eye) Dose Equivalent (LDE) - 15 rem/y (15,000 mrem/y)

Dose to an Embryo/Fetus of a Declared Pregnant Woman (occupational exposure)*

- Total Effective Dose Equivalent (TEDE) - 0.5 rem (500 mrem) over entire pregnancy
- TEDE should not exceed 0.05 rem (50 mrem) in any month

*Note: Individuals who voluntarily self-identify as pregnant should complete a Declaration of Pregnancy Form (Attachment B of this document). If an individual voluntarily informs the RSO in writing of their pregnancy, TWU will ensure that the dose to the embryo/fetus does not exceed the radiation dose limits listed above. This is accomplished by providing a fetal dosimeter for the duration of the pregnancy.

Individual members of the public

- 2 mrem in any one hour
- Total Effective Dose Equivalent (TEDE) - 0.1 rem/y (100 mrem/y)

B. Exposure Control

The only means of exposure from radiation producing equipment at TWU is external exposure. Common external exposure controls include the use of time, distance, and shielding to minimize radiation doses. In many X-ray devices the radiation is emitted in a primary beam. Any position off of the beam axis significantly reduces the risk of exposure. All hazards from ionizing radiations can be minimized by using the lowest energy of X-rays consistent with procedural requirements. The following procedures can assist with controlling radiation exposure.

1. Bone Density Scanner (DEXA)

Individuals performing scans with the bone density scanner must undergo training prior to being allowed to operate the device.

Rooms with a bone density scanner must have the operator placed at an appropriate distance which, per the manufacturer's specifications, does not require shielding; if this cannot be achieved due to space constraints, an appropriate shield (either mobile or immobile) must be used. Please contact the RSO for additional information on these requirements for your equipment.

2. Dental X-Rays

Individuals shall not be exposed to the useful beam except for healing arts purposes authorized by a dentist. Deliberate exposure for an individual training, demonstration, or other non-healing arts purposes is prohibited.

Rooms containing x-ray producing devices shall be used for only one x-ray procedure at a time.

In no case shall an individual hold the tube or tube housing assembly support during any radiographic exposure. Hand-held radiation machines shall be held only in the manner specified by manufacturer recommendation.

Individuals who are not receiving diagnostic services from x-ray producing medical equipment (or in limited cases, performing the x-ray procedure) are not permitted to be in the room when the x-ray procedure is taking place.

Patients receiving diagnostic services from x-ray producing dental equipment must be appropriately shielded (such as use of a 0.25mm thickness lead apron).

Patients who self-identify as pregnant should have their physician contacted prior to having an x-ray procedure performed on them; unnecessary procedures should wait until after the health status of pregnancy is resolved.

Individuals who self-identify as pregnant and are receiving dental x-rays should be provided with abdominal and thyroid shielding in accordance with the American Dental Association guidelines.

Individuals performing the x-ray procedure should make attempts to stand out of the room during the procedure, when possible. Individuals performing x-ray procedures who cannot leave the room during x-ray procedures must utilize a protective lead apron and keep body parts from having direct contact with the beam.

VI. EMPLOYEE DOSE MONITORING

Employee monitoring for radiation doses is done by area dosimetry badge monitoring and analysis, generally, as no employees are expected to exceed greater than 10% of dose limits. The purpose of radiation dosimetry is to measure the radiation dose equivalent received by occupationally exposed individuals. The results serve to verify and document compliance with the applicable dose limits (previously mentioned) as well as to identify problems and monitor the effectiveness of existing radiation safety controls. Texas regulations only require employee dose monitoring when employees are likely to receive an annual dose in excess of 10% of the dose limits described in the Radiation Dose Limits section above. Therefore, most users of radiation producing equipment will not be monitored individually for external radiation exposure (will not receive dosimetry "badges") because of the very low radiation exposure associated with the equipment. However, area dosimeters are maintained in all areas where individuals performing X-rays stand while operating the units, on handheld devices, and in the general area of the respective clinics. In the dental hygiene clinic, practitioners who self-identify as pregnant to the RSO in writing will be issued a fetal

dosimeter for the duration of the pregnancy to ensure that the dose to the embryo/fetus does not exceed the radiation dose limits listed above.

The following information shall apply to personal radiation dosimetry in cases where it is determined to be necessary:

A. Personal Radiation Dosimetry

- Radiation dosimeters appropriate for the potential exposure will be issued and monitored by the RSO.
- The RSO and RSC shall determine the "likely to exceed 10%" status of an individual and the dosimeter type.
- Wear periods are 3 months in duration. Each employee required to wear a personal dosimeter badge will receive a new monitoring badge from the RSO (or representative) every 3 months.
- Radiation dosimeters shall not be deceptively exposed.
- Dosimeters are issued to only one person. Dosimeters shall not be shared.
- Dosimeters in storage and not being worn shall not be stored near sources of radiation.
- Dosimeters should not be exposed to high heat, chemical or physical damage, or washed in a washing machine.
- No person shall wear dosimeters issued by TWU while working for another employer or institution.
- Authorized Users shall notify the RSO if they are concurrently working for another (non-TWU) employer with sources of ionizing radiation.
- Dosimeters shall not be worn during personal medical or dental x-ray examinations.
- Dosimeters shall not be worn after medical administration of radioactive materials (thyroid ablation therapy, cardiac stress tests, diagnostic nuclear medicine tests, etc.).
- Licensees shall notify the RSO immediately upon learning of possible deceptive exposures of dosimeters.
- Intentional deceptive exposures of dosimeters are forbidden and may result in enforcement actions.
- Lost or damaged dosimeters shall be reported to the RSO as soon as possible.
- Proper wearing of dosimeters:

- Whole body dosimeters are the most common type of monitoring device worn by persons operating radiation producing equipment and measure the dose received by a person's whole body. Whole body dosimeters shall be worn at the location on the body likely to receive the highest dose.
- Persons who wear a leaded apron should wear whole body dosimeters outside of any leaded apron. Those who perform diagnostic x-ray and/or fluoroscopy procedures should normally wear the dosimeter at the collar.
- Declared pregnant women, who wear dosimeters for fetal monitoring, shall wear the dosimeters on the abdomen. If a leaded apron is worn by the x-ray technician, the dosimeter should normally be placed on the abdomen, under the apron.

- Licensees or their designees shall collect and return used dosimeters to the RSO promptly after receiving replacement dosimeters at the beginning of a new wear period.
- Any person who works with any source of radiation at TWU (or did so in the past) may request a copy of their dose records at any time. These records are maintained by the RSO and are available from them upon request.

VII. RADIATION SURVEYS AND POSTINGS

A. Radiation Surveys (Area Monitors)

The Texas Radiation Control Program does not require area monitoring in dental clinics. However, in the dental hygiene clinic as well as DEXA areas, area dosimetry monitoring is conducted in a few locations to ensure the public dose is minimal as expected, and serves to provide potential exposure data for equipment operators.

B. Postings

The following signs are required:

- **"CAUTION- RADIATION AREA"** signs bearing the trefoil symbol shall be conspicuously posted on the entrance to each area or room containing operational X-ray equipment.
- A **Notice to Employees**, RC Form 203-1 for all areas with Radiation Producing Equipment (with the exception of the Dental Hygiene Clinic, which must use RC Form 232-1) must be posted conspicuously. Current versions of the notice can be obtained from the RSO or TDSHS website.

All equipment shall be labeled in a conspicuous manner that cautions individuals that radiation is produced when it is energized. Signs and postings should be removed when the hazard no longer exists (e.g. equipment removed).

VIII. TRAINING

All individuals who work with or (in some cases) near registered sources of radiation are required to complete basic radiation safety training conducted or approved by the RSO and/or the RSC, and area/task specific radiation safety training conducted by the respective Licensee, at a minimum. The depth of the safety training must be commensurate with the level of hazard to which the individual is exposed. All training completion certificates must be maintained on site, and copies sent to the RSO. Individuals shall NOT be allowed to work unsupervised with sources of radiation until completing appropriate radiation safety training. For equipment-specific operator training, see Attachments D and Attachment E for DEXA and Dental Hygiene equipment, respectively.

A. Basic Radiation Safety Training

All Licensees and Authorized Users who work with or are authorized to possess registered radiation producing equipment, are required to complete appropriate radiation safety training course(s) offered or approved by the RSO prior to working with radiation producing devices for the first time and biannually thereafter.

Training subject matter shall include, but is not limited to: fundamentals of radiation safety, pertinent Federal and State regulations, equipment to be used, and TWU specific procedures and recordkeeping requirements.

B. Area/Task-Specific Radiation Safety Training

Each Licensee is responsible for providing and documenting space and equipment-specific training to Authorized Users (including students) who work with registered radiation producing equipment under their control. This training shall address, as applicable:

- Area restrictions - where radiation producing equipment is used within the lab(s) and restrictions on that use.
- Procedures for security.
- Posting locations for required signs and notices.
- Walk-through review of protocols involving radiation producing devices.

- Ensuring equipment specific operating and safety procedures is read by authorized users (completion of this must be documented with the name, signature, and date for each user per regulations).
- Special handling techniques which will minimize exposures when using the equipment.

Training for individuals, who may be in the vicinity of the equipment during its operation shall include:

- A brief discussion of hazards of radiation;
- Recognition of warning signs;
- Areas from which such persons are restricted; and
- Person(s) to contact in the event of incident or emergency.

IX. INSPECTIONS

Licensees may be inspected for compliance at any time by either the Texas Department of State Health Services, the RSO, or EHS staff. The following information is intended to make the Licensee aware of the inspection program and to provide general information on what is expected during inspections:

A. Inspections by the Texas Department of State Health Services

Inspections conducted by TDSHS may be conducted without prior notice, however typically the RSO is contacted with a one to two week notice prior to inspections. Ordinarily, inspections occur at three years from the previous inspection date.

The Licensee is responsible for providing all required documents and may be required to be present during the inspection.

B. Inspections by the RSO or EHS

The RSO and EHS staff reserve the right to conduct inspections with no advanced notice. However, routine inspections are normally scheduled in advance. Inspections may include, but are not limited to:

- Review of training records;
- Review of approved worker list;
- Review of procedures;
- Review of registration authorizations and conditions;
- Performance of radiation area surveys, as appropriate;

- Review of equipment inventory;
- Review of security procedures; and
- Inspection of personal protective devices.

X. INCIDENTS AND EMERGENCIES

Any accident or injury involving excessive or uncontrolled radiation exposure to any individual or the theft/loss of control of a radiation producing device constitutes an emergency pursuant to this section. If a serious or life-threatening emergency exists, or for calls outside normal business hours (Mon.-Fri., 8-5) contact the TWU Department of Public Safety or 911. In all emergencies, the RSO/EHS should be contacted. Emergency contact information is provided below.

A. Emergency Contact Information

TWU EHS 24-Hour Emergency Number	**940-898-4001**
TWU RSO/EHS Director (Drew Townsend)	**940-898-3129**
Ambulance/Fire Department	**911**
TWU Department of Public Safety	**940-898-2911** Denton **214-689-6666** Dallas **713-794-2222** Houston
TDSHS 24-Hour Radiological Emergency Reporting *Used for reporting emergencies only.*	**512-458-7460**

B. What Constitutes an Incident or Emergency

- Loss or theft of any radiation producing equipment.
- High or potentially high accidental radiation exposure to an individual or to a member of the public.
- Deceptive or potentially deceptive exposure of a dosimeter.
- Any personal injuries which may involve radiation exposure.

If you are unsure if your incident constitutes an emergency, please contact the RSO or EHS immediately for guidance.

XI. RECORDKEEPING REQUIREMENTS

All Licensees who use radiation producing equipment on the TWU campus shall maintain the following records in a clear, concise, and orderly format and forward copies of all records to the RSO.

A. Required Records

- Copy of the current Radiation Producing Machines Registration issued by TDSHS.
- Equipment performance evaluations, maintenance records, and calibration records, as applicable.
- Operating and emergency procedures.
- Procedure manuals.
- Records of radiation safety training for each user.

All approved records from previous TDSHS inspections should be kept for at least 2 cycles of routine inspection.

B. Additional Records

In addition to maintaining duplicates of certain records, the RSO shall maintain the following records, which are available for review during normal office hours.

- Original copy of all equipment Registrations issued to TWU.
- Copies of current applicable regulations.
- Inspection reports and copies of all "Notices of Violation" issued by state or federal regulatory agencies and the TWU responses to those Notices.
- Current version of all applicable procedure manuals.
- Survey reports and area monitoring results.
- Dosimetry records.
- Survey instrument calibration records.

ATTACHMENT A – Glossary of Terms

"**Absorbed dose**" means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray (Gy). 1 Gy = 100 rad.

"**Adult**" means an individual 18 or more years of age.

"**Agreement State**" means a state which has executed an agreement with the U.S. Nuclear Regulatory Commission transferring to the state the responsibility for regulating uses of certain radioactive materials within its borders. Texas is an agreement state.

"**Agency**" means the Texas Department of State Health Services which runs the Radiation Control Program under the Division for Regulatory Services.

"**Annual Limit on Intake (ALI)**" means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year.

"**As low as is reasonably achievable (ALARA)**" means making every reasonable effort to maintain exposures to radiation as far below regulatory dose limits as is practical, consistent with the purpose for which the licensed or registered activity is undertaken, taking into account the state of technology, the economics of improvements in relation to benefits to public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of ionizing radiation and licensed sources of radiation in the public interest.

"**Authorized User**" means any appropriately trained individual (including faculty, staff, students, volunteers, visiting researchers etc.) working with radioactive materials or radiation producing devices under the direction of a licensee. The term includes licensees as well.

"**Background radiation**" means radiation from cosmic sources; non-technologically enhanced naturally occurring radioactive material, including radon, except as a decay product of source or special nuclear material, and including global fallout as it exists in the environment from the testing of nuclear explosive devices. "Background radiation" does not include sources of radiation from radioactive materials regulated by the Texas Bureau of Radiation Control (BRC).

"**Becquerel (Bq)**" means the System International (SI) unit of activity. One becquerel is equal to 1 disintegration or transformation per second (dps).

"**Bioassay**" means the determination of kinds, quantities, or concentrations, and, in some cases, the locations of radioactive material in the human body, whether by direct measurement, in vivo counting, or by analysis and evaluation of materials excreted or removed from the human body.

"**CFR**" means Code of Federal Regulations.

"**Declared Pregnant Woman**" means a woman who voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

"**Deep dose equivalent (Hd or DDE)**" which applies to external whole body exposure, means the dose equivalent at a tissue depth of 1 centimeter (1000 mg/cm2).

"**Dose**" is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, total organ dose equivalent, or total effective dose equivalent.

"**Dose equivalent (HT)**" means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the sievert (Sv) and rem. 1 Sv = 100 rem.

"**Dose limits**" means the permissible upper bounds of radiation doses established in accordance with these rules. For purposes of the rules, "limits" is an equivalent term.

"**Dosimeter**" means devices designed to be worn by a single individual for the assessment of dose equivalent. Examples of individual monitoring devices are film badges, thermoluminescent dosimeters (TLDs), and pocket ionization chambers.

"**Effective dose equivalent (HE)**" means the sum of the products of the dose equivalent to each organ or tissue (HT) and the weighting factor (WT) applicable to each of the body organs or tissues that are irradiated (HE = ▫ WTHT).

"**Embryo/fetus**" means the developing human organism from conception until the time of birth.

"**Entrance or access point**" means any opening through which an individual or extremity of an individual could gain access to radiation areas or to licensed or registered sources of radiation. This includes portals of sufficient size to permit human access, irrespective of their intended use.

"**Exposure**" means the quotient of dQ by dm where "dQ" is the absolute value of the total charge of the ions of one sign produced in air when all the electrons (negatrons and positrons) liberated by photons in a volume element of air having mass "dm" are completely stopped in air. The unit of exposure is the coulomb per kilogram (C/kg) or the roentgen (R). 1 R = 2.58 x 10-4 C/kg.

"**Exposure rate**" means the exposure per unit of time, typically milliroentgen per hour (mrem/h).

"**External dose**" means that portion of the dose equivalent received from any source of radiation outside the body.

"**Extremity**" means hand, elbow, arm below the elbow, foot, knee, and leg below the knee. The arm above the elbow and the leg above the knee are considered part of the whole body.

"**Eye dose equivalent (LDE)**" means the external dose equivalent to the lens of the eye at a tissue depth of 0.3 centimeter (300 mg/cm2).

"**Gray (Gy)**" means the System International (SI) unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (100 rad).

"**Healing arts**" means any system, treatment, operation, diagnosis, prescription or practice for the ascertainment, cure, relief, palliation, adjustment or correction of any human disease, ailment, deformity, injury, or unhealthy or abnormal physical or mental condition.

"**High radiation area**" means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 millisievert) in 1 hour at 30 centimeters from any source of radiation or from any surface that the radiation penetrates.

"**Human use**" means the internal or external administration of radiation or radioactive material to human beings for healing arts purposes or research and/or development. Human use is specifically prohibited under all licenses issued to Texas Woman's University.

"**Individual**" means any human being.

"Individual monitoring devices" means devices designed to be worn by a single individual for the assessment of dose equivalent. For purposes of this section, "personnel dosimeter," "dosimeter," and "personnel monitoring equipment" are equivalent terms. Examples of individual monitoring devices include, but are not limited to, film badges, thermoluminescence dosimeters, optically stimulated luminescence dosimeters, pocket ionization chambers (pocket dosimeters), and electronic personal dosimeters.

"**Internal dose**" means that portion of the dose equivalent received from radioactive material taken into the body.

"**Ionizing radiation**" means any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter. Ionizing radiation includes gamma rays and x rays, alpha and beta particles, high speed electrons, neutrons, and other nuclear particles.

"**License**" means a form of permission given by the Texas Department of State Health Services (TDSHS) Division for Regulatory Services, Radiation Control Program, or the U.S. Nuclear Regulatory Commission (NRC) to an applicant (in our case, Texas Woman's University) who has met the requirements for licensing set out by that Agency (TDSHS or U.S. NRC)

"**Licensed material**" means radioactive material received, possessed, used, or transferred under a license issued by the Texas Department of State Health Services, Division for Regulatory Services, Radiation Control Program or the U.S. Nuclear Regulatory Commission.

"**Licensee**" regulatorily means any person or organization who is licensed by the Texas Department of State Health Services, Division for Regulatory Services, Radiation Control Program or the U.S. Nuclear Regulatory Commission. Under the regulatory definition, TWU is the licensee. For the purposes of this document, Licensee means those persons listed on the TWU Radioactive Materials License and those persons who are responsible for radiation producing equipment on the TWU X-Ray Registration.

"**Lost or missing source of radiation**" means a source of radiation whose location is unknown. This definition includes licensed material that has been shipped but has not reached its planned destination and whose location cannot be readily traced in the transportation system.

"**Member of the public**" means any individual, except an individual who is performing assigned duties for a licensee or registrant involving exposure to sources of radiation.

"**Minor**" means an individual less than 18 years of age.

"Monitoring" means the measurement of radiation and the use of the results of these measurements to evaluate potential exposures and doses. For purposes of this section, "radiation monitoring" and "radiation protection monitoring" are equivalent terms.

"**Natural radioactivity**" means radioactivity of naturally occurring nuclides whose location and chemical and physical form have not been altered by man.

"**Occupational dose**" means the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to sources of radiation. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research programs, or as a member of the public.

"**Permit**" means a form of permission given by the TWU Radiation Safety Committee to an applicant (faculty of Texas Woman's University) to possess, store, and/or use radioactive material or radiation producing devices under the authority granted to TWU in the applicable License. A Permit is issued to one individual; never to a department, office or group of individuals.

"Public dose" means the dose received by a member of the public from exposure to radiation from licensed/registered and unlicensed/unregistered sources of radiation, whether in the possession of the licensee/registrant or other person. It does not include occupational dose or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with this section, or from voluntary participation in medical research programs, or as a member of the public.

"**Quality factor (Q)**" means the modifying factor that is used to derive dose equivalent from absorbed dose.

Radiation	Quality Factor
Beta	1
Gamma	1
X-ray	1
Alpha	20
Neutron	varies from 3 - 10

"**Rad**" means the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 erg per gram or 0.01 joule per kilogram (0.01 gray).

"**Radiation**" means one or more of the following:

1) Gamma and x rays; alpha and beta particles and other atomic or nuclear particles or rays;

2) Stimulated emission of radiation from any electronic device to such energy density levels as to reasonably cause bodily harm; OR
3) Sonic, ultrasonic, or infrasonic waves from any electronic device or resulting from the operation of an electronic circuit in an electronic device in the energy range to reasonably cause detectable bodily harm.

"**Radiation area**" means any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 millisievert) in 1 hour at 30 centimeters from the source of radiation or from any surface that the radiation penetrates.

"**Radiation machine**" means any device capable of producing ionizing radiation except those devices with radioactive material as the only source of radiation.

"**Radiation safety officer (RSO)**" means an individual who has a knowledge of, and the authority and responsibility to apply appropriate radiation protection rules standards, and practices, and who must be specifically authorized on a certificate of registration or radioactive material license.

"**Radioactivity**" means the disintegration of unstable atomic nuclei with the emission of radiation.

"**Rem**" means the special unit of any the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor (1 rem = 0.01 sievert).

"**Restricted area**" means an area, access to which is limited by the licensee or registrant for the purpose of protecting individuals against undue risks from exposure to sources of radiation. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

"**Roentgen (R)**" means the special unit of exposure. One roentgen (R) equals 2.58 x 10-4 coulombs/kilogram of air. (See "Exposure").

"**Shallow dose equivalent (HS or SDE)**" which applies to the external exposure of the skin or an extremity, means the dose equivalent at a tissue depth of 0.007 centimeter (7 mg/cm2) averaged over an area of 1 square centimeter.

"**Sievert**" means the System International (SI) unit of any of the quantities expressed as dose equivalent. The dose equivalent in sievert is equal to the absorbed dose in gray multiplied by the quality factor (1 Sv = 100 rem).

"**Survey**" means to take measurements of levels of radiation or concentration of radioactive material present.

"**Total effective dose equivalent (TEDE)**" means the sum of the deep dose equivalent for external exposures and the committed effective dose equivalent for internal exposures. TEDE = DDE + CEDE

"Total organ dose equivalent (TODE)" means the sum of the deep dose equivalent and the committed dose equivalent to the organ receiving the highest dose.
TODE = DDE + CDE

"Trefoil symbol" means the universal radiation warning symbol.

"Unrestricted area" means an area, access to which is neither limited nor controlled by the licensee (or Authorized User).

"Whole body" means for purposes of external exposure, head, trunk (including male gonads), arms above the elbow, or legs above the knees.

"Worker" means an individual engaged in work under a license or a Permit.

ATTACHMENT B - Declaration of Pregnancy Form

Section I. Voluntary Declaration of Pregnancy

In accordance with the Texas regulations for Control of Radiation in 25 TAC 289.232(j)(3)(A)(i)(IV), "Dose equivalent to an embryo/fetus", I voluntarily declare that I am pregnant. My estimated date of conception is (month and year) _____ as regulatory required.

I understand that the dose equivalent to my embryo/fetus during my entire pregnancy will not be allowed to exceed 0.5 rem (5 mSv), unless this limit has already been exceeded between the time of conception and the date of declaration as stated. By attesting this document, I understand that I have met the definition of a declared pregnant woman[1].

_____ _____

Signature and Date Employee/Student ID

_____ _____

Name (Printed) Date of Birth

Section II. Rescinding Pregnancy Declaration

The pregnant worker may undeclare the above declaration in writing at any time without explanation and the dose monitoring will be discontinued and the applicable radiation worker occupational dose limits will apply.

I, _____, declare that I no longer wish to be considered a declared pregnant woman.

_____ _____

Signature and date Employee/Student ID

[1] 25 TAC 289.231 (c) (12) defines a declared pregnant woman as: A woman who has voluntarily informed the registrant, in writing, of her pregnancy and the estimated date of conception. The declaration remains in effect unless the declared pregnant woman voluntarily withdraws the declaration in writing or is no longer pregnant.

ATTACHMENT C – Application to Use Radiation Producing Equipment

TWU is required by state law to register each radiation producing equipment or device. This includes x-ray machines, electron microscopes, bone densitometers, and atomic absorption. The Licensee is the person who will be responsible for the safe use of the radiation producing equipment. Submit the completed form to the RSO.

Licensee Name				Department	
Building & room number where device will be stored					
Phone Number		Email Address			
Type of device (e.g. analytical x-ray, diffraction x-ray, densitometer)					
Device manufacturer		Device model number		Device serial number	
TWU inventory control tag		Maximum kVP of device		Maximum mA of device	
Number of x-ray tubes		□ 0 □ 1 □ 2		□ µCi □mCi	
Interlocks/safety engineered into the device					
Intended use of device					
Training & experience of applicant regarding devices of this type					
Provide a sketch of the room or lab with device placement indicated. Also indicate occupational uses of nearby areas. Attach the sketch on a separate page.					

Others authorized to use this equipment		
Name	Title	Role

Signature of Applicant		Date	
RSO Approval		Date	
Department Head Approval		Date	

ATTACHMENT D

OPERATING AND SAFETY PROCEDURES – BONE DENSITOMETRY/DEXA

This Attachment establishes procedures to be followed for the operation of DEXA units on the Denton and Houston campuses. The procedures were developed to minimize radiation exposure to participants and employees and maintain compliance with the Texas Department of State Health Services (DSHS) regulations.

1. **Operating, Safety, and Emergency Procedures**
   A. Follow all manufacturer operating, safety, and emergency procedures as well as the applicable procedures outlined in this document.
   B. The Notice to Employees sign shall be posted within rooms housing the DEXA units.
   C. Caution Radiation Area signs shall be posted outside of rooms housing the DEXA units.
   D. The Certificate of Registration, operation and safety procedures, recent notices of violation, and the equipment user guides shall be located in the rooms housing the DEXA units.
   E. This facility will make the location of these operation and safety procedures known to any person credentialed to operate a respective DEXA machine. Annually, each operator will record their acknowledgement with their name, signature, and date they read it (see DEXA Appendix A below). The RSO will review it and maintain a copy.
   F. Individuals will be scanned for research purposes and will operate according to the Texas Woman's University- Houston Institutional Review Board (IRB). All individuals participating in research protocols will provide informed consent prior to being scanned. No DXA scans will be performed on patients referred from medical professionals for the purpose of clinical diagnostics.
   G. A copy of the Texas Regulations for Control of Radiation is available at the Texas Department of State Health Services Website (https://www.dshs.texas.gov/radiation/x-ray/laws-rules.aspx) and in the RSO office, Graduate Research Building, room 311 at TWU Denton, TX and operators shall be familiar with pertinent sections of 25 TAC 289.23 I, 25 TAC 289.202, 25 TAC 289.203, 25 TAC 289.227, 25 TAC 289.226 (W).

2. **Participant Safety and Area Monitoring**
   A. Area monitoring using dosimeters will be conducted in the rooms housing the DEXA units and shall be located in the area the operator is located.
   B. Area monitoring will be evaluated quarterly to ensure that employees are not exposed in excess of 5 rem per year. Research faculty on the TWU Houston campus certified to operate the DXA will be responsible for sending the Houston area monitors to Landauer for exposure analysis. The RSO at the Denton Campus will be responsible for sending the Denton area monitors and for receiving, assessing, and informing authorized users of any exposures of 100 mRem or more (after background subtraction) per quarter.

C. Individual monitoring is not required for DXA operators because the DXA equipment does not produce in excess of 500 millirems in a year according to 289.23 l(n)(I) and (s)(3).
D. No minors are allowed to operate the Horizon W DXA machine or work in the room in which it is housed during machine operation.
E. All operators will have continual communication with the participant being scanned.
F. Re-scans can be performed based on the following criteria only after consent for a second exam is obtained:
G. Participant movement during the exam
H. Positioning problem
I. Jewelry or other object not removed
J. Hands positioned along sides, not flat
K. Too tall for the table, feet cut out of the scan
L. Equipment failure
M. Obtaining consent for a second exam: If the scan can be repeated based on the conditions outlined above, you need to obtain permission from the participant to complete a second scan. No more than two scans can be performed in one day on the same participant.
N. All operators will be positioned according to the statement of ALARA (any radiation exposures maintained to As Low As Reasonably Achievable).
O. By serving as an ad hoc member of the TWU-Houston IRB, a medical professional will provide oversight for the DXA operations at this facility.
P. The computer to access the DXA system will be password protected. Only trained individuals shall know the password to the DXA system.

3. Quality Assurance Programs

A. Automated quality assurance testing will be performed according to the manufacturer's instructions (Hologic, Inc.) established in the user guide. This includes one time per month and at the beginning of any day a participant is scanned.
B. Discrepancies in QA results will be reported immediately to the manufacturer.
C. No participants will be scanned until all failing QA tests are corrected.
D. The Horizon W technician is responsible for performing all QA procedures.
E. All data will be backed up according to manufacturer's instructions to an external drive and to the APEX System Backup. The procedure will be based on the APEX Data Archiving Best Practices manual which will be housed in the Density Room, 10133.

4. Training

A. Each operator is required to complete 16 hours of instruction on the use of the DEXA.

Training will be provided by either the manufacturer or by an independent contractor who is capable of providing such training.

B. In addition, each operator must receive 4 hours of Radiation Safety Training initially, and every 2 years thereafter in accordance with Texas Administrative Code Title 22 Section 194.15.

C. Copies of all training records should be sent to the RSO, as well as maintained on site.

DEXA APPENDIX A
RECORD OF INSTRUCTION OF INDIVIDUALS
IN OPERATING AND SAFETY PROCEDURES FOR
TEXAS WOMAN'S UNIVERSITY BONE DENSITOMETRY/DEXA EQUIPMENT

These procedures have been made available to each individual who operates the x-ray equipment on the date(s) indicated. [See §289.227(i) (2)(D)]

_____ _____

(Signature of RSO) (Date)

Equipment Operator Statement:

I have read these procedures and agree to follow them.

_____ _____
(Signature of Equipment Operator) (Date)

_____ _____
(Signature of Equipment Operator) (Date)

_____ _____
(Signature of Equipment Operator) (Date)

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(Signature of Equipment Operator) (Date)

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_____ _____
(Signature of Equipment Operator) (Date)

_____ _____
(Signature of Equipment Operator) (Date)

ATTACHMENT E

OPERATING AND SAFETY PROCEDURES - TWU DENTAL HYGIENE CLINIC

Introduction

The Texas Woman's University Dental Hygiene radiology clinic operates in accordance with Texas Administrative Code 289.232 as evidenced by compliance with radiation safety guidelines outlined in this document.

These procedures will minimize exposure to patients, employees and students. They are provided to comply with the rules enforced by the Texas Department of State Health Services (DSHS), Radiation Control. The rules require that each dental x-ray facility be registered with DSHS, Radiation Control. The certificate of registration contains conditions and restrictions that apply to the use of the x-ray machines in this facility. These rules are available for your review in the TWU Dental Hygiene Clinic Dispensary, in the DH shared drive, or online at https://dshs.texas.gov/radiation/x-ray/laws-rules.aspx.

The Radiation Safety Officer designated for this site is **Drew Townsend – 940-898-3129** (atownsend4@twu.edu) The RSO has the responsibility and authority for assuring safe radiation practices and serves as the contact person between this facility and the DSHS, Radiation Control. Direct all your questions or concerns on radiation safety to the RSO for this facility.

A. Operator and Patient Safety

1. Credentialing Requirements for Operators of X-ray machines
    a) All operators of x-ray machines must meet the requirements of the Texas State Board of Dental Examiners.
    b) All operators of x-ray machines will be appropriately trained on operating and safety procedures and this will be documented in DH Appendix A.
    c) Trained, licensed qualified operators will supervise students.

2. Individual monitoring requirements
    a. Individuals who operate only dental x-ray machines are exempt from individual monitoring requirements [See §289.232(e)(7)]. However, TWU still uses dosimeter badges to monitor exposure in areas where x-rays are taken as an added measure.
    b. Occupational dose limits are found in §289.232(j)(3)(A).
    c. If any employee is pregnant or becomes pregnant, they may voluntarily inform the RSO in writing of the pregnancy via the Declaration of Pregnancy form, available from the RSO. If the RSO is informed of the pregnancy, the facility must ensure that the dose to the embryo/fetus does not exceed 0.5 rem (500 mrem) during the entire pregnancy [See §289.232(j)(3)(A)(1)(V)]. A declaration of pregnancy may be revoked in writing at any time at the request of the individual who completed the original form. When a pregnancy is declared, the individual is given a fetal dosimeter as a precaution to ensure the fetal dose limits are not exceeded even though it is not anticipated the individual would be exposed to radiation in excess of 100 mrem during the pregnancy.
    d. If you suspect there has been an excessive exposure or a radiation incident, immediately notify the RSO and your supervisor.

3. Holding of Patients and/or film
    a. Mechanical radiograph holding devices or restraining devices shall be used at all times. [See §289.232(j)(11)]:
    b. Do not hold the tube housing and/or the support housing during an exposure [See §289.232(c)(4)]. The only exceptions are dental x-ray machines designed to be held during an exposure and only when the operator is following the manufacturer's procedures.
    c. If it becomes necessary for an individual to hold a patient or film, the clinician should not be a self-declared pregnant person. The clinician should wear protective devices (e.g., lead aprons) and keep out of the direct beam.

4. Posting Notices and Instructions to Workers: and Posting a Radiation Area
    a. Read the "Notice to Employees" Sign posted in the sterilization area on the bulletin board, and in the faculty office.
    b. The certificate of registration, operating and safety procedures, and any notices of violations involving radiological working conditions are located in the dental hygiene dispensary in a yellow folder on the bookshelf adjacent to the dispensary desk.
    c. Your rights and obligations as a radiation worker are found in §289.232(j)(3)(D).
    d. The rooms in which the x-ray machines are located and operated are a radiation area and are restricted.
        a. The radiation areas are designated by "Caution Radiation Area" signs

B. Operation of the X-ray machine and Film processing

1. Ordering of the X-ray exams

No x-ray exams shall be taken unless ordered by dentists licensed by the Texas State Board of Dental Examiners [See §289.232(b)(1)(B)]:

The following dentist order dental exams at this facility:
Dr. Robyn Reed, DDS
Dr. Leslie Culp, DDS
Dr. Brady Swenney, DDS

a) The operator must be able to continuously see, hear, and communicate with the patient.
b) During the exposure, the operator must be where their exposure is as low as reasonably achievable and stand at least six feet from the source of radiation or behind a protective barrier.

2. Operator Position During Exposure [See §289.232(j)(11)(C)]
    a) The operator must be able to continuously see, hear, and communicate with the patient.

b) During the exposure, the operator must be where their exposure is as low as reasonably achievable and stand at least six feet from the source of radiation or behind a protective barrier.

3. Use of a technique chart [See §289.232(j)(5)(A)]
    a) Use of a technique chart aids in reducing the exposure to the operator and patient and it must be used for all exposures.
    b) Our technique charts are displayed in the vicinity of the control panel of each x-ray machine and are graphically displayed on each x-ray machine with the exception of the panoramic machine which adjusts the output automatically based on the size of the patient. (See DH Appendix B)

4. Restriction and Alignment of the beam
    a) Use the beam limiting devices provided on the x-ray machine.

5. Use of Portable machines [See DH Appendix D]
    a) Portable x-ray equipment, NOMAD Pro2, will be used in designated areas within the dental hygiene clinic.
    b) As an additional precaution, dosimeters are placed in specific areas to monitor the level of radiation exposure in the surrounding area, and within a six-foot radius. Dosimeters are changed out and sent off for analysis, quarterly, by the TWU RSO.
    c) If the NOMAD Pro2 unit, which has been authorized for mobile use is used offsite, it shall be used only in designated areas pre-determined by an individual in charge at the host site and the TWU Dental Hygiene Program Director.

6. Exposure Requirements Operators Must:
    a) Must be positioned so that his/her exposure is as low as reasonably achievable (ALARA)
    b) All operators must maintain a distance of 6 feet or more away while exposing radiographs.
    c) No operator shall expose a radiograph with any other person in the radiograph room besides the patient.
    d) Lead aprons will be utilized on each patient during every exposure including panoramic exposures.
    e) Operators should never stand in line with the direct beam of exposure.
    f) Operators will never “practice” taking radiographs on one another or any patient at any time.
    g) All exposures will be taken **after** supervising instructor has approved them
    h) Exposure determination will be followed utilizing the ADA Radiographic guidelines. This document is available in the student clinic manual and is accessible online.
    i) Operators will never retake an image without obtaining permission from the supervising instructor prior to exposure.
    j) If a retake is necessary, the original image should be moved into an extra position on the digital mount and not erased.

7. No film Processing is conducted as digital sensors and phosphor plates are utilized.

8. Digital Imaging Acquisition Systems

a) Our facility uses a digital imaging acquisition system. Processing will follow the quality assurance/quality control protocol established by TWU DH program for image processing. [See DH Appendix E]
b) QA/QC testing shall never be conducted using a human subject.
c) If an image test fails, TWU must initiate repair of the system within 30 days, and complete the repair within 90 days.
d) Documentation of QA/QC tests will be maintained in the yellow binder in the TWU Dental Hygiene Clinic Dispensary.

C. Inventory List [See DH Appendix C]

1. Texas Woman's University Dental Hygiene Clinic maintains an inventory of all radiation machines and it is verified at least annually (See DH Appendix C).
2. The yearly inventory of all radiation machines is located at the TWU Dental Hygiene Clinic Dispensary.

D. Equipment Performance Evaluations (EPEs) [See §289.232(j)(5)(J)

1. EPEs must be done within 30 days of a machine's installation, or within 30 days of service that may change the radiation output of the machine.
2. EPEs must also routinely be done for dental intraoral, panoramic, or cephalometric machines every four years.
3. A copy of all EPE documentation must be submitted electronically to the RSO, and a paper copy maintained in the binder at the dispensary.

E. Security and Control of Radiation Machines

1. Texas Woman's University faculty and staff monitor the radiation units anytime the clinic is in operation. The DH clinic is locked at the end of the day, and the TWU DPS monitors the Multipurpose Classroom Laboratory Building, where the clinic is housed.
2. The handheld units are signed out of the clinic dispensary by the dental hygiene clinical assistant and are returned and locked in the dispensary at the end of the day.
3. See DH Appendix D for the mobile handheld radiation unit security and control procedures.

DH APPENDIX A
RECORD FOR INSTRUCTION OF INDIVIDUALS
IN OPERATING AND SAFETY PROCEDURES FOR
TEXAS WOMAN'S UNIVERSITY DENTAL HYGIENE PROGRAM

These procedures have been made available to each individual who operates the x-ray equipment on the date(s) indicated. [See §289.227(i) (2)]

_____ _____

(Signature of RSO) (Date)

Equipment Operator Statement:

I have read these procedures and agree to follow them.

_____ _____
(Signature of Equipment Operator) (Date)

_____ _____
(Signature of Equipment Operator) (Date)

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(Signature of Equipment Operator) (Date)

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(Signature of Equipment Operator) (Date)

_____ _____
(Signature of Equipment Operator) (Date)

DH Appendix B
TEXAS WOMAN'S UNIVERSITY DENTAL HYGIENE PROGRAM
DENTAL TECHNIQUE CHART

PANORAMIC

PATIENT	kVp	mA	TIME	SID	SCREEN
Exposure	60~70	1~7.5	5.5~10	6 ft	

INTRAORAL

ADULT	kVp	mA	TIME	SSD	SCREEN
Anterior Region	60-70	12	.20 sec		
Posterior Region	60-70	16	.25 sec		
Bite Wing	60-70	12	.25 sec		
CHILDREN	6	mA	TIME	SSD	SCREEN
Anterior Region	60-70	6	.20 sec		
Posterior Region	60-70	10	.25 sec		
Bite Wing	60-70	8	.25 sec		

DH APPENDIX C

EQUIPMENT INVENTORY LIST

ANNUAL INVENTORY DATE: _____ PAGE _____ OF _____

FACILITY NAME: TEXAS WOMAN'S UNIVERSITY DENTAL HYGIENE DEPARTMENT

REGISTRATION NO.: R08296

MAKE	MODEL NUMBER	SERIAL NUMBER	LOCATION (EX. ROOM NO.)	STATUS
Sirona	D3507	38391	Rad Room #1	Active
Sirona	D3507	38941	Rad Room #2	Active
Sirona	D3507	38949	Rad Room #3	Active
Sirona	D3507	37679	Rad Room #4	Active
J. Morita Mfg. Inc.	XDP1	BL302	MCL 119	In-Active (10/16/20)
Sirona	D3507	38808	Rad Room #6	Active
Sirona	D3507	38825	Rad Room #7	Active
Aribex	NOMAD PRO2 (black)	22216	RM #111	Active
Aribex	NOMAD PRO2	23392	RM #105	Active
Aribex	NOMAD PRO2	25302	RM #105	Active
Aribex	NOMAD PRO2	25027	RM #105	Active
Aribex	NOMAD PRO2	23812	RM #105	Active
Sirona	ORTHOPHOS XG 5	369740	Rad Room #5	Active

DH Appendix D

Texas Woman's University Dental Hygiene Program
Mobile X-Ray Unit SOP

NOMAD Pro2 Dental Units

The Texas Woman's University (TWU) Dental Hygiene (DH) Program secured funds to purchase five NOMAD Pro2 radiology units. Four of the NOMAD Pro2 units were purchased to use in the TWU DH Clinic, and one NOMAD Pro2 (unit #5) expects to be used as a part of a planned portable dental equipment set up. All NOMAD Pro2 units are housed within the DH Clinic.

Prior to use of the NOMAD Pro2 for patient care, TWU DH requires each clinician to read the NOMAD Pro2 instructional manual, review instructional material provided by NOMAD Pro2, and complete the mandatory NOMAD Pro2 certification course. All course completions from faculty, staff, and students are kept within the clinic's dispensary.

Security and Storage of NOMAD Pro2 DH Clinic Units:

The four NOMAD Pro2 units #1, #2, #3, and #4 are located within the TWU DH clinical assistant dispensary. When the clinical assistant is not present, the NOMAD Pro2 units are stored and locked within the clinic dispensary.

1. All NOMAD Pro2 units #1, #2, #3, and #4 will be signed out by the TWU DH faculty or student through the TWU DH clinical assistant while operating in the TWU DH Clinic.
2. The NOMAD Pro2 unit, handset, charging cradle, and AC power supply will be stored in a climate controlled, optimal storage location located within the clinical assistant dispensary. The units are stored on a countertop to the right of the clinical assistant's desk. This area is cool, dry, and away from direct sunlight to avoid extreme conditions [below -20°C (-4°F) or above +60°C (+140°F), or beyond 95% relative humidity (non-condensing)].
3. When finished with the NOMAD Pro2, the unit and handset will be detached for charging purposes. Once charged they will remain disassembled until ready to use again.
4. The X-RAY LOCK and UNLOCK on the NOMAD Pro2 unit serves as the device security key to prevent unauthorized use.

Portable Dental Equipment:

The NOMAD Pro2 unit #5 will be transported to community events and used in conjunction with the portable/mobile equipment.

The following are mobile equipment used for community events:

1. Three portable dental chairs
2. Three portable dental units (compressor and vacuum)

3. Three mobile/portable operator stools
4. One NOMAD Pro2 unit #5 located in a combination locked mobile chest
5. Laptop computer with dental and imaging processing software
6. Two digital x-ray sensors

Security, Storage, and Transportation of Portable Dental Equipment:

The NOMAD Pro2 unit #5 used in support of the portable dental equipment is stored in the locked community closet with the other portable dental equipment when not in use.

When transporting the portable/mobile NOMAD Pro2 unit #5 to a community site, the NOMAD Pro2 is stored and transported to each location in a combination locked box surrounded with a protective fitted foam container. The TWU DH and Community Oral Health faculty are the only personnel who has access to the combination code for the locked NOMAD Pro2 unit #5.

Transportation of the NOMAD Pro2 to a community event will only be through an authorized TWU vehicle. During transportation, the NOMAD Pro2 unit #5 will be securely stored and tied down within the vehicle to ensure the unit will not be displaced during the transportation.

Examples of Community Events:

- Child Services : Denton Christian Preschool
- Indigent Care Services: Our Daily Bread
- Elderly Care Services: Good Samaritan Nursing Home
- Dallas Stroke Center

Operational and Radiation Safety Protocol for all NOMAD Pro2 units

The following are safety measures to be followed with all NOMAD Pro2 operation possibilities:

1. When exposing radiation with the NOMAD Pro2 x-ray unit, there will be a designated area or enclosed room provided by each dental or community site. The confined space will ensure the maximum safety or minimal exposure of the public to radiation.
2. A dosimeter is located on the top of all five NOMAD Pro2 units to monitor the level of radiation exposure to the clinician. The TWU Radiation Safety Officer (RSO) changes the dosimeter out quarterly. An examiner (Lanadauer, Inc.) analyzes the dosimeter.
3. *During Community events:* To ensure the proper safety measures when utilizing radiation within an open area, the TWU DH Program will use a ¼ inch Plexiglas barrier/shield to limit any backscatter radiation to the front of the operator and any persons within a six foot radius.
4. *Within the DH Clinic:* All NOMAD Pro2 units will be utilized in designated areas within the TWU DH clinic. Dosimeters are placed within these areas to monitor the level of radiation exposure in the surrounding area, and within a six-foot radius. The dosimeters are changed out quarterly by TWU RSO and are analyzed by an examiner (Lanadauer, Inc.).
5. All NOMAD Pro2 units contain an “operator radiation backscatter” protection shield; if used properly, this guarantees low exposure to the clinician.

6. When exposing radiation with the NOMAD Pro2, students will provide the standard of care in radiation safety. All student clinicians will place a lead apron (24" X 27" lead apron with thyroid collar) on their patient to protect from unnecessary radiation exposure. Students have the option to wear a lead apron as well anytime during the exposure to fully utilize the NOMAD Pro2 unit.

The following are clinician protocol using the NOMAD Pro2:

1. The NOMAD Pro2 unit will not be enabled until the patient and the clinical operator are in the correct position. This will confirm preventing interruption and inadvertent exposure of x-rays to anyone.
2. Exposures will not be attempted if anyone other than the patient is in the direct beam. If others are assisting, then they will wear protective covering as required by the local jurisdictions.
3. When selecting and using Position Indicating Devices (PIDs), measures should be taken to ensure the backscatter shield remains at the outer end of the collimator cone for maximum operator protection. See NOMAD Pro2 Operation Manual for more information.
4. After each use and during daily usage, the NOMAD Pro2 is stored on its side in an appropriate sized storage container.
5. Steps will be taken to endure the NOMAD Pro2 will not be knocked to the ground between uses. The unit will lay on the counter top or on an accessory tabletop stand. Internal mechanisms are in place for power to automatically shut the unit off after a period of inactivity (approximately three minutes).

DH Appendix E

Texas Woman's University Dental Hygiene Program
Radiology Quality Assurance/Quality Control

Table of Contents:

Texas Woman's University Dental Hygiene

Radiology QA/QC

Purpose:

· The purpose of the digital and phosphor plate QA/QC is to ensure the digital and phosphor plate acquisition system is functioning as it was designed to and there has not been any image degradation that would result in the need for a repeat x-ray exposure.

· Follow the QA/QC protocol established by **Texas Woman's University Dental Hygiene Radiology:**

- Test each sensor and phosphor plate using a purchased test tool or an inorganic object with at least three varying densities to test spatial resolution, noise, and contrast
- Set an interval for testing not to exceed three months or 90 days
- Compare the current image with previous images
- Perform corrective actions if needed
- Document the date the images were taken and compare and include the corrective action if needed

QA/QC should never be done on a human – ONLY on the identical phantom or inorganic object each time.

Texas Woman's University Dental Hygiene

Radiology QA/QC

Guidelines:

1. Computer data is backed up automatically each day by the University's IT department.

2. Equipment needed to perform Texas Woman's University Radiology QA/QC for Clinic and Students:

   - Old faulty Key Fob/Keyless Entry System (provided by Texas Woman's University)
   - White ink (on the backside; non-exposure side) to label

Clinic:

- 2a-1, 2a-2, 2a-3, 2a-4, 1a-5, 1a-6, 1a-7
- 2b-1, 2b-2, 2b-3, 2b-4, 1b-5, 1b-6, 1b-7
- 2c-1, 2c-2, 2c-3, 2c-4, 1c-5, 1c-6
- 2d-1, 2d-2, 2d-3, 2d-4, 0d-1, 0d-2

Labeled Clinic Phosphor Plates Transfer Boxes

- Radiology room 1
- Radiology room 2
- Radiology room 3
- Radiology room 4
- Radiology room 6
- Radiology room 7

Student:

- Student Clinic Locker #:
  - Discontinued after graduation class of 2021 (students no longer have phosphor plates)
- Access to Eagle Soft
- ScanX
- X-ray Units
- Nomad #1

3. All testing (Schick Sensors and PhosPhor Plates) must be done two times per semester or at least every three months. The schedule for Texas Woman's University Dental Hygiene Clinic and Students is as follows:

- September & December
- February & May

4. During the QA/QC of PhosPhor Plate evaluation,

- Phosphor Plates are examined for damage, peeling, bending, etc
- Phosphor Plates are tested for image quality

5. During the QA/QC of Schick Sensor evaluation

- Sensors, chords, and connections are examined for damage
- Sensors are tested for image quality

6. All Clinical Phosphor Plates image quality will be conducted in X-Ray Room #6 by the second Friday of the due month.

7. All Schick Digital Sensor image quality will be conducted in the room associated with that sensor.

8. All Student Phosphor Plates will be conducted in RM #6. Each student will be given a designated time/date to participate in testing during the radiology lab or clinic per their instructor. (No longer necessary after class of 2021)

9. The x-ray unit settings must be set to:

- Sensor
- Child
- Lower anterior
- 60 kV for 6/100 second

10. The Eagle Software must be set up for all Schick Sensor QA/QC testing

11. The ScanX and Eagle Soft will be used to process the Phosphor Plates

12. For all Clinical PhosPhor Plate and Schick Digital Sensors, the Clinical Assistant must compare the quality of images, then the RSO or DDS will confirm testing evaluation/testing

13. The Interval Testing form must be signed and dated upon completion

14. All students are responsible for completing QA/QC guidelines for their unique set of seven Phosphor Plates. (No longer necessary after the class of 2021.)

15. The Texas Woman's University Radiology binder and Eagle Software will keep an Interval Testing for each student and the clinic supply of PhosPhor Plates/Schick Sensors for up to six years to confirm the quality assurance

16. Images tested are kept in Eaglesoft as a patient under the following:

- PhosPhor Plates-Clinic QA/QC
- Senor-Clinic QA/QC
- PhosPhor Plates-Students(year) QA/QC
- Nomad QA/QC
- Pano QA/QC

17. All Eaglesoft x-ray mounts are labeled to coordinate with the Phosphor Plate storage box to help assist in completing accurate QA/QC testing:

- QA/QC PhosPhorPlates_Clinic Box 2a & 1a = 7 plates
- QA/QC PhosPhorPlates_Clinic Box 2b & 1b = 7 plates

- QA/QC PhosPhorPlates_Clinic Box 2c & 1c = 7 plates
- QA/QC PhosPhorPlates_Clinic Box 2d & 0d = 6 plates

18. For the Schick Sensor testing, an Eaglesoft x-ray mount is labeled according to the x-ray room #s; since there are only two sensors per room, each QA/QC Sensor_Clinic will include two rooms per mount and will be taken in a series of size 1, size 2, size 1, size 2 starting with the first x-ray RM # listed

- QA/QC Sensor_Clinic RM #1 & #2
- QA/QC Sensor_Clinic RM #3 & #4
- QA/QC Sensor_Clinic RM #6 & #7

19. Each Schick Sensor is labeled with the assigned room number

- There is a size 1 and size 2 sensor in each room (X-ray unite list sensor #)

Texas Woman's University Dental Hygiene

Radiology QA/QC

Testing Procedure for Phosphor Plates:

When taking PhosPhor Plate images:

1. Work in X-Ray Room #6
2. All plates are labeled on the black side of the plate with a number. This is the number order the x-ray should be taken in and then processed to ensure each image is accurately attached to the mount for the best QA/QC testing.
3. Lay the PhosPhor Plate on the countertop with the light blue side facing the ceiling, have the "a" facing towards the edge of the countertop/towards the person taking the radiograph.
4. The Key Fob is placed on the plate with the paperclip/ring facing the edge of the countertop/towards the person taking the radiograph and the Key Fob buttons facing the ceiling.
5. Place the PID (x-ray head) one inch above the counter
6. Check the machine to confirm the settings: **child, anterior = 60 kV for 6/100 second**
7. Press the x-ray exposure button
8. Ensure the PhosPhor Plate is placed in the transfer box and closed to keep out of light
9. Repeat as necessary to complete each PhosPhor Plate for the series
10. Log onto the computer and turn on the ScanX machine
11. Open the appropriate mount in Eaglesoft
12. Follow the Eaglesoft/ScanX instructions on how to process

Do not forget to process in the number order listed on each plate to ensure proper mounting

13. Compare to previous images and baseline
14. Complete Phosphor Plate Interval Testing Log

15. Complete a ghost process to confirm the image is removed from PhosPhor Plate.

- If it is the first time. A baseline needs to be established
- The computer will date each of the images
- Each test will be compared to the baseline image. If there is variation in images, the PhosPhor Plate will be replaced with a new plate; a new test form will be used if plates are changed.

This is an example of the PhosPhor Plate template provided in Eaglesoft.

Texas Woman's University Dental Hygiene

Radiology QA/QC

Testing Procedure for Schick Sensors:

When taking Schick Sensor images:

1. Work in X-Ray Room associated with the sensor #1 and #2. (Sensory numbers can be found on the x-ray unit)

2. Open Eagle Soft, Patient QA/QC senor Clinic, confirm the sensor is active, open the Sensor template QA/QC Sensor_Clinic with the corresponding room number.

3. Lay the Sensor with the cord on the countertop and the writing facing up towards the ceiling

4. Adhere the sensor to the countertop with blue slap tape to make a flat surface

5. Key Fob is placed on the sensor with the paperclip/ring facing the sensor cord and the Key Fob buttons facing the ceiling

6. Place the PID (x-ray head) one inch above the counter

7. Check the machine to confirm the settings: child, anterior = 60 kV for 6/100 second

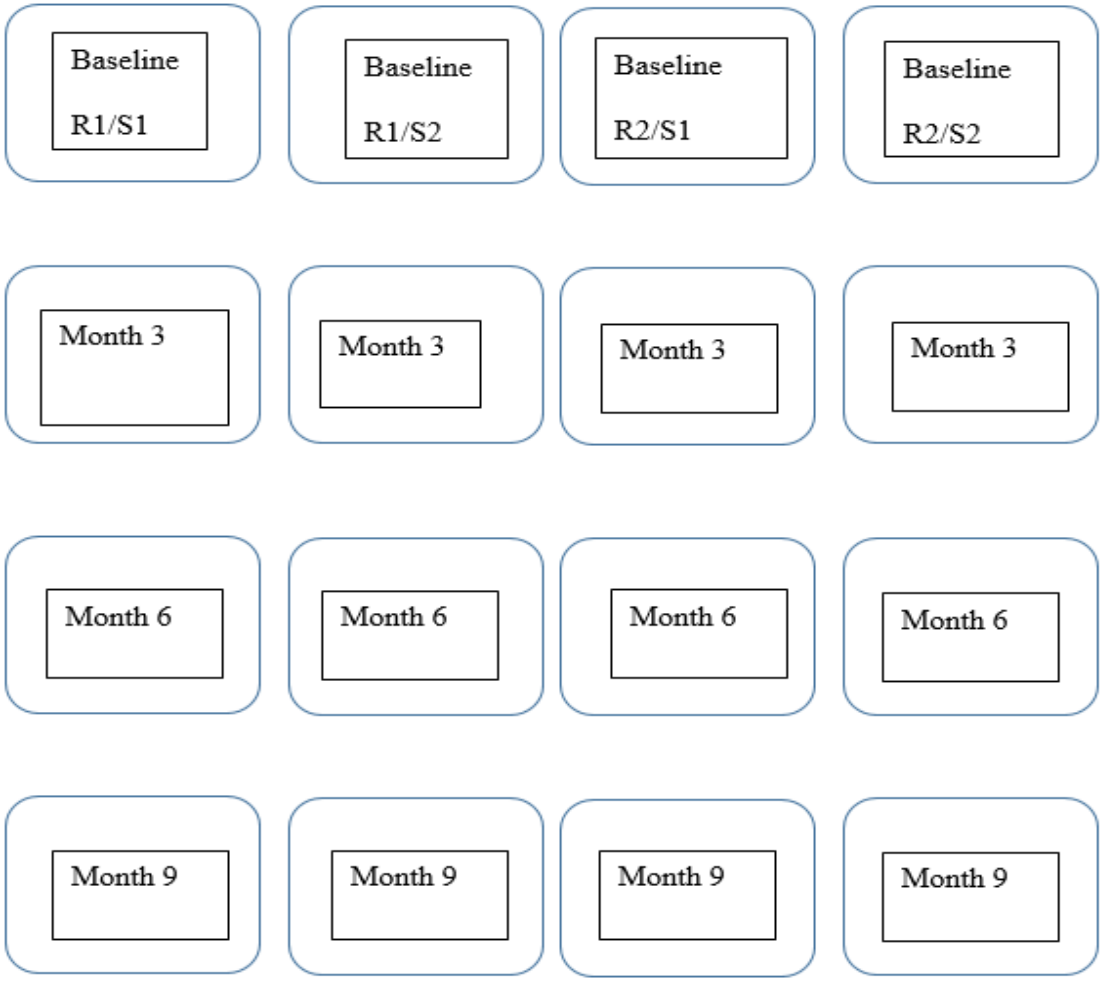
8. Press the x-ray exposure button

9. Repeat to complete the entire series needed

10. Compare previous images and sign Schick Sensor Interval Testing Log
    - If it is the first time. A baseline needs to be established
    - Two rooms will share a labeled Eagle Soft x-ray mount : RM #1 & #2, RM #3 & #4, RM #6 & #7
    - The computer will date each of the images
    - Each test will be compared to the baseline image. If there is variation in images, the sensor will be replaced with a new sensor. A new test form will be used if plates are changed.

This is an example of the Schick Sensor template provided in Eagle Soft

R= Room and S= Sensor



Texas Woman's University Dental Hygiene

Radiology QA/QC

Testing Procedure for Panoramic Machine:

1. The person testing the panoramic machine logs on to the computer and logs onto Eagle Soft
2. The File containing the QA/QC test for the panoramic machine is accessed
    - If it is the first time, a baseline needs to be established
3. Turn the pano machine on
4. The skull on the stand is positioned on the chin rest
5. The panoramic machine is set to the child setting
6. The operator leaves the room and holds down on the exposure control button until the panoramic exposure has been completed
7. The resulting panoramic image is compared with the baseline

Texas Woman's University Dental Hygiene Clinic QA/QC

The testing procedure for Nomad sensors:

1. Testing Nomad sensors will be in Radiology room #6 with Nomad #1.
2. Log onto Eagle Soft access QA/QC Nomad sensors.
3. Use template QA/QC Sensors 1999, 9037, 5153, 4967. See the example at the bottom of the page.
4. Test in order by size 0 (last four# 1999), size 1 (last four# 9037), size 2 (last four# 5153),size 2 (last four# 4967)
5. Adhere the sensor to the wall or sensor wall mount with blue slap tape
6. Place the Key Fob on the sensor with blue slap tap as well buttons facing out with paperclip facing sensor cord
7. Turn Nomad On to confirm the settings: child, anterior = 60 kV for 0.09 second
8. Place Nomad PID one inch from the wall
9. Press Nomad trigger once for READY the hold to trigger to expose.
10. Reap changing out the sensors.

★ Sensors for the Nomads one size 0 (S0- 26001999) one size 1 (S1- 24009037) two size 2 (S2- 25035153 & S2- 25034967)

★ All Nomad sensors will be tested in Radiology room #6.

Size0	Size1	Size2	Size2	
1	2	3	4	Baseline
5	6	7	8	Month 3
9	10	11	12	Month 6
13	14	15	16	Month 9
17	18	19	20	

Interval Testing Log

(Do not exceed three months)

Write the date in the box for the month completed QA

Eaglesoft corresponding X-Ray mount Name	Sep.	Dec.	Feb.	May	Name of Tester	Quality G or B	Need correction?	Correction date
Clinic PPP #2 DB964653 DB9646654 DB964651 DB964652								
Clinic PPP #2 DB963753 DB963752 DB963755 DB963754								
Clinic PPP #2 DB964657 DB964658 DB964655 DB964656								
Clinic PPP #1 CB203206 CB203120 CB203205 CB203110								
Clinic PPP #1 CB203204 CB203108 CB203104 CB203107								
Clinic PPP #0 BC321193 BC321191 BC321185 BC321187								
Clinic Sensor RM#1 15016297 14006770								
Clinic Sensor RM#2 15016293 14006539								

Interval Testing Log

(Do not exceed three months)

Write the date in the box for the month completed QA

Eaglesoft corresponding X-Ray mount Name	Sep.	Dec.	Feb.	May	Name of Tester	Quality G or B	Need correction?	Correction date
Clinic Sensor RM#3 15016292 14006534								
Clinic Sensor RM#4 15016260 14006771								
Clinic Sensor RM#6 15016272 14006528								
Clinic Sensor RM#7 25015237 14006776								
Pano RM#5								
Nomad sensor #0 26001999								
Nomad sensor #1 24009037								
Nomad sensor #2 25034967								
Nomad sensor #2 25035153								
Nomad sensor #2 25035977								

Interval Testing Log

(Do not exceed three months)

Write the date in the box for the month completed QA

Eaglesoft corresponding X-Ray mount Name	Sep.	Dec.	Feb.	May	Name of Tester	Quality G or B	Need correction?	Correction date
Nomad sensor #2 25037484								
Nomad sensor #2 25035613								
Nomad sensor #2 25036181								

Corrective Action for Schick Sensors

Date	Problem	Corrective action	Correction date	Initial

Corrective Action for Phosphor Plates

Date	Problem	Corrective action	Correction date	Initial

Texas Woman's University Dental Hygiene Clinic QA/QC

Ghost Image Interval Testing

Date	Sensor, Phos Phor Plate, Pano	Test ran Yes / No	Findings Yes / No	Corrective Action Yes / No	Initials of Tester	Note