The University of Southern Maine

XRF X-Ray Radiation Protection Program
Hand Held XRF Analyzer
X-Ray Radiation Protection Program

1. Purpose
   1.1. The purpose of this X-Ray Radiation Protection Program (XRPP) is to minimize radiation exposures to workers using a portable, X-Ray Tube based Thermo NITON Analyzer (XRF) at the University of Southern Maine (USM) to levels that are as low as reasonably achievable (ALARA), and to
   1.2. Ensure that use of the XRF is in compliance with all applicable State and Federal regulations.

2. Scope
   2.1. This XRPP applies to the use of the XRF at USM.

3. Responsibilities
   3.1. The Radiation Safety Officer (RSO) shall be designated as the individual in charge of the XRPP. The RSO will be responsible for ensuring the XRPP minimizes the risks associated with using the portable XRF and will ensure compliance with the regulations of the State of Maine related to XRF use.
   3.2. The RSO will advise and direct the Factory Trained Operator (FTO), who will prepare equipment specific operating and safety procedures for the safe operation of the XRF.
   3.2.1. The FTO has received Radiation Safety Training from the RSO and Radiation Safety Training and XRF specific training at an 8 hour course provided by Thermo NITON Analyzers.
3.2.2. The FTO will show receipt of the Factory training by providing a certificate of completion from the factory which is to be kept on file with other XRPP documents.

3.2.3. The RSO/FTO will:

3.2.3.1. Develop a training and certification program for authorized users.

3.2.3.1.1. Training shall include radiation safety, regulatory compliance, operational, and emergency procedures.

3.2.3.2. The RSO/FTO will maintain records of training including a copy of the training material.

3.2.3.3. Maintain a list of authorized users and will ensure that only authorized users operate the XRF Analyzer. See Appendix B.

3.2.3.4. Ensure that authorized users are issued and wear personal dosimetry while operating the XRF.

3.2.3.5. Maintain dosimetry records for authorized users.

3.2.3.6. Maintain manufacturer provided instruction manuals, operations, and maintenance records.

3.2.3.7. Ensure that labels on the XRF are intact and legible. Notify Thermo Fisher Scientific for assistance when labeling is damaged or illegible.

3.2.3.8. Review the XRPP content, implementation, and effectiveness annually to ensure the material is accurate and up to date.

3.3. Authorized Users are responsible for following only approved techniques and procedures for the safe operation of the XRF analyzer. The specific actions to be performed are as follows:

3.3.1. Follow proper operating procedures as described in training and ensure other individuals also adhere to these requirements.
3.3.2. Ensure that the label on the XRF is intact and legible.

3.3.3. Ensure proper use of dosimetry.

3.3.4. Be familiar with emergency procedures and know how to recognize and stop unsafe operations.

4. Operating Procedures

4.1. A copy of the User’s Guide, Operating, and Emergency Procedures shall be made available to all authorized users of the NITON XRF. A copy will be kept with the Analyzer and another copy shall be kept on file with the XRPP records.

4.2. Only authorized personnel with training on radiation safety, state regulations, operating and emergency procedures shall be allowed to operate the NITON XRF. All authorized personnel are responsible for complying with the requirements of this XRPP and will report any and all incidents involving the NITON XRF to the RSO/FTO.

4.3. The operator is responsible for ensuring that no part of a person’s body is at or near the measurement point, and no closer than one foot during a measurement (trigger finger excluded).

4.4. The operator will use special precaution when analyzing very small samples (i.e., smaller than the measurement window in any dimension), being aware that the sample may not be absorbing the entire primary beam. The operator will use a test stand whenever it is reasonably practical to do so to mitigate the elevated risk of analyzing small samples.

4.5. The operator will use special precautions when analyzing samples of low density, particularly plastics but also aluminum and titanium alloys and other similar low density materials. These samples will emit higher levels of scattered radiation.

4.6. The operator shall be aware that the NITON XRF is emitting radiation when lights are flashing.
4.7. The operator shall be aware that radiation in the primary beam could eventually cause physical harm if the device is used improperly and must be able to recognize the symptoms which would begin with skin reddening in the exposed area and at higher doses would appear as a burn or localized tissue damage.

4.8. Prior to each use:

4.8.1. The operator will inspect and maintain the Kapton window and all labels on the NITON XRF

4.8.2. The operator will fill out the utilization log

4.9. USM will maintain a log documenting use of the XRF that contains, at a minimum, date/time removed, date/time returned, and authorized user signing it out. At the front of this log will also be a list of authorized users. See Appendix A.

5. **Emergency Procedures**

5.1. In any case where one suspects that the x-ray tube remains on when the measurement is terminated:

5.1.1. Disconnect the battery pack immediately to turn off the x-ray tube, and

5.1.2. Notify the RSO/FTO @ 780-5406 or 420-4831 or 780-4126

5.1.3. Call Thermo Fisher Scientific’s Service Department in the United States, toll free, at (800) 875-1578.

5.2. In any suspected accidental exposure to primary beam:

5.2.1. Notify the RSO/FTO @ 780-5406 or 420-4831 or 780-4126

5.2.2. The FTO and RSO will investigate the incident and contact the State Radiation Control Program, and/or Thermo Fisher Scientific’s RSO.
5.2.3. The RSO will write an incident report of any such exposure which will include, at a minimum, the date and time of the exposure, the name of the exposed user, the circumstances leading to the exposure, and any outcomes, follow up, or additional actions required.

6. **Radiation Safety Training**

6.1. The FTO will receive 8 hour Equipment Specific Radiation Safety Training from Thermo NITON Analyzer LLC and Radiation Worker Safety training.

6.2. The RSO/FTO will develop and present Equipment Specific Radiation Safety Training for employees or students designated as authorized users.

6.2.1. The training will include testing for the authorized user to demonstrate knowledge and competency for safe use of the XRF.

6.2.2. This training will be documented by a sign-in sheet and completed tests.

6.3. Authorized users are required to attend Radiation Worker Safety training prior to XRF training.

6.4. Training records will be maintained by the RSO/FTO.

7. **Personnel Exposure Monitoring**

7.1. Dosimeters shall be issued to and be worn by all authorized users.

7.1.1. The dosimeters worn will be a whole body badge.

7.1.2. The dosimeter shall be worn at the waste or mid-point of the operator

7.1.3. A second dosimeter will be positioned on the outer case of the XRF.

7.1.3.1. This badge will record any xray backscatter radiation experienced during operation

7.2. Authorized users shall only wear issued dosimetry when operating the XRF.

7.2.1. Dosimetry when not in use shall be stored in same location where the XRF is stored.

7.2.2. Dosimeters should be protected from extremes of heat, moisture, and pressure.
7.2.3. Dosimeters shall be stored in a protected area to prevent loss, damage, and exposure to other sources of radiation.

7.3. Dosimetry services will be contracted through Landauer, Inc. at 2 Science Road, Glenwood, Illinois 60425-9979

7.4. The period of dosimeter use will be determined by quarterly exposure records and advise from the State Radiation Control Program.

8. Posting and Labeling

8.1. There is a relatively low radiation hazard associated with the XRF, and because the authorized user will be with the XRF at all times during its operation, posting radiation area signs will not be necessary.

8.2. A copy of the State of Maine Notice to Employees will be kept in the XRF case as well as on file with other XRPP documents and will be available for review at any time.

8.3. The label on the XRF will be checked periodically by the RSO/FTO as well as the authorized users of the XRF. The label will be checked for integrity and legibility. If the label becomes faded, worn, damaged, or defaced, the Analyzer will be promptly returned to Thermo NITON Analyzers LLC for relabeling.

9. Record Keeping

9.1. The RSO/FTO will be responsible for all the records associated with the XRPP. These records will be kept in the Core Lab of the Portland Science building and will be made available for review by any worker or state official upon request. The following is a list of records that will be kept at minimum:

9.1.1. Personnel training records

9.1.2. Manufacturer provided instruction manuals and service & maintenance records
9.1.3. Authorized Users

9.1.4. State Analytical X-Ray Regulations and Notice to Radiation Workers

9.1.5. XRF usage log


10. Quality Assurance / Annual Review

10.1. At the minimum, items on the following list will be done annually:

10.1.1. Radiation Safety Review for all workers

10.1.2. Operational & Emergency Procedures Review for all workers

10.1.3. Audit of the XRPP content, implementation, and effectiveness

11. References:

11.1. DOE G 441.1-5 “Radiation-Generating Devices Guide”

11.2. Thermo NITON Analyzers Sample Radiation Safety Program

11.3. NBS Handbook 111, Revised 1977

11.4. Radiation Safety Topics “Writing a Radiation Protection Program For the Industrial X-Ray Program For a Facility with Cabinet Radiographic or Analytical X-Ray Machines”

11.5. Table 11.4.19 “Good Work Practice for X-Ray Diffraction and X-Ray Fluorescence Units” The Health Physics and Radiological Health Handbook
## Appendix A

### Utilization Log

<table>
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# Appendix B

## Authorized Users List

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