



Environment, Safety, Health & Assurance

Interoffice Communication

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cc: Shawn Nelson
Topical Appraisal File 2012

From: Michael McGuigan, Radiation Safety Officer, ESH&A

Date: September 19, 2012

Subject: X-ray System Annual Audit and Exposure Survey

The Topical Appraisal is attached.

Topical Appraisal- X-ray system annual audit and exposure survey

1.0 Scope

This topical appraisal is being conducted to review the Laboratory's X-ray system annual audit and exposure survey program area.

2.0 Dates

The appraisal was performed during the month of August, 2012.

3.0 Methodology

The Laboratory's Radiation Generating Devices (RGD) annual audits, exposure survey results and process were reviewed. Applicable regulations, guidance, and standards were reviewed to guarantee that the Laboratory is meeting current industry standards.

3.1 References

The following references were reviewed for this appraisal:

- Title 10 of Code of Federal Regulations, Part 835 (10 CFR 835), *Occupational Radiation Protection*,
- DOE Guide 441.1C, *Radiation Protection Programs Guide*,
- DOE Standard 1098-2008 Ch1, *Radiological Control*,
- ANSI/HPS N43.2-2001, *Radiation Safety for X-ray Diffraction and Fluorescence Analysis Equipment*.
- ANSI N43.3, *American National Standard for General Radiation Safety-Installations Using Non-Medical X-ray and Sealed Gamma-Ray Sources, Energies Up to 10 MeV*

Per DOE Guide 441.1C and DOE Standard 1098-2008, on the occasion that conflicts exist between that of the requirements and guidance provide in the ANSI standards listed above and that of 10CFR 835, then the requirements of 10 CFR 835 take precedence.

3.2 Program Documentation

The following programmatic documents were reviewed:

- Radiation Protection Program Plan (10202.004), Due for review 01-01-2014,
- Ames Laboratory ESH&A Program Manual (10200.002), Last review 5-01-2011,
- Radiation Safety Manual (10202.001), Due for review 5-10-2012,
- Conducting Radiological Surveys Procedure (10202.060), Due for review 6-04-2012,
- Maintenance Procedures for Engineered X-ray Barrier Safety Systems (46200.005), Due for review 01-15-2012,
- Including the following files for the RGD systems listed in tables one and two.

Ames Laboratory X-ray Inventory (**Table One**)

Manufacture	Model	G. Leader	Bldg & Rm	Date of Audit/Exposure Survey
Phillips	PW 1830	Lograsso	MD 146	7/11/2012
PANalytical	PW3040	Lograsso	MD 159	4/9/2012
Rigaku	Geiger Flex 4036A2	Johnston	Zaffarano A202	9/14/2012
Rigaku	Rotaflex RTP 300RC	Goldman	ZaffaranoA221	10/27/2011
Rigaku	MiniFlex	Canfield	SpH 53	1/7/2012
GE Inspector Tech (LAUE)	GmbH	Goldman	Zaffarano A221	10/27/2011
Rigaku	007-HF	Goldman	Zaffarano A221A	10/27/2011
Phillips	XRG 3100	Corbett	SpH 352	4/30/2012
Rigaku	Ultra X	Vaknin	SpH B36	10/27/2011
Rigaku	DMaxTTR	Gschneidner	SpH B40	5/16/2012
Bruker	Smart Apex	Thiel	SpH 338	1/11/2012
Stoe	IPDS2	Thiel	SpH 338	1/11/2012
PANalytical	PW	Gschneidner	SpH 247/248	11/30/2011
STOE Stadi P		Corbett	SpH 336	5/7/2012
Thermo Scientific	Thermo Scientific XL3t 800	Paul Berge	MD 211A	7/12/2012
Rigaku	MiniFlexII	Canfield	Zaffarano A12	3/15/2012

Ames Laboratory X-ray System Preventative Maintenance Schedule (**Table Two**)

Building & Room #	Unit Description	Contact Person & Phone #	Date of PM	PM Performed by
MD146	Phillips	Lagrasso, Tom 4-8425	5/2/2012	J. Hjortshoj
MD159	Panalytical	Lagrasso, Tom 4-8425	5/3/2012	J. Hjortshoj
MD211A	Niton-hand unit, XL3t 800	Paul Berge, 4-5972	5/10/2012	J. Hjortshoj
Phy A12	Rigaku	Budko, Sergey 4-3986	3/20/2012	J. Hjortshoj
Phy A202	Rigaku	Johnston, David 4-5435	5/2/2012	J. Hjortshoj
Phy A221	Spellman	Goldman, Alan 4-3585	5/8/2012	J. Hjortshoj
Phy A221	Rigaku 1	Goldman, Alan 4-3585	5/8/2012	J. Hjortshoj
Phy A221A	Rigaku-007	Goldman, Alan 4-3585	5/8/2012	J. Hjortshoj
Sped 248	PANalytical	Rink, Roger	5/2/2012	J. Hjortshoj
Sped 336	Stoe-STAD	G. Miller	5/2/2012	J. Hjortshoj
Sped 338	Bruker Nonius	Anderegg, Jim 4-3480	5/2/2012	J. Hjortshoj
Sped 338	Seifert-STOE	Corbett, John 4-3086	5/2/2012	J. Hjortshoj
Sped 352	Philips	Corbett, John 4-3086	5/2/2012	J. Hjortshoj
Sped B36	Rigaku	Vaknin, David 4-6023	5/2/2012	J. Hjortshoj
Sped B40	Rigaku	Gschneider, Carl 4-7931	5/2/2012	J. Hjortshoj

3.3 Training

Training module AL-076 Radiological Worker II, Radiation Generating Devices training, was reviewed. A search was conducted in the training database for personnel coming due for retraining for AL-076 to the end of CY2012. Ten Ames Laboratory researchers are coming up on their retrain date. There are seven past due their retraining date. These researchers were emailed, informing them that they are no longer authorized to use any radiation generating device at Ames Laboratory until training is up to date. Each researcher's supervisor was copied in on this transmission. Dosimetry rings are confiscated until training is up to date. In addition, researchers that have indicated on their training needs profile that they require RGD training were contacted to question if they plan to use RGDs in their research. If so they were informed that they need to

take the RGD training prior to any usage of any Ames Laboratory RGDs. If there is no planned use of RGDs at Ames Laboratory their training profile is modified and RGD training is removed. Ten researchers were contacted and training modifications are still pending per a response from each researcher. The review of current training needs and subsequent training deficiencies, for AL-076, are being addressed.

3.4 Personnel Interviewed

Internal interview, data collection volume, analysis and methods were discussed with the following person below.

- John Hjortshoj, Supervisor-F&ES Electronics Group

No major changes to the Maintenance Procedures for Engineered X-ray Barrier Safety Systems. One mentionable; Given the complexity of some of the newer X-ray systems the removal of the fail-safe warning lamp to verify that the unit will not start will be changed to only doing this process on newly installed X-ray systems. The procedure currently starts that this will be accomplished on the six month preventive maintenance cycle. The purpose of this action is to see if the circuit logic is present to guarantee that the system turns off when the warning light burns out. This test only needs to be conducted once to verify the logic of the circuitry. It does not change over time.

4.0 Assessment Results & Discussion

Results of this appraisal are as follows:

The Radiation Protection Program Plan (#10202.004) and Conducting Radiological Surveys Procedure (#10202.060) are in compliance with 10 CFR 835 requirements. Procedure # 10202.060, Conducting Radiological Surveys, was due for review 06/2012. This document is being reviewed and is going through the update process. The Laboratory's Radiation Safety Manual was due for review May, 2012. No changes are necessary in section 11.0 which deals with radiation producing devices.

The majority of Ames Laboratory radiation generating devices are categorized as cabinet x-ray systems per DOE G441.1-1C. A cabinet x-ray system is any X-ray system with X-ray tube installed in an enclosure which, independently of existing architectural structures except the floor on which it may be placed, is intended to contain at least that portion of a material being irradiated, provided radiation attenuation, and exclude individuals from its interior during generation of X-radiation. Two X-ray systems do not fit this definition; Dr Allan Goldman's Rigaku system located in A221 Zaffarno and Dr. David Vaknin's Rigaku system located in B36 Spedding Hall. These systems have walk-in enclosures that are interlocked.

All Ames Laboratory radiation generating devices fit the definition of ANSI/HPS N43.2 as enclosed beam X-ray systems. ANSI/HPS N43.2, 6.2.2.3, Requirements for an enclosed beam X-ray system in addition to general requirements;

- 6.2.2.3.1, The radiation source, beam paths, sample, detector and/ or other devices shall be enclosed in a chamber, coupled chambers, beam pipes, whole system enclosure, etc. that cannot be entered by any part of the body during normal operations.
- 6.2.2.3.2, The inherent shielding of the chamber/enclosure walls shall be sufficient to limit the dose rate in all regions 5 cm from it outer surface to 0.0025mSv/hr(0.25 mrem/hr) during normal operation.

- 6.2.2.3.3, The system enclosure, sample chamber, etc. closure shall be interlocked with the X-ray tube high voltage sample and/or a shutter in the primary beam so that no X-ray beam can enter the sample chamber while it is open unless the interlock has been consciously and deliberately defeated.
- 6.2.2.3.4, the interlock required by section 6.2.2.3.3 shall be of fail-safe design.
- 6.2.2.3.5, If there is more than one port in the radiation sourced housing or more than one radiation source, all requirements under 6.2.2.3 must satisfied for each port in every source housing associated with the system.

ANSI/HPS N43.2 requires that radiation surveys, inspections and test of protective devices shall be made before a new installation is placed in routine operation and whenever changes are made that could adversely affect radiation protection (e.g. maintenance, relocation of equipment, radiation shielding modifications, etc.). In addition periodic surveys should be performed at least once every 12 months. Radiation generating devices are required to be surveyed annually.

Exposure surveys are conducted in and around each Ames Laboratory RGD system prior to routine operation. Table one is a list of Ames Laboratory systems. All surveys are up to date.

Each RGD's interlock system is checked by Research and Development Engineering Services on a six month preventative maintenance cycle. Records and system spot checks indicate that all RGD system preventative maintenance is up to date. Table Two list all systems in the maintenance program. Facilities and Engineering Services Group Procedure # 46200.005, "*Maintenance Procedures for Engineered X-ray Barrier Safety Systems*," was due for review and update 01/15/2012. Note that Table one has one more RGD than Table two. Dr Canfield's Rigaku Miniflex located in 53 Spedding Hall is a new system being added to the inventory.

Electron devices that generate x-rays incidentally are usually shielded to attenuate the emission of x-rays. Examples of such devices include electron beam welders, electron microscopes, pulse generators, microwave cavities (sometimes used as beam guides), etc. Guidance, DOE G 441.1-1C and that of the applicable ANSI standards recommend that preoperational inspections and exposure monitoring be conducted initially upon receipt and before general operation of these type of devices. There is no requirement for semiannual inspections and monitoring it is left up to the discretion of the local radiation safety authority which in the Lab's case is the RSO.

4.1 Strengths

None identified.

4.2 Noteworthy Practices

None

4.3 Findings

Level 3 Finding, Electron devices that generate x-rays incidentally should be reviewed and radiation exposure surveys reestablished for the file. Initial exposure survey results could not be located for all electron devices at the Laboratory. Estimated completion is January, 2013.

Level 3 finding, Procedure # 10202.060, Conducting Radiological Surveys, was due for review 06/2012. This document needs to be updated. At present this document is being reviewed and is going through the update process.

Level 3 finding, the Laboratory's Radiation Safety Manual (10202.001) is past its review date. The manual is being reviewed by the ALARA Committee. Estimated completion is January 2013.

Level 3 finding, the Laboratory's internal procedure, Maintenance Procedures for Engineered X-ray Barrier Safety Systems (46200.005) was due for review and update January, 2012. Supervisor-F&ES Electronics Group, John Hjortshoj, informed me that the document is in review and will be completed soon.

Level 3 finding, The Laboratory's X-ray Inventory list and Preventative Maintenance list will be harmonized for clarity and to reduce the chances of any confusion.

5.0 Overall Conclusions

The Laboratory's Radiation Generating Devices (RGD) annual audits and exposure survey results and process meet DOE guidance and ANSI standards. All exposure surveys were conducted as required/recommended, documented and on file.

6.0 Attachments

None.