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SM-40.410, RADIOLOGICAL CONTROLS MANUAL: INSTRUMENT CALIBRATION, JULY 13, 2012, JAMES BARNES

DOCUMENT CHANGE SUMMARY –This document replaces issue dated October 31, 2006. Procedure has been modified to reflect the termination of the Boeing-SSFL instrumentation laboratory function, the use of rented radiation measurement instruments, and revisions to SOP C-401.

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INTRODUCTION AND SCOPE

Boeing-SSFL no longer maintains a calibration facility for radiation detection instrumentation. Instruments will either be rented from a third party vendor or will be calibrated on-site by a third-party vendor.

This procedure applies to radiological activities conducted at the Boeing Santa Susana Field Laboratory (SSFL) campus ("Boeing-SSFL").

The terms "shall," "should," "may," etc. indicate procedural requirements or suggestions for good practices. These terms are intended to convey meanings typically used in quality assurance or standards documents (e.g., ANSI).

- "Shall" in this procedure denotes a mandatory requirement.
- "Should" denotes a recommended practice, but which is not required. "Should" is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required.
- "May" denotes an option. "May" indicates a course of action permissible within the limits of the procedure.

This procedure implements the requirements of SOP C-401, *Radiation Safety Program*. This procedure is intended to provide additional guidance to the requirements of the SOP. Stipulations of this procedure are to be interpreted in light of the SOP C-401 requirements.

Note that DOE dosimetry terminology has been changed. This procedure utilizes the former terminology. SOP C-401, Table 8 describes terminology equivalency.

REFERENCES

Regulatory

10 CFR 835, Occupational Radiation Protection
California Regulatory Code, Title 17, Division 1, Chapter 5, Subchapter 4, Radiation.
State of California Radioactive Materials License 0015-19.

Consensus Standards

*American National Standards Institute (ANSI) N323 -1978, Radiation Protection Instrumentation Test and Calibration.

*ANSI N323A -1997, Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments.

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Selected Procedures

*Boeing--DES System of Procedures (SOP) C-401, Radioactive Materials and Ionizing Radiation, and associated SM-40 and "RS-" procedures.

DEFINITIONS

Definitions affecting application of this procedure are provided in the references above indicated by an asterisk (*). For the purposes of simplicity, key definitions of terms are provided below.

Calibrate - (a) To adjust or determine the response or reading of an instrument relative to a series of conventionally true values for radiation sources. (b) To determine the activity of a radiation source relative to a standard or conventionally true value. [Note: to distinguish the processes, (b) is referred to in Boeing-DES procedures as "validation".]

Conventionally True Value (CTV) of a quantity - The commonly accepted best estimate of the value of a quantity. This and the associated uncertainty will preferably be determined by a national or transfer standard, by a reference instrument that has been calibrated against a national or transfer standard, or by measurement quality assurance (MQA) with the National Institute of Standards and Technology (NIST) or a qualified secondary laboratory.

Validated Source - A source whose radioactivity or dose rate fields have been verified against a NIST traceable standard and is used in the calibration process for radiation measurement instrumentation. Validated sources serve as the CTV for the HS&RS. [See "calibration", definition (b).]

Check Sources - A radioactive source, not necessarily calibrated, that is used to confirm the continuing satisfactory operation of an instrument. Check sources may be, but do not have to be, validated.

Transfer Standard - A physical measurement standard (specifically designed for transport) that has been compared directly or indirectly with the national standard. This standard is typically a measurement instrument or a radiation source used as a laboratory standard.

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PROCEDURE

1. Overview of Instrumentation Procurement and Use

- 1.1 HS&RS no longer maintains capability to perform instrument calibration. Accordingly, calibrated radiation measurement instruments may be obtained from rental vendors, or may be calibrated on site by vendor organizations.
- 1.2 Radiological instruments **shall** be used only to measure the radiation for which their calibrations are valid.
- 1.3 The vendor organization shall bear primary responsibility of acceptable calibration of their instrumentation. ANSI N323 *should* be the basis document for radiological instrumentation calibration. Calibrations *should* use sources traceable to the National Institute of Standards and Technology (NIST).
- 1.4 HS&RS **shall** specify acceptable instrumentation for the detection and measurement of radioactivity and radiation. To the greatest extent possible, equipment produced by commercial vendors **shall** be utilized.

Where special purpose or experimental designs are to be utilized, HS&RS **shall** generate and retain adequate documentation on the design and operating characteristics of the instrument to validate data or readings produced by the device.

- 1.5 HS&RS maintains records pertaining to location, ownership and calibration status (i.e. active, inactive, excess, out-of-cal, etc.) of the instruments.
- 1.6 Instruments whose calibration periods have expired **shall** not be used under normal circumstances. HS&RS will make reasonable attempts to recall instruments prior to the expiration of the period of calibration (See Section 6). The user, however, is responsible for ensuring that an out-of calibration instrument is not utilized; or, if conditions demand, that HS&RS is immediately notified of any emergency use of an out-of-cal instrument so that appropriate "as-found" checks can be made of its performance.
- 1.7 Radiological instruments **shall** be used only to measure the radiation for which their calibrations are valid. In unusual and limited situations it may be necessary to use an instrument in an application other than that envisioned by the manufacturer. Special calibrations *should* be performed for use of instrumentation outside manufacturer's specifications. The instrument *should* be adjusted, calibrated and labeled to identify the special conditions and used only under the special conditions for which it was calibrated.

2. Program Responsibilities

- 2.1 HS&RS uses instrumentation that is intended for the purposes of facility and are not conducted under the Metrology program. HS&RS may designate facility specific practices that may depart from the generic practices of Boeing Metrology procedures.

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- 2.2 The primary consensus standards applied to the HS&RS are ANSI 323 and ANSI 323A (see citations above). To the extent possible, HS&RS will utilize vendors that comply with these standards.
 - 2.3 HS&RS will specify acceptable instrumentation for the detection and measurement of radioactivity and radiation. To the greatest extent possible, equipment produced by commercial vendors **shall** be utilized.

Where special purpose or experimental designs are to be utilized, HS&RS (or its vendors) will generate and retain adequate documentation on the design and operating characteristics of the instrument to validate the data or readings produced by the device.
 - 2.4 As appropriate with procurement procedures, HS&RS will provide necessary information and support to qualify outside vendors as calibration and services suppliers.
 - 2.5 HS&RS will maintain a suitable recall system¹ for radiation measuring instruments.
3. User Responsibilities
- 3.1 A user **shall** ensure that instruments provided by a rental vendor or instruments being returned from repair/calibration are operating properly. The user *should* notify HS&RS of any instruments that fail to operate properly.
 - 3.2 A user *should* provide proper care and security of the instruments in possession.
 - 3.3 A user *should* initiate and properly communicate a request for service in accordance with the HS&RS procedures. Vendor labels may be used for indication of calibration data.
 - 3.4 A user *should* assure that the instruments in use are properly labeled. Inform HS&RS of any discrepancy or labeling change that may be required.
 - 3.5 A user *should* notify HS&RS of any status change (active, inactive, excess, out of service, etc.) of assigned instruments.
 - 3.6 A user *should* maintain all instruments that require service and/or calibration in a designated area accessible to HS&RS personnel.
 - 3.7 A user *should* conspicuously label any instrument that is inoperable or out of calibration.

¹ See Section 6 of this procedure.

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4. [DELETED]

5. HS&RS Calibration Recordkeeping

- 5.1 A record **shall** be maintained of all calibrations for each instrument. Modifications to the instrument **shall** be similarly documented, at the discretion of the Radiation Safety Officer. At the discretion of the RSO, some minor repairs or maintenance activities may not require a formal record.
- 5.2 Calibrated instruments **shall** be labeled with information pertinent to the calibration. At a minimum, the calibration label **shall** uniquely identify the instrument, and **shall** indicate the date that the calibration on the instrument expires. One or more separate labels may be utilized to provide this information. Any restrictions on use *should* be identified by label in the instrument.
- 5.3 Providers of rental instruments, and vendors performing calibrations for on-site equipment, shall provide documentation of the instrument's calibration.. Radiation Safety shall retain these documents in accordance with its document retention policies (See SM-40.407, *Radiological Recordkeeping*.)
 - 5.3.1 Instrument Property Control or other unique identification number
 - 5.3.2 Description
 - 5.3.3 Manufacturer
 - 5.3.4 Model Number
 - 5.3.5 Serial Number
 - 5.3.6 Current calibration or service expiration date
 - 5.3.7 Identification of the calibration standard used
 - 5.3.8 Technician identification
 - 5.3.9 Environmental conditions at the time of calibration, temperature, humidity and barometric pressure
 - 5.3.10 As found or initial instrument parameter readings (prior to any adjustments)
 - 5.3.11 Instrument parameter reading after adjustments
 - 5.3.12 Next calibration due date
 - 5.3.13 Calibration interval

6. Calibration Interval

- 6.1 Radiation instruments **shall** be calibrated at periodic intervals established and maintained by HS&RS to assure required accuracy and reliability. A calibration interval is defined as the period of time between successive scheduled calibrations for a given instrument. Intervals depend on the use, accuracy, type of standard or instrument, required precision, and condition which may adversely affect the measurement process.

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- 6.2 An individual instrument's calibration interval may be lengthened or shortened based on that item's performance history or other pertinent requirements. Such interval adjustment must ensure compliance with applicable regulations, procedures, and industry standards. Adjustments must be approved in writing by the Radiation Safety Officer.
- 6.3 Generic calibration intervals may be found in Table 1.
- 6.4 A calibration is valid through the end of the day given as the CAL VOID or CAL DUE date.

7. Recall System

NOTE: The Department of Energy (DOE) stipulates that "a system for tracking the location of portable survey instruments and for recalling those instruments for recalibration *should* be established. The location of portable survey instruments *should* be known by the calibration staff or by some identifiable group assigned with that responsibility."²

- 7.1 A management system is maintained to ensure that instruments are not left in use upon the expiration of the calibration period. The system ensures that an instrument is:
 - Recalibrated not later than its calibration due date; OR,
 - It is removed from service and labeled as being "out-of-calibration" pending recalibration.
- 7.2 The recall process consists of several activities which, in combination, ensure the expectations of Section 6.1 are met. The activities are:
 - Visual inspections performed in the course of duties (e.g., verification of calibration status as a routine action before use of a survey instrument) of instrument calibration labeling by HS&RS personnel, with the collection of instruments for recalibration in a timely manner based upon these routine checks; and,
 - A systematic tracking of instruments in order to identify those instruments for recall whose calibration period is approaching its end.
- 7.3 An electronic tracking system is maintained to assist in the recall of instruments. This spreadsheet is used as a tool to track instruments that are currently in the calibration cycles. A number of fields are defined in the database; some are mandatory entries required for tracking purposes, others are provided for the convenience of HS&RS staff in locating instruments for recall.

² DOE G 441.1-7. *Portable Monitoring Instrument Calibration Guide for use with Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection. 06/17/99.*

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7.3.1 All instruments that are enrolled in the calibration process **shall** be identified in the tracking database. Mandatory field entries for the database are:

- Instrument Model and Type
- Last Calibrated [The date of the most recent calibration.]
- Calibration Period (in weeks) [which, with *Last Calibrated* is used to calculate the *Calibration Expires After* date]
- Property Number [the unique identifier of the instrument]
- Routine Use Location (such as SSFL, Offsite) [Where, for tracking purposes, the instrument is assigned for use. This is the location of record (campus).]

These fields **shall** be accurately maintained through each calibration cycle of the instrument.

7.3.2 The following fields are used for the convenience of the HS&RS staff, and are not part of the mandatory recall data.

- Current Location [the facility where the instrument is currently being used]

7.4 Recall responsibilities are assigned as follows:

7.4.1 Instrument Users

7.4.1.1 Prior to the use of an instrument, the user is responsible for ensuring that the instrument is within its calibration period. This is to be done by referring to the calibration label of the instrument.

7.4.1.2 Users **shall** verify the calibration date and the instrument's location of record prior to placing an instrument into use after recalibration. HS&RS personnel are responsible for ensuring the Recall Database (see 7.4) reflects the correct recall location of record for the instrument.

7.4.1.3 Users are responsible for ensuring that an out-of-calibration or inoperable instrument is removed from service. A user who discovers such an instrument **shall** contact the instrumentation focal in a timely manner so that the instrument can be replaced by the vendor or recalibrated.

Any instrument that is not in calibration **shall** be removed from service and tagged as "out of calibration." Instruments that are installed in fixed locations or are too large to move may be labeled as "out of calibration" in lieu of physically moving them.

7.4.1.4 When notified by HS&RS, a user locates an instrument and makes it available for calibration. As a rule of thumb, instruments are generally located one week prior to the calibration expiration date. Instruments **shall** be located in time for return to the rental vendor or recalibration or for "out of calibration" labeling as required in Section 6.1.

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7.4.2 HS&RS Instrument Focal

- 7.4.2.1 The HS&RS instrument focal is responsible for ensuring the instrument inventory contains the correct mandatory data (see Section 6.3.1).
- 7.4.2.2 HS&RS instrument focal is responsible for providing a recall notification listing. In general, such a notification is provided at the beginning of each calendar month for instruments due in that month. Other frequencies may be used at the discretion of the HS&RS technician.
- 7.4.2.3 Unless other specific arrangements are made, instruments *should* be returned to the HS&RS instrument focal from the designated locations during the last week of their calibration periods. The HS&RS instrument focal will ensure that the instruments are then returned to the rental vendor for replacement.

Similarly, the HS&RS instrument focal is responsible for ensuring that an on-site calibration vendor is summoned to the site to recalibrate the fixed position equipment (e.g., sewer monitor, RMHF stack monitors, CAMS, air flow gauges, etc.) in a timely manner.

8. Maintenance

- 8.1 Preventive and corrective maintenance *should* be performed using components and procedural recommendations at least as stringent as those specified by the manufacturer of the instrument.
- 8.2 Prior to use, radiological instruments shall undergo calibration following any preventive or corrective maintenance or any adjustment that voids the previous calibration.
 - A battery change is *not* considered maintenance.
 - Beta frisker probes may be replaced or interchanged without voiding a calibration if a standardized efficiency of 10% is used.
 - Changing other types of detector probes from one instrument to another *voids* the calibration.

9. Instrument Malfunction

- 9.1 In the event an instrument is suspected of malfunctioning or performing not in accordance with expectations or specifications, it **shall** be labeled as non-operational and removed from service.

10. Environmental Controls

Radiation instrumentation response to interfering ionizing and non-ionizing radiation and environmental conditions *should* be determined. Any effect of these interferences **shall** be communicated to the user.

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11. Calibration Source Isotopes

- 11.1 Isotopes preferred for facility calibration are provided in Table 2.
- 11.2 Sources other than those specified in Table 2 may be utilized in calibration. These sources **shall** be stipulated in the appropriate instrument-specific calibration procedure, and the use of the alternate isotopes **shall** be noted on the instrument calibration datasheet.

12. Out-of-Tolerance Conditions

- 12.1 Instruments suspected of not functioning correctly **shall** be forwarded to the instrument vendor (or an on-site calibration check shall be performed) for an "as found" check. Further, instrument rental vendors and on-site calibration service vendors **shall** be instructed to conduct and document an as-found check on all instrumentation.
- 12.2 The HS&RS instrumentation focal **shall** notify user personnel when any out-of-tolerance condition greater than +/- 200% of tolerance is found during a calibration process.
- 12.3 User personnel **shall** be provided specifics of the out-of-tolerance condition to permit the user to ascertain any effect that the use of the instrument may have had on survey or analysis results.
- 12.4 HS&RS will evaluate such out-of-tolerance conditions to determine potential measurement impact from use of the defective equipment. The user **shall** review measurements taken with the defective or out-of-cal instrument.

If this review indicates that significant radiological protection decisions or actions (e.g., posting, stay times, Radiation Work Permit (RWP) requirements) may have been inappropriate (because of incorrect radiological data), the user **shall** prepare an incident report, **shall** correct survey data entries (annotating the out-of-tolerance situation on the survey form), and **shall** take appropriate corrective actions for radiological controls.

If review indicates that no significant control impact occurred, no further action is required.
- 12.5 The vendor organization will return an out-of-tolerance instrument to acceptable accuracy whenever physically and/or economically feasible.

13. Control of Subcontractor Calibration

- 13.1 If HS&RS "side-checks" equipment upon return from a vendor (e.g., following repair of equipment), the vendor does not need to be evaluated or inspected as a calibration service provider.
- 13.2 [DELETED]

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- 13.3 Where the vendor repair and calibration will be adopted as the primary calibration without HS&RS side-checking, HS&RS **shall** review the vendor's operations (including site visit, if appropriate), and **shall** certify the vendor as qualified to perform calibrations of equipment to be used in HS&RS operations. A vendor may be qualified to provide a wide array of services (requiring a more extensive audit and oversight effort), or may be qualified for specific services (requiring a less rigorous qualification protocol).
14. "Operator-to-Calibrate" Equipment
- 14.1 Some equipment may be calibrated by end user personnel who are not qualified as HS&RS technicians. Such calibrations shall be conducted as described in this section.
- 14.2 An approved calibration procedure for the equipment shall be provided by HS&RS (Metrology approval is NOT required). Documentation requirements for the calibration activity shall be designated in the procedure.
- 14.3 The equipment shall be identified by an "Operator-To-Calibrate" sticker (using, or similar to, those issued by the Boeing Metrology program).
- 14.4 The sticker shall designate the calibration procedure to be followed by the user, and a copy of the procedure shall be readily available for use by the operator (either in electronic or hard-copy form).
15. Storage and Handling
- 15.1 It is the responsibility of all instrument user personnel to assure that radioactive standards and survey instruments are handled, stored, and transported in a safe, reliable manner which prevents instrument damage and/or calibration degradation.
- 15.2 Check sources **shall** be stored in locations designated in the appropriate Use Authorizations. Radioactive materials **shall** be locked into storage when not in use. Rooms containing radioactive materials **shall** be locked when an Authorized User is not in attendance, unless otherwise provided for in a Use Authorization.

BUSINESS/QUALITY RECORDS

Record Type	Record Identification	Retention Code	Quality Record Location
B	Form 727-F-5, Calibration Report,	SHE0136	SSFL Building 4100; 4057

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**Table 1
Calibration Intervals**

<u>Type of Equipment</u>	<u>Examples</u>	<u>Periodicity</u>
Portable Survey Instrumentation	Portable Gamma Survey Instruments (e.g., R02, Bicon-5) Portable Pancake Friskers Nal survey instruments Micro-R meters Bicon microRem meters Ludlum 2221 counters	52 weeks
AC Powered Survey Instrumentation	Pancake Friskers (e.g., Ludlum Model 177) Area Radiation Monitors (e.g., Dosimeter "Black Box," Gammalarms) Continuous Air Monitors Stack Monitors Effluent Monitoring Systems	52 weeks
Air Movers and Portable Air Sampling Equipment	RAS Pumps	52 weeks
	Flowmeters	52 weeks
	Emergency Vehicle Air Sampler	52 weeks
Functional Process Controls	In-line Monitors; Effluent Monitors, etc.	52 weeks

**Table 2
Traditional Nuclides Used for Calibration Sources**

Calibration Field	Isotope [Primary Emission]
Contamination Monitor (Beta)	Tc-99 [0.292 MeV Beta]
Contamination Monitor (Alpha)	Th-230 [4.68 / 4.62 MeV Alpha]
Field Survey Instruments (Gamma)	Cs-137 [0.662 MeV Gamma] Am-241 [0.060 MeV Gamma]
Field Survey Instruments (Beta)	Depleted Uranium Slab [Complex Beta]