

# **Summary Report of G-59 Task Force on the Use of Electronic Technologies during X-ray Inspections**

This is a work product of CRCPD's G-59 Task Force on the Use of  
Electronic Technologies during X-ray Inspections

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This publication was supported in part by grant number FD-004840 from the Food and Drug Administration.

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**Prepared by  
G-59 Task Force on the Use of Electronics Technologies  
During X-ray Inspections**

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**September 2016**

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## EXECUTIVE SUMMARY

The G-59 Task Force on the Use of Electronic Technologies during X-Ray Inspections was tasked with examining how Radiation Control Programs (RCPs) are utilizing technologies in the collection of x-ray inspection data. In addition, the G-59 Working Group was tasked with identifying and describing the benefits associated with the use of electronic technologies in x-ray inspections and identifying best practices from state/local agencies.

There is broad consensus that deployment of electronic hand held systems in support of public health inspections can have significant impacts on productivity, quality, and consistency. The operational improvements achieved when a hand-held system is introduced can be significant. New York City experienced a 25% increase in productivity from the use of a hand-held inspection system in its food safety program<sup>i</sup>. El Paso County, Colorado reports seeing a 33% increase in productivity when it introduced a hand-held inspection system for its Environmental Health program<sup>ii</sup>. New York State Department of Health has developed a flexible hand-held system that it has deployed for a wide range of inspection types (water supply, food service, indoor tanning, and sanitary surveys) and reports significant productivity improvements across all inspection types. Texas A&M Health & Safety Inspections saw an increase in productivity of 51% and flexible utilization of data allowed it to create a targeted risk-based inspection process that was not achievable when it used paper forms.<sup>iii</sup> In addition to operational improvements, hand-held inspection solutions allow for inspection outcomes to be subjected to detailed analytical assessment to identify trends in inspector consistency, high risk facilities, population level risks, and compliance trends across jurisdictions and types of institutions. Another advantage is the ability to make inspection outcomes more transparent to the public and the regulated community.

To better understand how Radiation Control Programs (RCPs) are utilizing electronic hand-held systems, the Working Group conducted a survey of 18 RCPs regarding their use of handheld systems (laptops, tablets etc.) used during radiology inspections to collect inspection outcome information and/or to guide the inspection process. The survey reviewed with RCPs what electronic devices were used to support the inspection process, the software used, the functionality of the software, if inspection outcomes were entered into a central database, and whether scheduling of inspections was being performed as part of an electronic inspection solution.

The survey found one RCP had an integrated hand-held solution that fully captured inspection and compliance outcomes electronically and automatically transferred that data to a central server that allowed the RCP to develop standard reports tracking trends and public health risks. The remaining 17 RCPs used hybrid inspection support systems that used a combination of paper forms, spread sheets on laptops, and/or scanned paper forms. Overall, the data that was captured during the inspection was stored in ways that made evaluation and analysis of inspection outcomes difficult.

For recording inspections outcomes, the survey found that eleven RCPs are using laptops, two use tablets and five rely on paper forms. Among those RCPs that recorded inspection outcomes

in electronic format, four RCPs used Excel spread sheets, two used a software package called “Ocean” that creates an inspection e-form, one used MS Access, one used MS Word and one used a custom software development solution. Several RCPs recorded inspection outcomes in several formats for a single inspection (paper form, electronic inspection form, MS Excel spread sheet with data transferred to paper form, printing of electronic form for submission for quality assurance review, and/or scanning of paper form for emailing of outcome to supervisor). To assist in making compliance determinations, most RCPs using paper forms also used laptops in the field with Excel spread sheets to make some compliance determinations. The survey found that eight RCPs transferred readings from Unfors, Piranha, RadCal, Accu Gold and/or Fluke devices directly into an excel spread sheet with built-in formulas to make compliance determinations.

Three of the RCPs used the capability of electronic inspection forms to include inspection guidance and compliance determination information directly in the electronic form. While filling out the inspection form, staff could open up policy and procedure documents and/or short descriptions regarding the goal of the compliance question and how to make a compliance determination. These RCPs reported that this approach helped improve consistency between staff as all of the relevant guidance was easily accessible. Among RCPs that used an electronic inspection form, three had the capacity to generate notices of violation using standardized language and print the inspection and violation reports in the field.

One of the significant advantages to a handheld solution is the ability to track and assign work electronically to staff. For example, a supervisor can assign work to inspection staff, review inspection route information, and monitor in real-time progress with meeting productivity targets. Automated scheduling systems are commonly found in public health inspection programs that use hand-held devices. No RCP reported the ability to manage the assignment of work through an automated assignment process that was part of an electronic inspection system. RCPs employed a range of methods for assigning work to inspection staff, including assigning staff to geographic regions, supervisors sending lists of inspections with target completion dates, and staff coming into central location to collect inspection lists.

All of the RCPs interviewed captured some of the information from an inspection in a central data-base but there was a wide range of data being collected. The survey identified one RCP with the ability to automatically sync all of the data collected on handheld device to a central data-base. Seventeen RCPs manually entered portions of the inspection outcomes into a central data-base, with the majority capturing limited information such as the date of the inspection and if a violation was issued. One RCP had to manually enter all of the inspection results collected on paper forms into a data-base. The majority of compliance determinations were not being captured electronically by most RCPs due to the labor intensive nature of manually entering inspection outcomes into a data-base.

The RCPs interviewed reported limited ability to generate standard reports regarding compliance trends, evaluate public exposure/risks systematically, or track qualitative information about inspection outcomes between inspectors. The majority of RCPs captured information in a central data-base that allowed it to track inspection completion and if violations were issued. The type of violations issued was not consistently tracked among the eighteen

RCPs interviewed. As a result, most inspection outcomes become static data points and most RCPs interviewed had a very limited ability to capture trends in compliance at a particular facility, types of facilities, or different equipment types. The lack of informatics relating to the outcome of an inspection makes it difficult for RCPs to evaluate the impact of their efforts or identify where there might be systemic gaps in procedure or knowledge within the radiation safety community that can be addressed through regulatory or collaborative action.

The Working Group's review identified that there is a large gap between best practices employed by other public health programs that use hand held devices as part of their inspection process compared to RCPs. While nearly all of the programs interviewed expressed a desire for more robust data-analysis capabilities and the ability to capture inspection outcomes electronically, few had the resources or commitments from their Administrations to effect these changes. The cost to an individual RCP to develop a customized software solution that includes routing of inspections, scheduling inspections, and built-in analytic reports tracking inspection outcomes and consistency between inspectors can reach over \$1 million. Examples of how RCPs have designed electronic inspection forms and the workflow for an automated inspection system are provided in Appendix A.

Identifying ways to reduce the barriers to adopting best practices in conducting inspections and the ability to manage data efficiently may allow RCPs to adopt systems similar to those found in other public health regulatory programs. Towards this end, the Working Group reviewed the types of inspection forms that were being used for radiography, fluoroscopy, and computed tomography inspections. Many RCPs were making compliance determination using very similar metrics, though the exact phrasing of the compliance questions were as varied as the number of programs interviewed. By establishing that a number of RCPs are making similar assessments of the risks to public health, there is an opportunity to standardize a basic electronic inspection solution that could be leveraged to reduce the development time/cost of adoption by other RCPs. Additionally, RCPs making comparable compliance determination across jurisdictions and recording outcomes using the same criteria allows for a more transparent assessment of compliance trends and public health risks. A list of common compliance determinations for each of the three equipment types is presented in Appendix B. An example of how violation descriptions could be standardized, including a reference code that could allow for tracking of compliance trends between jurisdictions, is provided in Appendix C.

The Working Group's review of compliance questions identified three broad categories within the inspection process common to all RCPs interviewed: quality control, health & safety, and equipment specification. These compliance questions were related to either the operations of the facility or the x-ray producing equipment. The largest gap between inspectional approaches between RCPs related to quality assurance and the degree to which actual testing was performed. These differences were largest for inspections related to computed tomography. The Working Group suggests that including an evaluation of quality assurance efforts as part of the inspection process should be seen as a best practice approach. The ability of a facility to properly and consistently implement their quality assurance program represents the day to day ability to protect patients and workers from inappropriate exposures, respond proactively to operational errors and optimize dose/image quality.

Having identified the advantages of incorporating hand-held devices into the inspection process and determining that there is broad commonality among RCPs in making compliance determinations, the next question is whether there are opportunities to speed the adoption of technological innovations. The Working Group identified a number of commercial off-the-shelf electronic inspection programs on the market that have been used for a number of public health inspections, including ACCELA, Custom Data Processing, Iron Mountain Data, GroveWare, and Inspect2go among many others. In a number of cases, the RCPs reported others in State Government had utilized hand-held inspection solutions to improve inspection processes. Pennsylvania has developed a robust customized software solution that operates on a standard laptop. One RCP is developing a fully integrated tablet solution that eliminates paper, allows for flexible routing, lets supervisors assign work electronically, makes it so inspectors can map facility locations to assist in route creation, and allows all data collected to be transferred to a central data-base. Several RCPs are actively investigating hand-held solutions. Clearly, there are innovative solutions in place and/or being pursued that could be leveraged to speed the adoption of best practices in integrating electronic inspection support systems, data-management, and inspectional practices by other RCPs.

**Appendix A: Examples of Hand Held Solutions and Work Flow/Business Process of Environmental Health Inspections:**

**Example A1: E-Form for Medical Fluoroscopy Using Custom Hand-Held Software (All data is captured in central data-base using custom software developed for RCP)**

Page 1 Comments

BRP-XR-05  Medical Fluoroscopy Inspection

**Facility**  **Registration** 01-00049

**Inspector** Michael Hudak **Date** 08/07/2013

Unit Number xr05 Tube Serial Number

Location/Room/Suite  Console Serial Number

Control Manufacturer  Manufacture Date

Control Model  Installation Date

Certified  Y  N Shields  Y  N

Type (UF, OF, C)  Shields Sat  Y  N

Posting/Labeling Sat  Y  N PB Gloves, Aprons  Y  N

Type of Receptor (II, Scrn)  PB Gloves, Aprons Sat  Y  N

Maximum Intensifier Size  Operator/Aux Personnel Prot  Y  N

Auto Brightness Unit  Y  N Dead Man Switches  Y  N  N/A

Image Recording  Y  N Dead Man Switches Sat  Y  N  N/A

Image Recording - How  Tube Ganged  Y  N  N/A

Tube Indicator Sat  Y  N Interlocked  Y  N  N/A

Tech Indicator Sat  Y  N Barrier Leakage Radiation Sat  Y  N  N/A

Lead Drapes  Y  N Primary Barrier Sat  Y  N

Lead Drapes Sat  Y  N Beam Collimation Sat  Y  N

Bucky Slot Cover Sat  Y  N  N/A Minimum Field Sat  Y  N

SSD (cm)  SSD Sat  Y  N

HVL-kVp Ind  HVL-kVp Meas  HVL  Filtration Adeq  Y  N

|                            | kVp  | mA   | Mag Mode   |   |
|----------------------------|--|--|--|---|
|                            | EER (R/min)  | Indicated  | Indicated  | (FoV)   |
| <b>Adult Normal</b>        | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | High Level Unit <input type="checkbox"/> Y <input type="checkbox"/> N |
| <b>Adult Max</b>           | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> |   |
| <b>High Level Normal</b>   | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | Alarm Sat <input type="checkbox"/> Y <input type="checkbox"/> N       |
| <b>High Level Max</b>      | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> |   |
| <b>Image Record Normal</b> | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> |   |
| <b>Image Record Max</b>    | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> | <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span> |   |

IIIR (R/Min)  Resolution  kVp used

Output Checks  Y  N Records Sat  Y  N 5 min Timer Sat  Y  N Signal Sat  Y  N

Scatter Protection Adequate  Y  N

Survey Equipment Used

Device Comment

**Example A2: E-Form for Medical Fluoroscopy Inspection Using Ocean Software (Data entered into electronic form cannot be extracted readily and form is managed similar to paper)**

Test date:

**Tested equipment**

|                         |                      |                                |
|-------------------------|----------------------|--------------------------------|
| <b><u>Generator</u></b> |                      |                                |
| <b>Name:</b>            | <b>Model:</b>        | <b>Type:</b> HF/DC             |
| <b>Serial #:</b>        | <b>Manufacturer:</b> |                                |
| <b><u>Tube</u></b>      |                      |                                |
| <b>Name:</b>            | <b>Insert type:</b>  | <b>Serial #: Manufacturer:</b> |

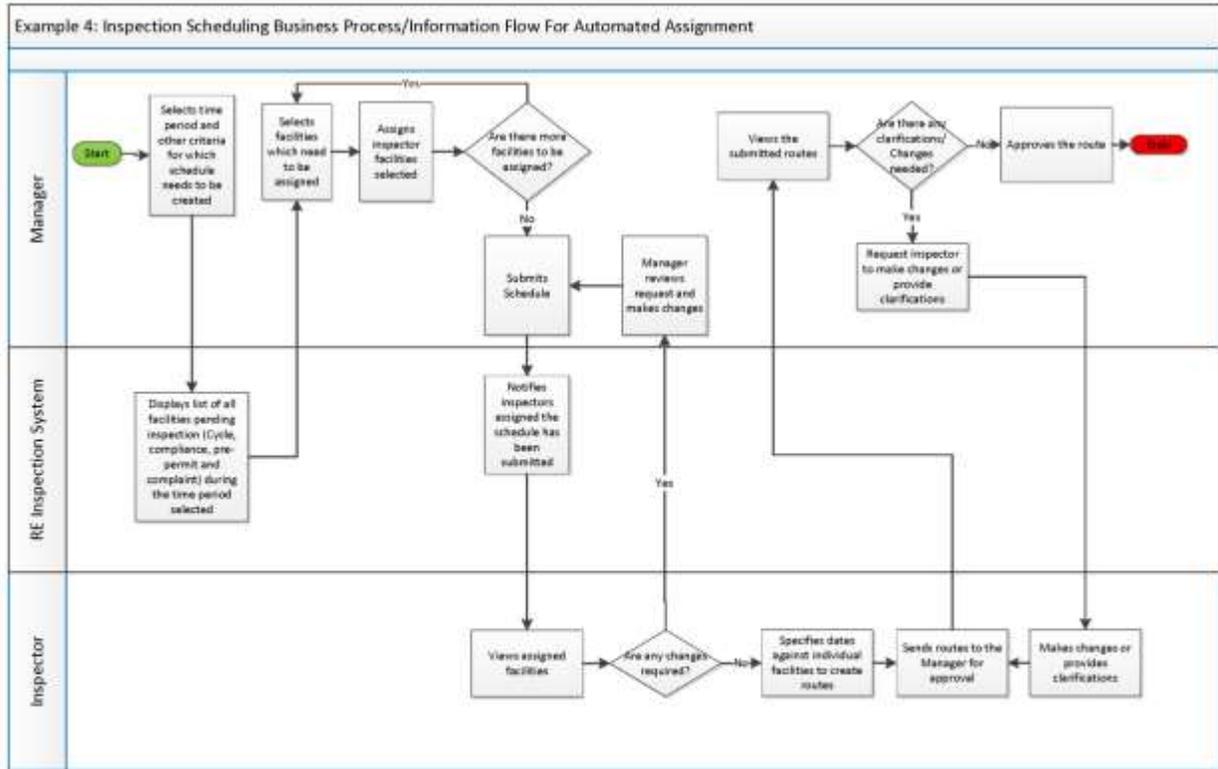
**Questionnaire**

| #  | Question   | Answer | Result | Recomm |
|----|--|--------|--------|--------|
| 1  | <b>Person Interviewed</b>  |        |        |        |
| 2  | Name(s)  |        |        |        |
| 3  | <b>Registration</b>  |        |        |        |
| 4  | Registration available [180 NAC 10-002.01, item 2]   |        |        |        |
| 5  | Registration information current [180 NAC 2-008.01]  |        |        |        |
| 6  | <b>Radiation Protection</b>  |        |        |        |
| 7  | Radiation Protection Program [180 NAC 4-004.01]  |        |        |        |
| 8  | Reviewed every 12 months [180 NAC 4-004.03]  |        |        |        |
| 9  | Written safety procedures provided [180 NAC 6-003.01, item 1.d.]                               |        |        |        |
| 10 | Scale drawing showing room shielding available [180 NAC 6-003.01, item 2.c.]                   |        |        |        |
| 11 | Shielding plan reviewed by qualified expert (after 6/27/83) [180 NAC 6-003.03]                 |        |        |        |
| 12 | ALARA practices being followed [180 NAC 4-004.02]  |        |        |        |
| 13 | <b>Training</b>  |        |        |        |
| 14 | X-ray machine operator(s) certified [180 NAC 6-003.01, item 1.b.]                              |        |        |        |
| 15 | Operator Names   |        |        |        |
| 16 | <b>Personnel Monitoring</b>  |        |        |        |
| 17 | Personnel monitoring provided [180 NAC 4-022.01]   |        |        |        |
| 18 | Name and highest exposure:   |        |        |        |
| 19 | Name and current year-to-date exposure:  |        |        |        |
| 20 | Demonstration of compliance with dose limits [180 NAC 4-022]                                   |        |        |        |
| 21 | Exposure records maintained adequately [180 NAC 4-052]   |        |        |        |
| 22 | Annual review of radiation exposure and hard copy for each badged employee [180 NAC 10-004.02] |        |        |        |
| 23 | Worker instructed if possible to receive in excess of 100 mrem/year [180 NAC 10-003.01]        |        |        |        |
| 24 | <b>Posting/Labeling</b>  |        |        |        |
| 25 | NRH-3 posted [180 NAC 10-002.03]   |        |        |        |
| 26 | Notice to location of documents [180 NAC 10-002.02]  |        |        |        |

This report was created with Ocean 1 (2)



### Example A4: Example of Automated Inspection Scheduling System Work Flow



## Appendix B: Example Template Questionnaire for Compliance Determinations for Radiographic, Fluoroscopy, and Computed Tomography Inspections

### Suggested Template Compliance Questions for Computed Tomography

#### A. Facility – Quality Control

|  | Yes                      | No                       | Comments |
|--|--------------------------|--------------------------|----------|
| <b>1. New CT installations</b>   |                          |                          |          |
| New installation?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| HVL determined for each new CT room?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| All weekly and monthly tests completed before patient clinical scans conducted?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Annual and semiannual tests completed within 30 days of commencing patient scans with the new installation?                              | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>2. New x-ray tubes</b>  |                          |                          |          |
| New tube installed?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Were all weekly and monthly tests completed before patient clinical scans conducted?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Were annual and semiannual tests completed within 30 days of tube replacement date?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>3. Patient logbook</b>  |                          |                          |          |
| Logbook available?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Logbook indicates the type of scan?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Logbook indicates whether scan conducted with contrast?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Scan parameters noted in logbook?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>4. Annual quality control report</b>  |                          |                          |          |
| Report available?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Includes all monthly QC testing?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Includes all semi-annual QC testing?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Includes an evaluation of patient CT dose for adult and pediatric head and abdomen doses for the clinical protocol used at the facility? | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>5. Semi-annual quality control tests</b>  |                          |                          |          |
| Report available?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| For high contrast resolution?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| For low contrast resolution?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| For dose profile width measurements?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>6. Monthly quality control tests</b>  |                          |                          |          |
| Tests available?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| For hard copy output device?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| For CT number scale accuracy?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| For slice positioning accuracy?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| For imaged slice thickness?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| For light localization accuracy?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| For table movement accuracy?   | <input type="checkbox"/> | <input type="checkbox"/> |          |

|   | Yes                      | No                       | Comments |
|---|--------------------------|--------------------------|----------|
| <b>7. Daily quality control tests</b>   |                          |                          |          |
| Reports available?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Includes CT number for water?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Includes CT image uniformity  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Includes CT noise evaluation?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| All test data recorded?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| All results verified within tolerance values?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| If not, is corrective action implemented?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Does facility verify that CT images are artifact free?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>8. Technique charts</b>  |                          |                          |          |
| Posted?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Near operator's location?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Contain (for each scan protocol: adult head, adult abdomen, pediatric head)                                 | <input type="checkbox"/> | <input type="checkbox"/> |          |
| 1. kVp?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| 2. mA?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| 3. number of slices?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| 4. image reconstruction algorithm   |                          |                          |          |
| <b>9: Laser system</b>  |                          |                          |          |
| Visible in ambient lighting?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>10: Documentation</b>  |                          |                          |          |
| Does the Facility have available a list of all test equipment used in Quality Control testing?              | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Are all appropriate calibration records available?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>11. Quality assurance manual</b>   |                          |                          |          |
| Manual is maintained and available?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Manual contains:  |                          |                          |          |
| List of equipment to be tested?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| List of tests to be performed and frequency of each test?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Acceptability limits for each test?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Sample forms to be used to record the data for each test?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Protocol for correction when testing indicates non-compliance?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| List of individuals responsible for testing, supervising, and repairing or servicing the equipment?         | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Location of reference materials?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>12: QA committee</b>   |                          |                          |          |
| Committee organization, duties, and membership listed in the QA manual?                                     | <input type="checkbox"/> | <input type="checkbox"/> |          |
| QA committee minutes for the past three years maintained?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>13: QC testing</b>   |                          |                          |          |
| Did a Qualified Medical Physicist conduct all required QC tests, and provide a report with recommendations? | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Were copies of the QC tests reports obtained for State records?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| All non-compliant issues discovered as part of the Quality Control testing are resolved within 30 days?     | <input type="checkbox"/> | <input type="checkbox"/> |          |

## B. Facility – Health and Safety

|   | Yes                      | No                       | Comments |
|---|--------------------------|--------------------------|----------|
| <b>14. Operator licenses</b>  |                          |                          |          |
| Is CT unit operated only by licensed persons (State or ARRT (CT) certified)?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Are all licenses are available for review?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>15. Equipment records</b>  |                          |                          |          |
| Equipment records for each x-ray room and mobile CT (if applicable) include:  |                          |                          |          |
| Acceptance testing & radiation survey?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Repair records?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Are records maintained for the last three years?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>16: Personnel monitoring program</b>   |                          |                          |          |
| Were all monitoring reports available and found acceptable?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Were monitors submitted in a timely fashion?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Are all radiation exposures within permissible limits?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Was the State regulatory agency notified of reportable overexposures?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Were monitors supplied to required personnel?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Are all monitors stored properly?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Are monitors worn in proper manner?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Are the radiation monitor reports reviewed by authorized personnel?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>17. Mechanical and electrical safety items</b>   |                          |                          |          |
| Any records of mechanical and electrical safety items checked and properly functional?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| When malfunctioning mechanical and/or electrical safety items are found, are repairs done promptly?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Safety burton/Indicators are functional and checked daily?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>18. Radiation Safety Survey</b>  |                          |                          |          |
| If the Facility relocated/ change any of their CT units, was the Radiation Safety Survey Performed and submitted w/in 60 days of relocation/change? | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>19. Staff training</b>   |                          |                          |          |
| Do all staff undergo training to operate CT unit properly?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| All staff are trained in state regulatory issues?   | <input type="checkbox"/> | <input type="checkbox"/> |          |

|  | Yes                      | No                       | Comments |
|--|--------------------------|--------------------------|----------|
| <b>20. Written policy and procedures</b>           |                          |                          |          |
| Procedures available?                              | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Covers holding of patients                         | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Covers use of gonadal shielding                    | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Covers scoliosis shielding procedures              | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Covers policy for pregnant workers and patients    | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Covers personnel monitoring                        | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Covers monitoring for per diem or agency employees | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Covers x-ray screening                             | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Covers repeat, reject analysis                     | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Covers cassette integrity and screen maintenance   | <input type="checkbox"/> | <input type="checkbox"/> |          |

### C. Equipment – Quality Control

|  |                          |                          |  |
|--|--------------------------|--------------------------|--|
| <b>21. Scan Parameters</b>   |                          |                          |  |
| CT scan parameters indicated prior to patient scan?  | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>22. CTDIvol and DLP</b>   |                          |                          |  |
| CT unit(s) display CTDIvol and the DLP for each patient scan?  | <input type="checkbox"/> | <input type="checkbox"/> |  |
| Is this information entered into the patient's chart?  | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>23. Phantom scans</b>   |                          |                          |  |
| Are images of ACR/manufacture phantom demonstrating compliance obtained on both film and digital archive media?  | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>24. Phantom adequacy</b>  |                          |                          |  |
| Phantom at least 14cm in length and a diameter of 32cm for CT whole body scanners AND at least 16cm in diameter of CT head systems?                          | <input type="checkbox"/> | <input type="checkbox"/> |  |
| Instructions available for proper utilization for dose measurements at the Facility?   | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>25. Non-routine protocols</b>   |                          |                          |  |
| All non-routine CT patient protocols pertaining to Brain Profusion studies, CT Lung screenings, or Pediatric studies have been obtained for state records?   | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>26. Protocol review</b>   |                          |                          |  |
| Is the name of the designated radiologist(s) reviewing CT protocols for appropriate technique settings vs. desired image quality obtained for state records? | <input type="checkbox"/> | <input type="checkbox"/> |  |

## D. Equipment – Health and Safety

|  | Yes                      | No                       | Comments |
|--|--------------------------|--------------------------|----------|
| <b>27. Facility Radiation Survey</b>   |                          |                          |          |
| Survey available?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Survey completed by Qualified Physicist?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Operator and Public regulatory limits are in compliance with State regulatory statutes?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>28. Manufacturer's Information</b>  |                          |                          |          |
| Is technical and safety information supplied by manufacturer available during inspection?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>29. Exposure switch</b>   |                          |                          |          |
| Switch is dead-man type with manual override to terminate radiation exposure?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Switch located behind a protective barrier?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>30. Operator's Position</b>   |                          |                          |          |
| Indications of CT conditions visible from any position from which scan can be initiated?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Audible communication with the patient from the CT Operator's location?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Visual communication with patient from the CT operator's location?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>31. Tomo plane</b>  |                          |                          |          |
| Does the CT unit have the means to permit visual determination of the location of tomo plane or reference plane offset from tomo plane?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>32. Termination of exposure</b>   |                          |                          |          |
| Timer indicators terminate exposure when required?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Premature termination of exposure results in a reset of CT conditions?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>33. Exposure limit</b>  |                          |                          |          |
| Means provided such that exposure from system does not exceed 100mR/hr except when x-ray transmission data are being collected for use in image production or technique factor selections? | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>34. X-Ray control and gantry visual indicators</b>  |                          |                          |          |
| a. Provided whenever x-rays are produced?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| b. Indicate if shutter is open or closed?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| c. Is there visual indication of x-ray production even if x-ray production is less than 1/2 sec?   | <input type="checkbox"/> | <input type="checkbox"/> |          |

## Suggested Template Compliance Questions for Fluoroscopy Inspections

### A. Facility – Health and Safety

|   | Yes                      | No                       | Comments |
|---|--------------------------|--------------------------|----------|
| <b>1. Declared pregnancy</b> Declared pregnant worker are monitored?            | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>2. Excessive readings reported</b>   |                          |                          |          |
| Excessive monitor readings reported to regulatory agency along with RCA report? | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>3. Gonadal shielding</b> Gonadal shielding present?                          | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>4. Personnel monitoring</b>  |                          |                          |          |
| Number of people monitored _____  |                          |                          |          |
| Company _____   |                          |                          |          |
| Location of control badge adequate?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>5. Operator exposure</b>   |                          |                          |          |
| Facility workload (mA-min/wk) _____   |                          |                          |          |
| Operator exposure (mR/wk) _____   |                          |                          |          |
| Exposure is regulatory compliant?   | <input type="checkbox"/> | <input type="checkbox"/> |          |

### B. Equipment – Quality Control

|   |                          |                          |  |
|---|--------------------------|--------------------------|--|
| <b>6. Medical Physicist</b><br>Fill in name and credentials (accreditation) or license number, if applicable.<br>_____  |                          |                          |  |
| <b>7. Quality assurance program</b>   |                          |                          |  |
| Records are available and complete?   | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>8. Fluoroscopic Type</b>   |                          |                          |  |
| Pick one:   |                          |                          |  |
| Under Table      Over Table      Fixed C-Arm      Mobile C-Arm  |                          |                          |  |
| <b>9. Auto collimation</b>  |                          |                          |  |
| Present?  | <input type="checkbox"/> | <input type="checkbox"/> |  |
| Tracks smoothly as SID changes from minimum to maximum?   | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>10. Stepless adjustment</b>  |                          |                          |  |
| Beam limiting device has means of stepless adjustment of x-ray field?<br>Stepless adjustment provides continuous field sizes from max obtainable to 2" by 2" or less? | <input type="checkbox"/> | <input type="checkbox"/> |  |

|  | Yes                      | No                       | Comments |
|--|--------------------------|--------------------------|----------|
| <b>11. Collimator</b>  |                          |                          |          |
| Type _____   |                          |                          |          |
| Collimator operates smoothly from maximum size to 5x5 cm size?<br>(except mobile fluoro systems)           | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>12. Field size</b>  |                          |                          |          |
| Length or width does not exceed visible area of image recep by 3% of<br>SID?                               | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Sum of excess length and excess width does not exceed 4% of SID?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>13. Fluoroscopic unit specs</b>   |                          |                          |          |
| kVp _____ mA _____   |                          |                          |          |
| Other technique factors _____  |                          |                          |          |
| Source skin distance _____ Source image distance _____   |                          |                          |          |
| note if means to limit SSD present _____   |                          |                          |          |
| Note any specs out of limits _____   |                          |                          |          |
| <b>14. Five minute timer</b>   |                          |                          |          |
| Timer signals audible signal after 5 minutes of beam on time?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Audible tone continues until timer reset?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>15. Activation of the high level dose rate</b>  |                          |                          |          |
| Special means to activate?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Continuous audible tone once activated?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>16. X-ray field Image Intensifier alignment</b>   |                          |                          |          |
| X-ray field does not exceed size of the II for any SID distance for both II<br>systems and non- II systems | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>17. Non - Image Intensifier system requirements</b>   |                          |                          |          |
| Minimum field size at greatest SID <= 2" by 2"?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Means to show when x-ray perpendicular to image receptor?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>18. Fluoroscopic units used for radiation therapy simulation systems</b>                                |                          |                          |          |
| Unit has means to indicate total cumulative exposure time?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Unit is capable of being reset between x-ray exams?  | <input type="checkbox"/> | <input type="checkbox"/> |          |

|  | Yes                      | No                       | Comments |
|--|--------------------------|--------------------------|----------|
| <b>19. Entrance skin exposure (ESE)</b>  |                          |                          |          |
| ESE performed periodically, using the settings for the most common fluoro exam conducted on the unit? (Done in the AEC rate mode.) | <input type="checkbox"/> | <input type="checkbox"/> |          |
| The ESE values for patient sizes ranging from children to heavy adult posted on/near the unit.                                     | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Does the ESE for the average patient phantom not exceed $\leq 5$ R/minutes in non-magnification mode?                              | <input type="checkbox"/> | <input type="checkbox"/> |          |
| The maximum ESE rates do not exceed 21CFR performance limits for systems with and without HLC?                                     | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>20. HVL measurement</b>   |                          |                          |          |
| Measured at _____ kVp  |                          |                          |          |
| Exposure with _____ mm Al: _____   |                          |                          |          |
| Exposure with 0 mm Al: _____   |                          |                          |          |
| Ratio: _____ Ratio is >50%?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>21. kVp accuracy measurement</b>  |                          |                          |          |
| Measured at _____ kVp  |                          |                          |          |
| kVp accuracy is $\pm$ _____ % of indicated kVp   |                          |                          |          |
| kVp manufacturer's specification _____   |                          |                          |          |
| <b>22. Primary protective barrier interlocks</b>   |                          |                          |          |
| Does primary protective barrier have interlocks to prevent fluoroscopic radiation when the barrier is removed?                     | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>23. Field / spot sizing</b>   |                          |                          |          |
| X-ray field/ spot sizing (e.g. 4 to1, etc) within manufacturer specs?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>24. Film processor QA program for photospot films</b>   |                          |                          |          |
| Determination and plotting of QA processor variables performed?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Routine processor PM performed?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>25. Repeat-reject analysis</b>  |                          |                          |          |
| Repeat-reject analysis done to determine the causes of repeat/rejected patient films?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>26. Spot film reproducibility</b>   |                          |                          |          |
| Spot film reproducibility done for exposure with timer setting $\geq 100$ milliseconds?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Values are compliant with federal standards?   | <input type="checkbox"/> | <input type="checkbox"/> |          |

|  | Yes                      | No                       | Comments |
|--|--------------------------|--------------------------|----------|
| <b>27. Image quality check</b>   |                          |                          |          |
| Is the Low contrast performance with State Statutes for clinical settings?                     | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Is high contrast resolution conducted using a line pair test tool?                             | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Is the high contrast performance with State Statutes for clinical settings?                    | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>28. Cine exam report</b>  |                          |                          |          |
| A report detailing the radiation dose from typical cine patient exams is present, and current? | <input type="checkbox"/> | <input type="checkbox"/> |          |

### C. Equipment – Health and Safety

|  |                          |                          |  |
|--|--------------------------|--------------------------|--|
| <b>29. Bucky slot cover</b>  |                          |                          |  |
| Bucky slot cover is in good condition?   | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>30. Multiple tubes</b>  |                          |                          |  |
| Indication present to show tube selection?   | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>31. Postings etc</b>  |                          |                          |  |
| Non-expired certificate of registration posted?  | <input type="checkbox"/> | <input type="checkbox"/> |  |
| All required warning signs posted?   | <input type="checkbox"/> | <input type="checkbox"/> |  |
| Facility has current State Regulations available?  | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>32. Serial fluoro image recording</b>   |                          |                          |  |
| Means available to terminate exposure but permit completion of any single exposure?                              | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>33. Warm up procedure</b>   |                          |                          |  |
| Is equipment warm up protocol available in QA manual?  | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>45. Dead-man switch</b>   |                          |                          |  |
| Fluoroscopic activation uses a dead-man exposure switch?   | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>34. Foot switches</b>   |                          |                          |  |
| Foot Switches are be protected with metallic covers to guard against electrical shorts due to contrast spillage. | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>35. Licensed practitioner</b>   |                          |                          |  |
| Licensed practitioner performs and interprets fluoro procedures?   | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>36. Sale, relocation, or disposal</b>   |                          |                          |  |
| Owner notified department of sale, relocation or disposal?   | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>37. Patient log</b>   |                          |                          |  |
| Patient log available and contains particulars of fluoroscopic exam?   | <input type="checkbox"/> | <input type="checkbox"/> |  |

|  | Yes                      | No                       | Comments |
|--|--------------------------|--------------------------|----------|
| <b>38. Personnel monitoring</b>  |                          |                          |          |
| Personnel monitoring devices assigned to all fluoroscopy users?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Personnel monitoring records are reviewed?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Unusual exposures are investigated?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>39. User protection</b>   |                          |                          |          |
| Type(s) of user protection provided (circle one or more)   |                          |                          |          |
| Protective garments    Protective shields    Protective drop down shields  |                          |                          |          |
| Are all protective devices tested periodically and in good condition?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>40. Operator radiation safety</b>   |                          |                          |          |
| Requirements for operator radiation safety survey satisfied?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>41. Scatter radiation</b>   |                          |                          |          |
| Scatter radiation from above the table is attenuated by at least 25mm lead equivalent?                             | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Scatter radiation from under the table is attenuated by at least 25mm lead equivalent (except special procedures)? | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>42. Wiring</b>  |                          |                          |          |
| Wiring and cables maintained in good repair?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>43. Exposure rate with attenuation block</b>  |                          |                          |          |
| Exposure rate with attenuation block $\leq 2$ mr/hr at 4" from any accessible surface                              | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>44. Primary transmission rate</b>   |                          |                          |          |
| mR/hr per patient ESE: _____   |                          |                          |          |
| <b>45. Tube potential indicated</b>  |                          |                          |          |
| X-ray tube potential and current continuously indicated to operator and/or at control panel?                       | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>46. Alignment</b>   |                          |                          |          |
| Center of x-ray field aligned with center of portion of image receptor chosen within 2% of SID?                    | <input type="checkbox"/> | <input type="checkbox"/> |          |

#### **D. Equipment Specification**

|   |                          |                          |  |
|---|--------------------------|--------------------------|--|
| <b>47. Indication of perpendicular</b>  |                          |                          |  |
| Equipment permitting variable angle has means provided to show when x-ray perpendicular to image receptor | <input type="checkbox"/> | <input type="checkbox"/> |  |

|  |                          | Yes                      | No                       | Comments |
|--|--------------------------|--------------------------|--------------------------|----------|
| <b>48. Override for oversizing</b>   | Override for auto sizing | <input type="checkbox"/> | <input type="checkbox"/> |          |
|  | provided?                | <input type="checkbox"/> | <input type="checkbox"/> |          |
| If yes, is it clearly labeled for override and has signal visible to fluoroscopist that override is activated? |                          |                          |                          |          |

## Suggested Template Compliance Questions for Radiographic Inspection

### A. Facility – Quality Control

|   | Yes                        | No                       | Comments |
|---|----------------------------|--------------------------|----------|
| <b>1. Annual image quality assessment</b>   |                            |                          |          |
| Is an evaluation of Image Quality, assessed by an appropriate phantom/clinical, conducted annually? | <input type="checkbox"/>   | <input type="checkbox"/> |          |
| <b>2. Gonadal shielding</b>   | Gonadal shielding present? |                          |          |
|   | <input type="checkbox"/>   | <input type="checkbox"/> |          |
| <b>3. Log book</b>  |                            |                          |          |
| Log book indicates required patient detail including number of patients x-rayed per month?          | <input type="checkbox"/>   | <input type="checkbox"/> |          |
| <b>4. Protective garments - mobile</b>  |                            |                          |          |
| Are operator protective garments provided for mobile x-ray users?                                   | <input type="checkbox"/>   | <input type="checkbox"/> |          |
| <b>5. Certifications</b>  |                            |                          |          |
| X-ray machine operator(s) certified or State Licensed?  | <input type="checkbox"/>   | <input type="checkbox"/> |          |
| Are all the doctors Board certified?  | <input type="checkbox"/>   | <input type="checkbox"/> |          |
| <b>6. Training</b>  |                            |                          |          |
| All occupationally exposed personnel are provided with initial safety training?                     | <input type="checkbox"/>   | <input type="checkbox"/> |          |
| Training records maintained for each worker?  | <input type="checkbox"/>   | <input type="checkbox"/> |          |

### B. Equipment – Quality Control

|   |                          |                          |  |
|---|--------------------------|--------------------------|--|
| <b>7. Reproducibility for kVp and timer</b>   |                          |                          |  |
| Coefficient of variability determined? Indicate value _____                           | <input type="checkbox"/> | <input type="checkbox"/> |  |
| Coefficient of Variability within limit of _____ (<=5% for certified equipment)       | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>8. AEC/photo-timer</b>   |                          |                          |  |
| Photo-timer technique indicated on technique chart?                                   | <input type="checkbox"/> | <input type="checkbox"/> |  |
| Reproducibility of photo-timing density control settings evaluated?                   | <input type="checkbox"/> | <input type="checkbox"/> |  |
| Photo Timing Chart available from manufacturer?                                       | <input type="checkbox"/> | <input type="checkbox"/> |  |
| Density settings changes cause exposure to change as per manufacturer specifications? | <input type="checkbox"/> | <input type="checkbox"/> |  |
| <b>9. Center alignment</b>  |                          |                          |  |
| Center of x-ray field aligned to center of image receptor within 2% of SID?           | <input type="checkbox"/> | <input type="checkbox"/> |  |

|   | Yes                      | No                       | Comments |
|---|--------------------------|--------------------------|----------|
| <b>10. Collimation</b>  |                          |                          |          |
| Is beam-limiting device provided?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Does the beam-limiting device numerically indicate the field size?                                      | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Method of collimation _____   |                          |                          |          |
| Collimation type (circle one):  |                          |                          |          |
| Manual   Auto   Cone   Diaphragms   Iris   Rectangular   Circular                                       |                          |                          |          |
| <b>11. Collimation function</b>   |                          |                          |          |
| Stepless adjustment of the x-ray field size available?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Collimator operates smoothly throughout range?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>12. Cut-off</b>  |                          |                          |          |
| Cut-off on the clinical images present on more than 50% of total images reviewed?                       | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>13. Entrance Skin Exposure Measurements</b>  |                          |                          |          |
| a. Available?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| b. Posted?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>14. Exposure data</b>  |                          |                          |          |
| Examination Projection: _____   |                          |                          |          |
| Technique factors: _____ kVp _____ mA _____ MS _____ inches/cm  |                          |                          |          |
| c. SID _____  |                          |                          |          |
| d. Exposure results: _____ mR   |                          |                          |          |
| e. Current _____  |                          |                          |          |
| <b>15. Alignment of the radiation field with light field</b> (using alignment gauge)                    |                          |                          |          |
| Measured radiation field: Length _____ Width _____  |                          |                          |          |
| Difference between alignment gauge template and radiation field viewed on film or CR or DR cassette:    |                          |                          |          |
| Length dimension _____ (cm/in) Width dimension _____ (cm/in)  |                          |                          |          |
| Is the sum of the differences in the length direction plus the width direction less than 4% of the SID? | <input type="checkbox"/> | <input type="checkbox"/> |          |

|   | Yes                      | No                       | Comments                 |
|---|--------------------------|--------------------------|--------------------------|
| <b>16. Filtration/HVL</b>   |                          |                          |                          |
| Reading with 0 mm Al _____  |                          |                          |                          |
| Reading with _____ mm Al added _____ at _____ kVp.  |                          |                          |                          |
| Ratio: _____%   |                          |                          |                          |
| Is this ratio of exposure with added filtration divided by the exposure with zero filtration $\geq 50\%$ ?                              | <input type="checkbox"/> | <input type="checkbox"/> |                          |
| In compliance?  | <input type="checkbox"/> | <input type="checkbox"/> |                          |
| <b>17. mA linearity</b>   |                          |                          |                          |
| For mA linearity (determined by 21CFR standards): is the ratio $\leq 10\%$ between 2 consecutive mA stations?                           | <input type="checkbox"/> | <input type="checkbox"/> |                          |
| Measured mA linearity is _____ % different  |                          |                          |                          |
| between _____ mA & _____ mA   |                          |                          |                          |
| <b>18. mAs linearity</b>  |                          |                          |                          |
| For mAs units, the measured mAs linearity (determined by 21CFR standards): is the ratio $\leq 10\%$ between 2 consecutive mAs stations? | <input type="checkbox"/> | <input type="checkbox"/> |                          |
| Measured mAs linearity is _____ % different   |                          |                          |                          |
| between _____ mAs & _____ mAs   |                          |                          |                          |
| <b>19. Grid</b>   | Grid used?               | <input type="checkbox"/> | <input type="checkbox"/> |
| Grid ratio for table exams: _____   |                          |                          |                          |
| Grid ratio for wall bucky: _____  |                          |                          |                          |
| <b>20. Collimator light field illumination</b>  |                          |                          |                          |
| The collimator light field illumination is $>15$ foot-candles at SID = 39.4"?   | <input type="checkbox"/> | <input type="checkbox"/> |                          |
| Measured value: _____   |                          |                          |                          |
| <b>21. kVp Accuracy</b>   |                          |                          |                          |
| Specs for kVp accuracy _____  |                          |                          |                          |
| Measured values ( fill in ): _____  |                          |                          |                          |
| Is % deviation from Set kVp values determined?  | <input type="checkbox"/> | <input type="checkbox"/> |                          |
| Compliance determination ascertained?   | <input type="checkbox"/> | <input type="checkbox"/> |                          |

|  | Yes                      | No                       | Comments |
|--|--------------------------|--------------------------|----------|
| <b>22:Collimator</b>   |                          |                          |          |
| Collimator settings for X-ray field: length _____ width _____  |                          |                          |          |
| Measured light settings : length _____ width _____   |                          |                          |          |
| Legend assessment: length ( Absolute(a - b )), width (Absolute (a - b )) is less than 2% of the SID set? | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>23. SID</b> Does measured SID comply with indicated SID?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>24: Indication of perpendicular</b>   |                          |                          |          |
| Means or device to indicate when x-ray beam perpendicular to image receptor                              | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>25. PBL function</b>  |                          |                          |          |
| Prevents X-ray production when either length or width of x-ray greater than 3% SID?                      | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Prevents x-ray production when sum differences of length and width > 4%?                                 | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Prevents x-ray production when beam limiting device at SID for which PBL not designed?                   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>26. PBL(size)</b>   |                          |                          |          |
| Field size may be made smaller than image receptor size through stepless adjust?                         | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Any change in image receptor size or SID causes automatic return to PBL?                                 | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Able to make x-ray field size smaller than size of minimum field size at SID 39.4" <= 2" by 2"?          | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>27. PBL(key)</b>  |                          |                          |          |
| Key required to defeat PBL?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Key remains in place during entire override of PBL?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Each key for PBL override clearly labeled as required?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>28. Portable/mobile</b>   |                          |                          |          |
| Collimator and spacer present to limit source to skin distance to >=12"?                                 | <input type="checkbox"/> | <input type="checkbox"/> |          |
| SID indicates SID within 2%?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>29. Single purpose x-ray system with fixed collimator</b>   |                          |                          |          |
| X-ray fully intercepted by image receptor?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Sufficient diaphragms to meet all image receptor size and SID combinations?                              | <input type="checkbox"/> | <input type="checkbox"/> |          |

|  | Yes                      | No                       | Comments |
|--|--------------------------|--------------------------|----------|
| <b>30. Personnel monitoring</b>  |                          |                          |          |
| Type of monitoring system_____   |                          |                          |          |
| Supplier_____  |                          |                          |          |
| Review of occupational radiation exposure reports:<br>Highest exposure - name and current year-to-date exposure<br><br>_____ |                          |                          |          |
| Control badge procedures adequate?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Badges worn properly?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Individual worker is informed of their monitoring results when each monitoring report is received?                           | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Number of excessive exposures_____   |                          |                          |          |
| Review period_____   |                          |                          |          |
| Exchange frequency_____  |                          |                          |          |
| Typical exposure_____  |                          |                          |          |
| Dosimeters provided are appropriate for the radiation type and energy?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Was an investigation performed for any occupational exposure above limits?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>31. Technique Factors</b>   |                          |                          |          |
| Posted?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Current?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Clearly indicated and permanently marked?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Accurate?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Includes patient's size?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>32. Repeat-reject analysis</b>  |                          |                          |          |
| The facility conducts a repeat reject analysis for their patient images?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>33. Artifact evaluations</b>  |                          |                          |          |
| The facility conducts artifact evaluations for imaging system?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>34. Timer accuracy</b>  |                          |                          |          |
| Timer Accuracy meets manufacturer specs or 10% of indicated/measured?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Measured _____ % at _____  |                          |                          |          |
| <b>35. Facilities using film screen for imaging</b>  |                          |                          |          |
| Annual cassette integrity measurements performed for all cassettes?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Screen cleaning protocol established?  | <input type="checkbox"/> | <input type="checkbox"/> |          |

|                                     |
|-------------------------------------|
| <b>36. Film size</b>                |
| Film size: _____ (specify in or cm) |

**C. Equipment – Health and Safety**

|  | Yes                      | No                       | Comments |
|--|--------------------------|--------------------------|----------|
| <b>37. Appropriateness of patient imaging</b>  |                          |                          |          |
| Examinations with x-rays are authorized by appropriately qualified practitioner?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Is the appropriately qualified practitioner (designated as having the overall responsibility for review of patient clinical exams) listed in quality assurance manual? | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>38. Visibility from operator's position</b>   |                          |                          |          |
| a. All entrance doors visible?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| b. Control panel visible?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| c. Communication and view of patient adequate?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>39. Visual and audible indicators</b>   |                          |                          |          |
| Visual and audible indication as to the production of x-rays operating correctly (for certified radiation units)?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>40. Condition of wiring</b>   |                          |                          |          |
| Is wiring free of tears, cracks, and fraying?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>41. Warm up</b>   |                          |                          |          |
| Is equipment warm up conducted prior to each clinical usage?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>42. Exposure Switch</b>   |                          |                          |          |
| Is it a dead-man type switch?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Location of exposure switch adequate?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Only one remote exposure switch for each tube?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>43. Exposure termination</b>  |                          |                          |          |
| Provision provided for the operator to terminate exposure?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>44. Monitoring for holders</b>  |                          |                          |          |
| Is personal monitoring available for patient holders?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>45. Control panel labeling</b>  |                          |                          |          |
| Control panel indicates the Manufacturer and model?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Control panel indicates max kVp & mA/s?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>46. Multiple tubes with one control panel</b>   |                          |                          |          |
| Multiple tubes with one control panel: only one tube activated at any time?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>47. Operator exposure</b>   |                          |                          |          |
| Exposure: _____ (mR/wk)  |                          |                          |          |

|   | Yes                           | No                       | Comments                 |
|---|-------------------------------|--------------------------|--------------------------|
| <b>48. Portable/Mobile x-ray unit requirements</b>  |                               |                          |                          |
| Exposure control allows operator to stand $\geq$ 6' from patient?   | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Operator required to wear lead apron?   | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| If manufactured with device to measure SID, device is present?  | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| <b>49. Preset timer</b>   |                               |                          |                          |
| Terminates exposure at end of set time?   | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Does not operate at zero setting and/or 'Off Position'?   | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Operator may terminate exposure when exposure > 1/2 sec.?   | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| <b>50. Protective devices / garments</b>  |                               |                          |                          |
| Protective garments available and in good condition?  | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Appropriate patient protective devices available and in good condition?   | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Is it apparent that protective devices are being used routinely?  | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| <b>51. Radiation Protection Survey:</b>   |                               |                          |                          |
| Performed and submitted to the regulatory authority within 60 days of installation?   | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Performed and submitted the regulatory authority within 60 days of relocation /change?  | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Requirements of equipment safety survey complaint with State statutes?  | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Survey includes room diagram and scatter measurements?  | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Scale drawing showing room shielding available?   | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Shielding plan reviewed by qualified expert?  | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| <b>52. Inspector's review of quality control documents</b>  |                               |                          |                          |
| Review of QA Program to determine compliance with State requirements  | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Medical Physicists Quality Control Reports  | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Medical Physicist's Quality Control Recommendations   | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Records of calibrations, surveys, etc. are maintained?  | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| <b>53. X-ray room signage</b>   |                               |                          |                          |
| Close Door During X-ray sign posted?  | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Pregnant patients to notify the LRT sign posted?  | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| Notice to Employee sign posted?   | <input type="checkbox"/>      | <input type="checkbox"/> |                          |
| <b>54. Tube head stability</b>  | The x-ray tubehead is stable? | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>55. Leakage radiation – mobile units</b>   |                               |                          |                          |
| For mobile x-ray units, is leakage radiation exposure not more than 2 mR/hr at any accessible surface of the unit (for capacitor discharge systems only)? | <input type="checkbox"/>      | <input type="checkbox"/> |                          |

|  | Yes                      | No                       | Comments |
|--|--------------------------|--------------------------|----------|
| <b>56. QA Program for film processing</b>  |                          |                          |          |
| Daily evaluation of film sensitometric parameters (film speed, contrast, BASE+FOG, developer temperature) for compliance with control Levels in the QA manual? | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Program evaluates darkroom cleanliness and darkroom safelight fog levels?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Program evaluates film storage conditions?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Processor undergoes routine monthly cleaning and replenishing of chemistry?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Analysis of fixer retention is done?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Documentation/records are present for all of above?  | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Screen film contact checked?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| No loose films stored in film bin?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>57. Relocation / sale</b>   |                          |                          |          |
| Regulatory authority notified of relocation/sale of equipment?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>58. Registration posted</b>   |                          |                          |          |
| Valid registration is available, current and posted?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| <b>59. Reporting</b>   |                          |                          |          |
| Was Reporting of patient radiation incidents or events, as defined by State Statute, done?   | <input type="checkbox"/> | <input type="checkbox"/> |          |
| Reporting records supplied for review by Inspector?  | <input type="checkbox"/> | <input type="checkbox"/> |          |

**Appendix C: Example of Suggested Violation Citation Language for Insertion into NOV and Standard Violation Codes to Promote Comparison of Compliance Determinations Between Jurisdictions**

| Standard Violation Code to Allow Comparison Between Jurisdictions | Suggested Violation Summary for writing Notice of Violation  | Violation Severity Classification (Example, Public Health Hazard, Critical, General) | State Citation Nomenclature (for example: 175.01) |
|---|--|--|---|
| 6884  | Radiation safety officer not provided to ensure proper implementation of a radiation protection program.                         |  | RCP Code Citation                                 |
| 6885  | Sensitometry not performed or grossly inadequate.  |  | RCP Code Citation                                 |
| 6886  | No visual indication observable from operator's position provided whenever X-rays are produced                                   |  | RCP Code Citation                                 |
| 6887  | Equipment records are not maintained and do not include initial acceptance testing for each x-ray room and/or mobile x-ray unit. |  | RCP Code Citation                                 |
| 6888  | During fluoroscopy, tube potential (kV) was not indicated continuously.  |  | RCP Code Citation                                 |
| 6889  | Annual determination of dose for pediatric abdomen (if pediatric cases are performed) is not performed or is not complete.       |  | RCP Code Citation                                 |
| 6890  | Operator did not implement a radiation protection program sufficient to ensure compliance with the provisions of this code.      |  | RCP Code Citation                                 |
| 6891  | QA/QC check failure is not resolved by repeating the test successfully or having the unit serviced.                              |  | RCP Code Citation                                 |
| 6892  | Possible to make an exposure when the timer is set to zero or off position, if ether position provided.                          |  | RCP Code Citation                                 |
| 6893  | Annual fluoroscopic tests are not performed for 5 minute timer.  |  | RCP Code Citation                                 |
| 6894  | Sensitometry data is not run and plotted on each day that patient radiography is conducted.                                      |  | RCP Code Citation                                 |

|      |  |  |                   |
|------|--|--|-------------------|
| 6895 | Training programs: a training program is not provided for all personnel (licensed x-ray techs, aides, etc.) who work in or frequent any controlled area on required worker protections and rights. |  | RCP Code Citation |
| 6896 | When high option control is in use, for equipment without automatic exposure, an audible signal is not heard.  |  | RCP Code Citation |
| 6897 | Patient radiography was not discontinued when quality assurance had not been performed.  |  | RCP Code Citation |
| 6898 | Mechanical supporting or restraining devices are not available.  |  | RCP Code Citation |
| 6899 | Primary barrier interlock is not adequate.   |  | RCP Code Citation |
| 6900 | Records of the QA/QC checks are not maintained.  |  | RCP Code Citation |
| 6901 | Annual fluoroscopic tests are not performed for tracking.  |  | RCP Code Citation |
| 6902 | Daily localization system accuracy in air is not adequate.   |  | RCP Code Citation |
| 6903 | Patient log book maintained does not include the number of views taken.  |  | RCP Code Citation |
| 6904 | Exposure control device is not adequate.   |  | RCP Code Citation |
| 6905 | The minimum half-value layer is less than 1.5 mm aluminum equivalent (units manufactured after December 1, 1980).  |  | RCP Code Citation |
| 6906 | Individual did not adhere to rules, regulations or orders imposed by the Department to protect the public health and safety from radiation hazards.  |  | RCP Code Citation |
| 6907 | The written policy and procedures are not available for x-ray screening.   |  | Code Citation     |
| 6908 | Automatic mode maximum exposure rate exceeded 10 Roentgens per minute.   |  | Code Citation     |
| 6909 | Registrant did not cause to be made all surveys that are necessary to comply with this code and/or are necessary to evaluate radiation levels and potential radiological hazards.                  |  | Code Citation     |
| 6910 | Semi-annual resolution (low contrast) tests are not conducted or are not complete for the helical mode.  |  | Code Citation     |
| 6911 | Annual automatic exposure control (AEC) or manual exposure performance assessment is not adequate.   |  | Code Citation     |
| 6912 | Radiographic Units: Quarterly positive beam limitation (PBL) tests are not performed.  |  | Code Citation     |

|      |   |  |               |
|------|---|--|---------------|
| 6913 | Exposure of an individual used for holding patients is not being monitored.   |  | Code Citation |
| 6914 | On installation of new unit: all annual and semi-annual tests were not performed or completed within 30 days of the new installation commencing patient CT scans. |  | Code Citation |
| 6915 | Tube head does not remain stationary when placed in an exposure position.   |  | Code Citation |
| 6916 | Single purpose equipment not provided with means to limit the field at the plane of the image receptor to dimensions no greater than those of the image receptor. |  | Code Citation |

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<sup>i</sup> Personal communication, Elliot Marcus, Associate Commissioner Bureau of Community Sanitation, New York City Department of Health & Mental Hygiene.

<sup>ii</sup> <https://www.accela.com/company/customers/success-stories/el-paso-county>

<sup>iii</sup> Erich Fruchtnicht, John W. Fellers and Clay D. Hanks - Safety Inspections Continuous Improvement, Effectiveness & Efficiency, Professional Safety, pp 28-35, July 2013 ([http://www.asse.org/assets/1/7/Fender\\_F1Fruc\\_0713.pdf](http://www.asse.org/assets/1/7/Fender_F1Fruc_0713.pdf))