

X-Ray Image Logger Radiation Survey Form

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Introduction

The purpose of these tests and surveys, is to insure the safety of the operator and individuals working in the area. IODP's X-ray imaging is operated with multiple layers of safety as follows.

1. Safe and proper use of the equipment thru staff training.
2. Signage warning of the potential hazards
3. Passive shielding around the x-ray source and potential radiation exposure paths.
4. External switch to shut down the x-ray source.
5. Fail safe, inter-lock system of switches on access doors that will prevent the source from generating x-rays unless all are closed.
6. System status lights that indicates that power to the x-ray source is on, fail-safe circuit is complete and x-rays are actively being generated.
7. An independent area monitoring system to notify the user and immediately shut down the x-ray source should any of the above steps fail.

The individual conducting the tests should be familiar with the x-ray source operation and trained to conduct the following tests safety by an experienced staff. Before you start, you and anyone assisting you must meet the following criteria...

- You must be wearing a whole body radiation monitor during the entire time that tests are being conducted. *The monitors are provided by TAMU HSE department and distributed by the Lab Officer.*
- *Your TAMU Radiation safety training must be up to date.*
- You have completed the instrument specific training for the 2D X-ray imager.
- You are familiar with the IMS or the vendor's provided software for operating the X-ray source and flat panel detector.
- You have read the manual for Fluke 451P-RYR radiation survey meter and have been trained in how to use it properly. *The survey meters are kept in the Laboratory Officers office on bridge deck.*

Before Start

1. Visually inspect the passive shielding. Insure that panels and coverings are in place and properly attached. *Please note that the current system is a proto-type with shielding attached by Velcro and plywood. Small gaps that are seen externally, should be covered with internal shielding that may not be visible. The purpose of the survey is to verify that this is the case.*
2. Launch the controlling software and verify communications with the X-ray source.
3. Verify that the area monitoring system is on (display will be active).
4. Confirm that the X-ray status lights are working (part of the safety check list):

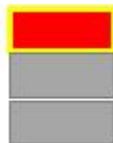
- a. Amber light is lit when the x-ray source is connected to power.



- b. Green light is lit when the load and unload doors are closed, FPD access door is closed, and the emergency shut off switch is **not engaged**.



- c. Red light is lit when x-rays are generated. The light will blink quickly as it powers on and then slowly once the kV and mA are stable.



When both the amber and green lights are lit, the system is ready for x-rays to be powered on.



When all three lights are lit, X-rays are on!



*****IMPORTANT: If these lights are not working, do not conduct further tests until the issue has been resolved.*****

Survey Instructions

1. Surveys are made with the Fluke 451P-RYR in **integration mode**. Read the manual and be familiar with the survey meter's operation.
2. Check that the Calibration date is valid. The calibration information is available on the side of the Fluke 451P-RYR

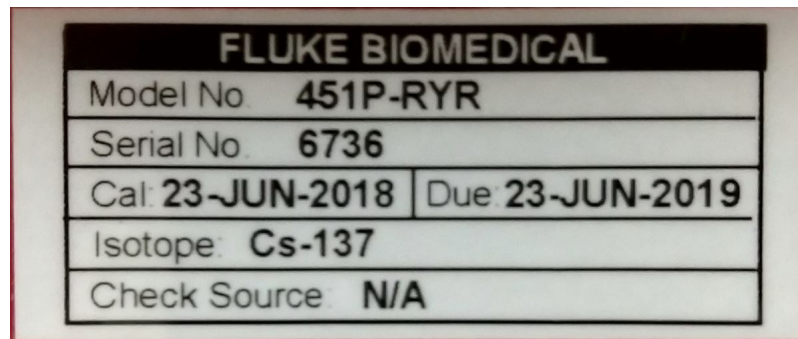


Figure 1- Survey meter calibration information found on the survey meter

3. Wait at least 5 minutes (or more) after turning the meter on before using. Room temperature must be stable.
4. ALWAYS **remember to move slowly!** Sudden movements will increase the meter's value, wait and let the values settle.
5. ALWAYS remember that the value on the meter is based on a 30-sec integration values. This means that for measurements at a point (marked with a yellow X in the survey map) wait at least 30 sec. For surveys that use the term "along" or "around" (marked with a green line in the survey map), move the detector slowly keeping the same orientation and record the highest value seen.
6. Surveys are done with the source powered at **120kV** and **1mA**. The use of **Image Utility** is recommended to perform them (**Instruments > Camera: Image Utility**).

It is likely that you will have to set the area monitor high alarm to something near 10Kcps in order to perform the survey. Counts less than 10Kcps are still a fraction of the safe limit. When the survey is complete, restore the high alarm to twice background.

7. Surveys of the Load Shield or Unload Shield are done with a whole round water standard with its end half-way into the beam with empty half toward the shield being surveyed (**Figure 2**).

We place the core into the beam to create the maximum lateral scattering situation. This important for the surveys of the load and unload sides of the system and the area monitors, as well.

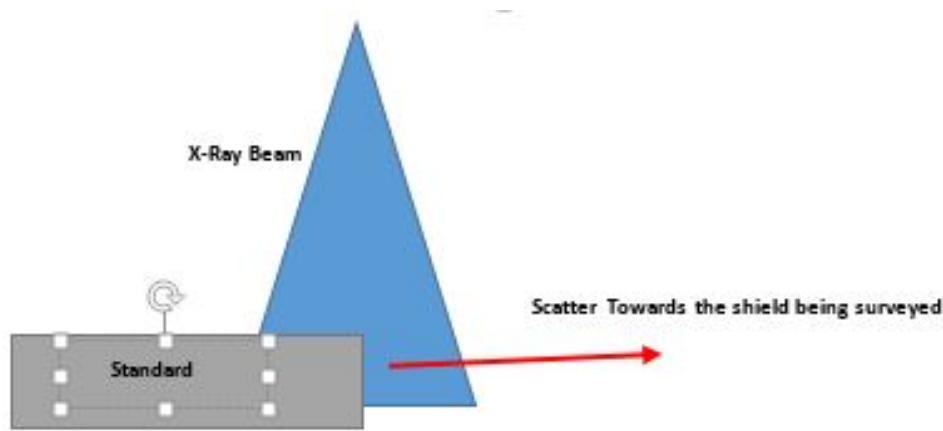


Figure 2-Direction of radiation scatter when standard is centered in the beam path

8. Use the attached forms and location diagrams to record your survey results.

Safety Circuit Instructions

For the following tests, the core entry area must be secured with only the qualified test personnel in the space.

- Close and lock the doors to the downhole lab and catwalk. Post a staff member near the door to the stairwell to prevent people from entering the core entry area.
- Also, make sure that the Load/Unload and Emergency Off tests (steps 2 and 3) are successful before you start the Area Monitor tests because you may need to use the doors or X-Ray off switches to power down the X-Ray source should the Area Monitor fail to shut down the system!

*For the following tests, power the X-ray source at minimal levels (80kV, .8mA) with **no core in beam**.*

1. Door switches: With the X-rays on, open the Load end door a few millimeters and verify that the X-Rays shut down. The vinyl lead shielding must continue to cover the gap! Repeat above for the other unload end door.

2. Emergency Off: With the X-rays on, press the Emergency X-Ray OFF button (found above the load end) and verify that the X-Rays shut down.

3. Area Monitor Alarm :

a. The **Low level alarm** should set at **~1.0 kcps above the background** and the **high level alarm ~1.2 kcps**.

Only the high level alarm will shut down the X-Ray source. The low level alarm will trigger an audible alarm, but the X-ray source will remain on.

b. Remove the vinyl lead shielding as shown from the Load end, power the X-Rays and move to the unload end of the track and be prepared to open the Unload door.

c. X-ray system should immediately shut down once the X-rays are on (blinking red light). If the system does not shut down immediately kill the x-rays by opening the unload door. If the test failed, adjust the high level alarm as necessary.

d. Repeat steps b and c for the unload end removing the vinyl lead shielding as shown. Stand by the load end.

e. When done, make sure to restore the lead vinyl shielding properly to ensure there are no leaks

f. Power up the X-rays to full power to confirm that the shielding has been restored. The area monitor should not give a high or low level alarm when the shielding is in place.

Please note that the background radiation level change with latitude and may require adjustment accordingly so that false alarms are not triggered but the system will still detect a shield failure quickly.



Survey Forms

Copy the following pages into a new work document for your expedition. Fill out the form, convert to a pdf format, add a digital signature field, digitally sign (locked) and e-mail to the Supervisor of Technical Support.

Filename: Exp "exp" X-ray Imager Radiation Survey.pdf

Follow the location diagrams, at the end of the document, to complete this survey.

Location	Description	$\mu\text{R/hr}$	Notes
LOAD DOOR - FRONT Survey Form - Standard placed with blue end centered on the detector and the remaining core toward the unload end. Source: 120 kV, 1 mA			
1	Along the top seam		
2	Along the door seam		
3	At the end just under the keyboard countertop		
4	Along the door seam		
5	Along the join between the MS-GRA shield and door		
6	Along the outer side corner		
7	Center of MS-GRA front panel, 40 cm from the top		
8	Center of MS-GRA side panel.		
9	Along the outer side corner		
10	Along the outer top corner		
UNLOAD DOOR - FRONT Survey Form - Standard placed with blue end centered on the detector and remaining core toward the load end. Source: 120 kV, 1 mA			
11	Along the join of the Source and MS-GRA shields		
12	Center of X-RAY front panel, 40 cm from the top		
13	Along the outer top corner		
14	Center of Top panel		
15	Along the outer side corner		
16	Along the seam between the unload shield and the source shield		
17	Center of X-RAY side panel, 40 cm from the top		
18	Along the door seam		
19	Along the top of the door		

20	Center of the panel at the end of unload door		
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BACKSIDE Survey Form - Standard placed with blue end centered on the detector and the remaining core toward the load end. Source: **120 kV, 1 mA**

21	Along the door seam		
22	Along the outer side corner		
23	Center of X-RAY back panel, 40 cm from the top		
24	Along the join between the MS-GRA shield and door		
25	Along the outer side corner		
26	Center of MS-GRA back panel, 40 cm from the top		
27	Along the outer side corner		
28	Along the center of the panel		

BOTTOM Survey Form - These measurements are taken below the countertop. No standard on the track. Source: **120 kV, 1 mA**

29	Center of the MS-GRA Shield		
30	Directly under the detector (Source Shield)		
31	Around the detector (Source Shield)		

Area Alarm Sensors and Safety Circuit Check

At The Area Detectors			
Location	Description	µR/hr	Notes
Above LOAD DOOR	Next to detector		
Above UNLOAD DOOR	Next to detector		
BACKGROUND	X-Rays Off		
Location		kcps	Notes
Area Monitor w/X-Rays OFF (Value on monitor display)			
Area Monitor w/X-Rays ON (Value on monitor display)			
High Alarm Setting			
Low Alarm Setting			

Switch/Interlock	Passed
Emergency X-Ray OFF switch	
Load Door Interlock	
Unload Door Interlock	
Area Monitor Interlock	

Survey Date: _____

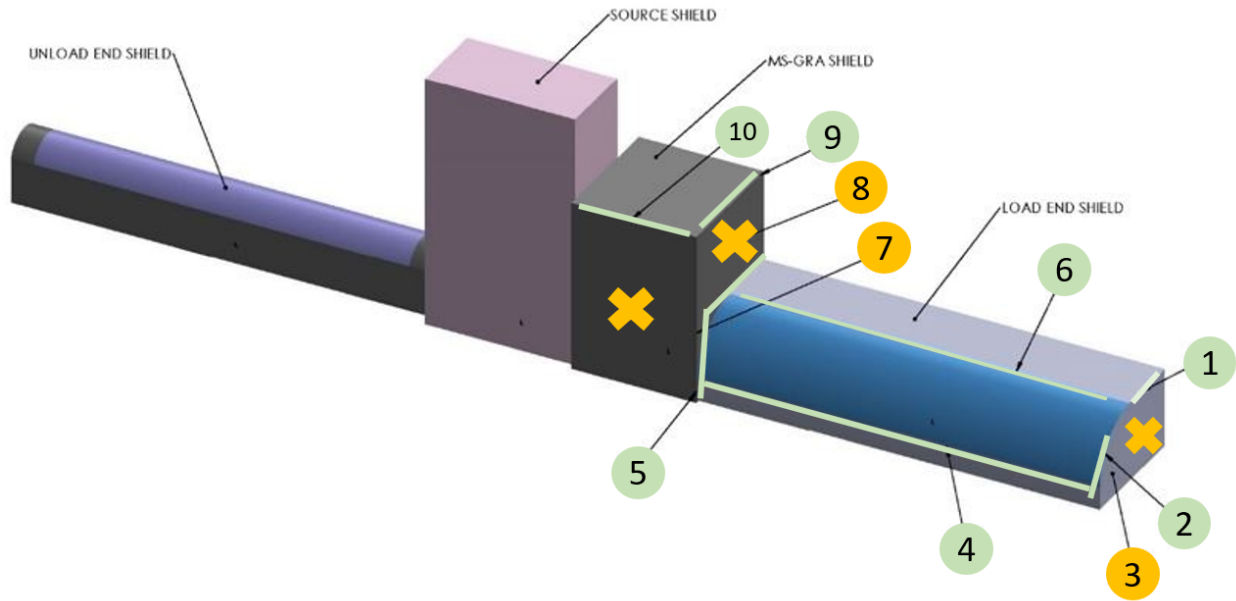
Associated Expedition (optional):----- _____

Name of Surveyor: _____

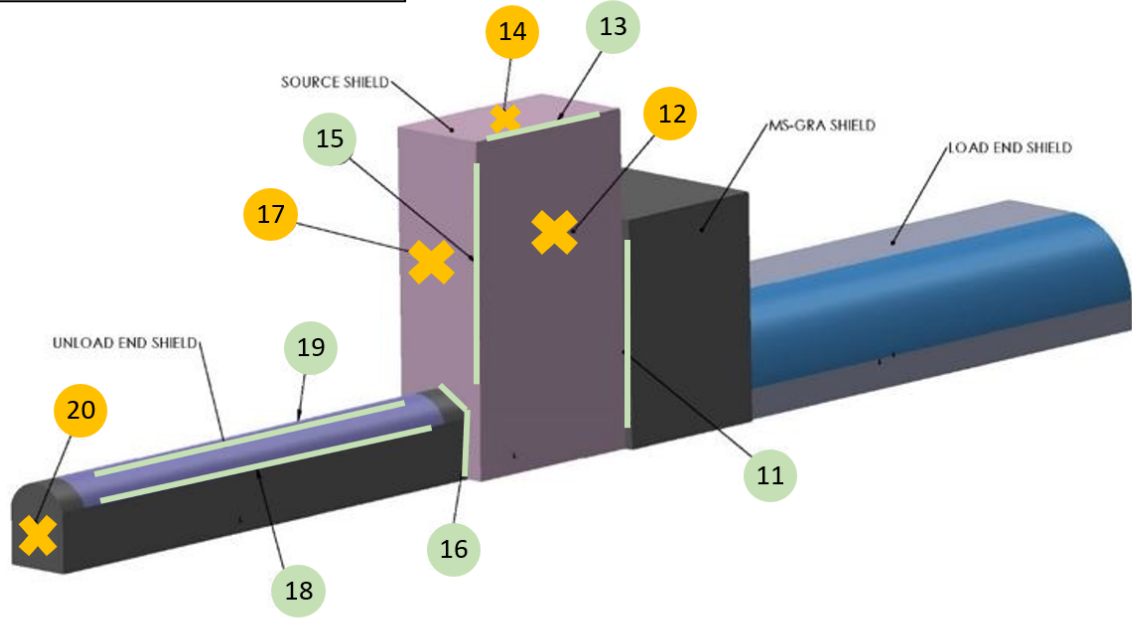
Surveyor's Signature: _____

Survey Maps

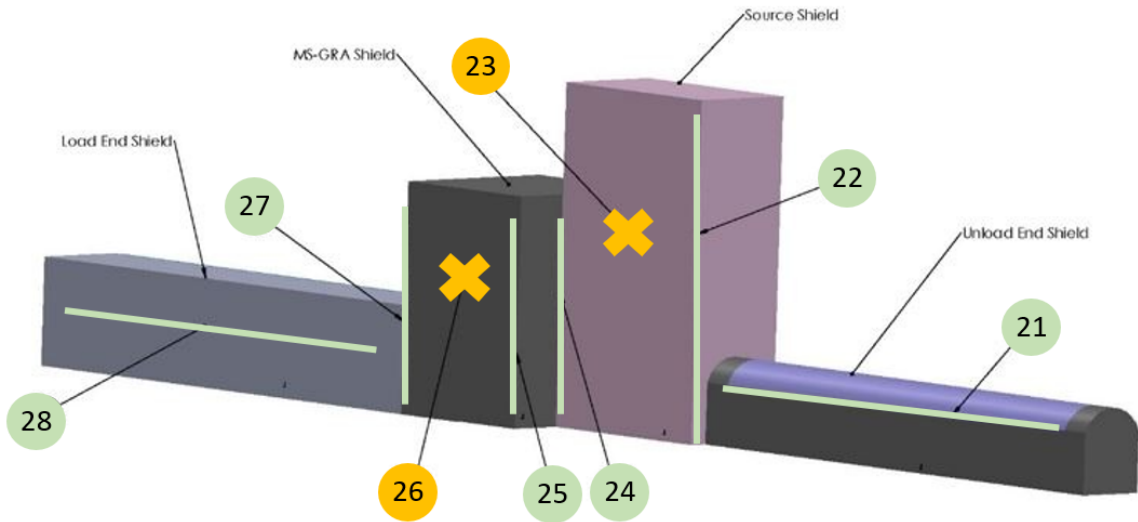
LOAD DOOR - FRONT



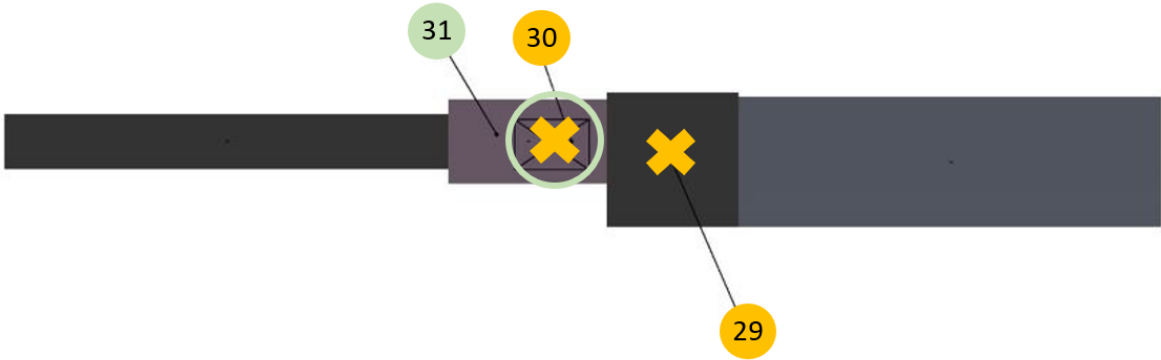
UNLOAD DOOR - FRONT



BACKSIDE



BOTTOM



Archive Versions

[Radiation Survey Form - 01032020](#)

[Radiation Survey Form_4Nov2021](#) ([Confluence version](#), [Word Version](#))