

# PUERTO RICO NUCLEAR CENTER

PROCEDURES FOR OPERATING Co<sup>60</sup> GAMMA  
IRRADIATION FACILITY



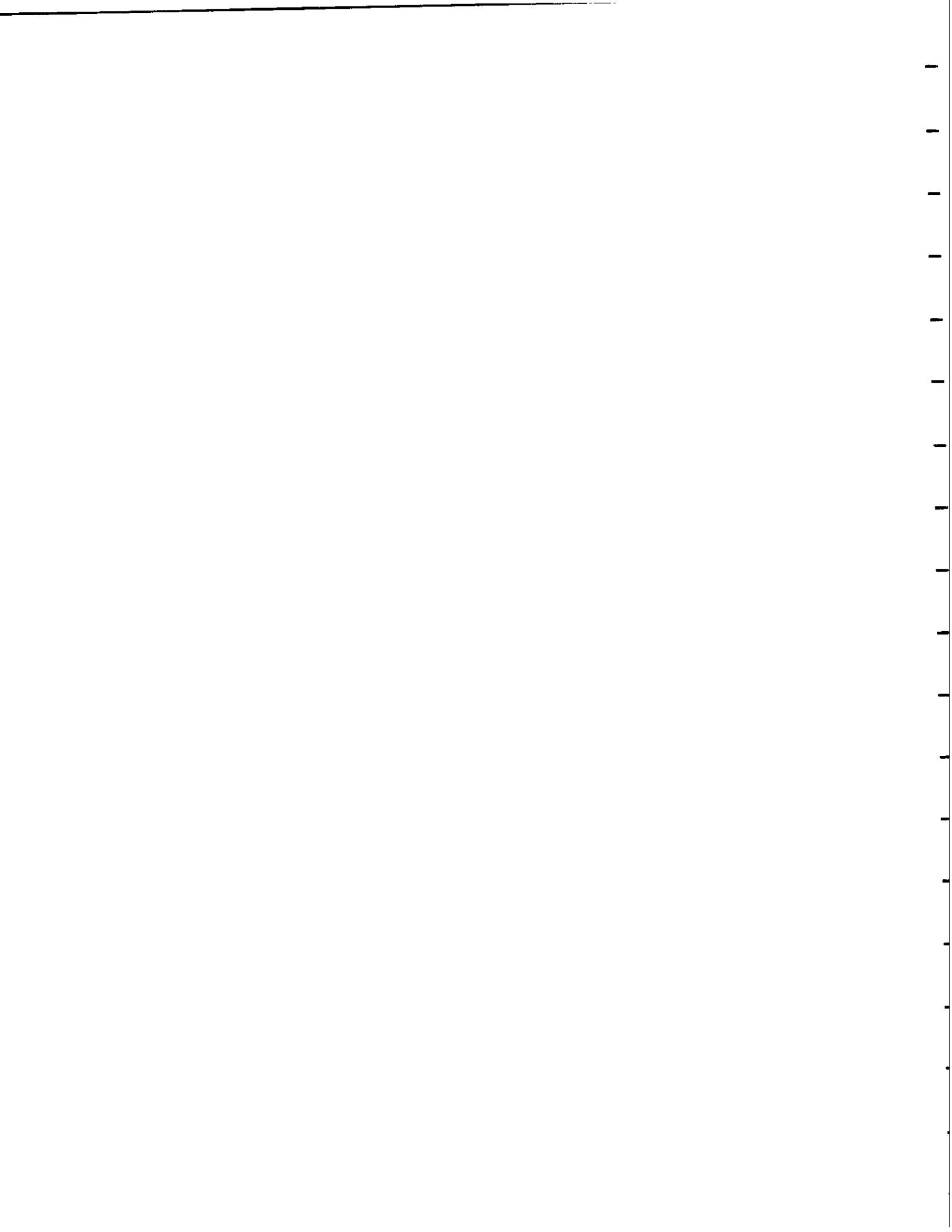
OPERATED BY UNIVERSITY OF PUERTO RICO UNDER CONTRACT  
NO. AT (40-1) 1822 FOR U. S. ATOMIC ENERGY COMMISSION



AUTHORIZATION

This Procedure for Operating Co<sup>60</sup> Gamma Irradiation Facility has been reviewed and approved by the Safety Committee. It is hereby approved and made operative as of April 30, 1964.

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Procedures for Operating Co<sup>60</sup> Gamma  
Irradiation Facility

1. DESCRIPTION OF SOURCE

(A) ROOM

The cobalt-60 Gamma Irradiation Facility (GIF) for PRNC is housed in room 121 in the PRNC building at Mayaguez. This room has a double door to the rear corridor and two separate single doors to laboratory room 103. The room will have a cabinet for storing grappling hooks etc., tables for working space, tanks of O<sub>2</sub>, N<sub>2</sub> and compressed air, and a water circulating system for the pool.

(B) POOL

A pool 9' x 8' x 14' 6" deep that is located in room 121 contains the Co<sup>60</sup> using water as a shield. A dry well is adjacent to one end of the pool with an aluminum plate separating the two sides. The dry well will not be used and the port will be shielded as necessary to reduce scattered radiation through the dry well.

A portable steel bridge which goes across the top of the pool will serve as the base for the operator conducting irradiations.

A platform 4' x 8' is located 10 feet below the water in the pool. This platform has twelve cylinders

to hold the capsules. It will hold the hollow cylinder variable geometry irradiator.

A radiation monitor with audio alarm is preset at 20 mr per hour. The probe will be attached to the underside of the bridge above the platform area where the irradiations will be conducted.

(C) HOLLOW CYLINDER VARIABLE GEOMETRY IRRADIATOR

The  $\text{Co}^{60}$  is contained in twelve pencil type capsules each containing approximately 200 curies. The capsules are inserted in the Hollow Cylinder Variable Geometry Irradiator (VGI). The VGI is adjustable to form a hollow cylinder from 1 inch to 18 inches in diameter. A symmetrical field can be obtained by using 12, 6, or 3 capsules.

(D) SAMPLE HOLDERS

Samples to be irradiated will be placed in wide mouth polyethylene bottles of appropriate size from one to eighteen inches in diameter. The cap of the bottle has a connection for attaching a rod. A connection for fastening an air hose and a tube for release of excess air from positive pressure is part of some caps.

II. AUTHORIZED PERSONNEL AND RESPONSIBILITIES

(A) SUPERVISOR RESPONSIBILITIES:

1. In charge of facility.
2. Responsible for training of assistant supervisors.
3. Responsible for keys for GIF.
4. Responsible for changing geometry of variable geometry irradiator.
5. Responsible that procedures are fully complied with.
6. Responsible for scheduling use of GIF.
7. Responsible for recommending to Health Physics personnel to be assistant supervisors.

(B) ASSISTANT SUPERVISOR RESPONSIBILITIES:

1. Responsible for items 3, 4, 5, 6 under supervisor.

(C) PERSONNEL USING FACILITY RESPONSIBILITIES:

1. Responsible for filing form 663 with Health Physics.
2. Responsible for making appointment to use facility.
3. Responsible for placing and removing materials to be irradiated.
4. Responsible for insuring that materials placed in pool do not contaminate facility.

III. LOADING AND UNLOADING SOURCE PROCEDURE

(A) STORAGE CONDITIONS

The capsules will be stored in individual cylinders in the platform in the pool or in the variable geometry irradiator. The grapplers etc. will be locked in their cabinet.

(B) PROCEDURE FOR LOADING, UNLOADING AND CHANGING GEOMETRY

There will always be two persons involved in loading or unloading the VGI, at least one being the supervisor or an assistant supervisor. The step by step procedure is as follows:

1. Put signs on doors of 121 and lock the room.
2. Unlock cabinet containing grapplers, portable monitor, etc.
3. Check monitor and radiation detection alarm; check portable survey meter.
4. Turn off all lights and count capsules in twelve holders as well as check VGI in pool. Check is by Cerenkov effect with lights off.
5. Turn lights on.
6. One person with portable survey meter is on side of pool to check for radiation during rest of procedure.



7. Using grappler remove  $\text{Co}^{60}$  capsules one by one from VGI and place in capsule holders.
8. Turn off all lights and count capsules in twelve holders as well as check VGI in pool. Check is by Cerenkov effect with lights off. The VGI will be double checked with lights off and on to make sure no capsule has been left in by mistake.
9. Turn lights on.
10. Remove VGI from pool and place on table.
11. Set VGI to desired position.
12. Return VGI to pool and platform.
13. Using grappler, place  $\text{Co}^{60}$  capsules one by one in VGI.
14. Return grapplers, etc. to cabinet and lock.
15. Check compressed air (or  $\text{N}_2$ ,  $\text{O}_2$ ) supply and connections.
16. Ready for irradiation.

NOTE: Scientific staff may use room 121 as a laboratory during irradiations but will not be present when loading or unloading of capsules to the VGI is being conducted. Because of the storage of  $\text{O}_2$  cylinders in the room it is STRICTLY forbidden to smoke or use open flame.

IV. SAMPLE IRRADIATION PROCEDURE

The responsibility for an irradiation procedure will fall on the person conducting the experiment after he has become familiar with the facility. Until then, the supervisor will be responsible.

Samples to be irradiated will be placed in polyethylene containers and kept dry. They may be irradiated in air, oxygen or nitrogen atmospheres. The procedure is as follows:

1. Place sample in polyethylene container.
2. Secure cap on container.
3. Connect appropriate air pressure hose to cap.
4. Connect ram rod to cap.
5. Lower container in pool just below surface and test for air pressure by observing bubbles from outlet.
6. Set time for desired interval (determined from charts).
7. Place container in VGI and start timer.
8. When time interval has elapsed, remove container from pool and place on table.
9. Shut off air pressure.
10. Remove ram rod.
11. Remove air hose.
12. Remove cap.
13. Take out sample.
14. Record in log book.

V. SAFETY PROVISIONS IN CASE OF UTILITIES FAILURE OR MALFUNCTION

(A) WATER LOSS

The pool is provided with a water level alarm set to sound when the level drops 4" below normal (14').

There are three ways in which water may be lost from the pool: (1) evaporation (2) pumping (3) earthquake cracking walls. Evaporation loss will be compensated by the water line with a float valve that opens when the water level drops one inch.

The pump will be modified so that all outlets from it go into the pool. This will not affect its standard operation as the purpose is to circulate and filter the water. If an earthquake occurs of sufficient magnitude to crack the reinforced concrete walls resulting in a loss of the water the area will be vacated. The radiation alarm should sound (if there were still electricity) but no detailed corrective procedures are offered at this time. The circumstances would be such that they could best be worked out after such an eventuality.

(B) POWER FAILURE

The operation of the GIF is entirely a manual operation. The alarm systems are electrical and lights to observe the operations also are electrical, but otherwise

the facility is independent of electrical power. A battery operated portable light is available. In the event of electrical failure, all experiments will be stopped and the GIF put in stand-by condition (as if in storage) following the previously outlined procedure.

(C) CAPSULE INCIDENT

There are various ways in which a capsule incident is conceivable.

1. Drop

If a capsule is dropped it would always fall to the bottom of the pool or to the platform or other object above the bottom. Whenever a drop occurs, the capsule will not present a radiation hazard. The corrective procedure is to pick it up with the grappler and place it where it belongs.

2. Jamming in VGI

If this incident occurs a Health Physicist will be called before proceeding.

The VGI is made of aluminum and a capsule could become wedged in it. If this does occur, all other capsules will be removed from the VGI. The capsules are not forced into place so any

jamming should be of a minor degree. The capsule will be pulled up with the VGI held in place until it becomes loose. A sudden release of the capsule cannot occasion a radiation hazard because it could be lifted over four feet before radiation can be detected at the surface.

3. Capsule raised too high in loading VGI

The grappier used to transfer the capsules from their storage container to the VGI is designed with such a length that when the capsule is six inches above the top of the VGI the opposite end of the grappier strikes the ceiling in room 121. The grappier will always be held in a vertical position when used to transfer the capsules. The radiation monitor audible alarm sounds when the level reaches 20 mr/hr. A second person will be at the pool side to observe errors of judgment as to distance and will have a portable survey meter to indicate radiation levels.

4. Lifting VGI with capsule still in irradiator.

Before raising the VGI, the capsules will always be counted in the twelve capsule holders

on the platform. The VGI will be checked for any capsules with light on and off (for Cerenkov effect). When the VGI is raised from the pool, it will be done slowly and the operation will be monitored in the manner described for accidental capsule raising.

5. Sample bottle cannot be removed from the VGI.

The platform has two brackets fastened to it which cover the edges of the VGI. If the bottle becomes jammed so that an upward pull would lift the entire VGI, the brackets will limit the movement to 3 inches.

The procedure that will be followed under these circumstances is to remove the capsules as outlined in Section II. Then the entire VGI can be removed from the pool and the bottle separated from it.

10/16/64

