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Proton Radiography User Manual

Rev 2.3, 2026

Welcome from the pRad Capability Leader

Thank you for proposing experiments using proton radiography at LANSCE. We are looking forward to working with you. This manual serves as an introduction to the pRad Team, its operational environment, and what you can expect throughout your experiment cycle.
Additional information about pRad is available at https://lansce.lanl.gov/facilities/pRad/index.php. We will work closely with you to provide the best experimental data possible.

Please email me or any team member if you need help, have questions, or have suggestions.
Mary Sandstrom

Note: Experiments involving plutonium or other Special Nuclear Materials (SNM) have additional approval steps, documentation, and safety requirements. Users proposing such experiments must consult the Actinide User's Manual and should contact the pRad Capability Leader to obtain the most recent version.

Purpose and Scope

This document describes the processes, requirements, and expectations for users conducting proton radiography (pRad) experiments at LANSCE. It is intended for Principal Investigators (PIs), co-investigators, and supporting experimenters preparing and executing experiments within the pRad capability.

This manual defines user responsibilities, pRad team responsibilities, and required interfaces with LANSCE operations, safety, and engineering organizations. Where conflicts arise, applicable institutional policies and safety basis documents take precedence.

Proposal Process and Annual Scheduling

A call for proposals is released in December. For the 2026 run cycle, submissions due by January 19, 2026. The Proposal Advisory Committee (PAC) will meet in mid-February to review, rank, and select proposals, with notifications sent in March with a final schedule. The run cycle typically begins in the summer and extends through December, as shown in Figure 1.

Three months are allocated to plutonium experiments, and the remaining user experiments are scheduled during the rest of the run cycle. While Pu experiments and other experiments are often scheduled in separate blocks, the order may vary from year to year depending on programmatic priorities.

Early planning and communication with your Point of Contact (POC) is strongly encouraged for all experiments. For the most up-to-date information on deadlines, proposal forms, and guidance, please visit the pRad user website or contact your POC. **Figure 1** below illustrates a typical annual run cycle at pRad, showing proposal deadlines, review periods, and how experiment types are generally scheduled.

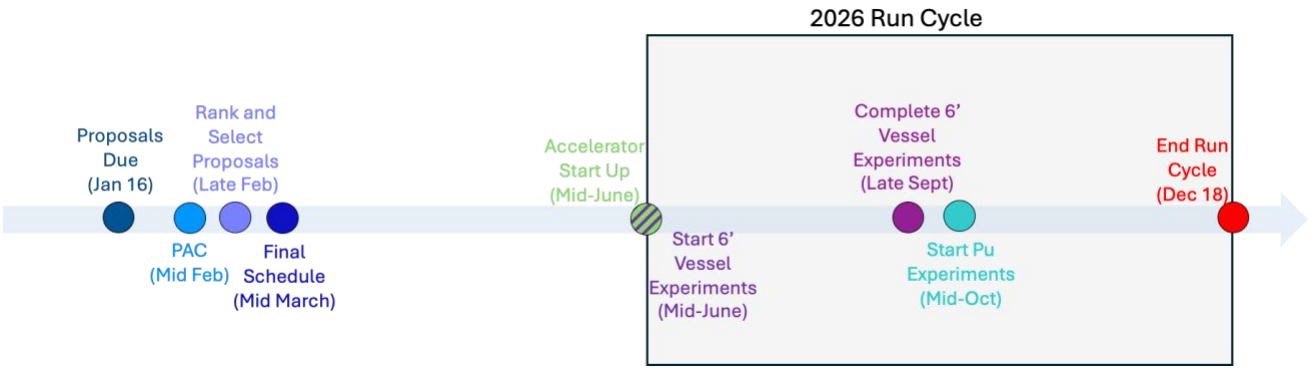

Figure 1. Nominal pRad Run Cycle

Experiment Preparation and Shot Milestones

Before beginning experiment preparation or delivery, it's important to understand the facility's operational and safety framework. pRad operates under an Authorization Basis, which defines the overall limits of facility operations—such as maximum allowable explosives, special nuclear materials (SNM), and configuration types. All experimental work must also align with an associated Integrated Work Document (IWD) that governs the specific safety controls and procedures in place for execution.

To determine whether your experiment falls within these established controls, work closely with your Point of Contact (POC) and relevant subject matter experts (SMEs). If your design exceeds these limits—such as HE mass, SNM quantity, or vessel design—additional internal reviews may be triggered. In some cases, this may involve an Unreviewed Safety Issue Determination (USID) or a formal update to the Authorization Basis. The pRad Team will manage these reviews; please note that reviews can take several months to complete and may affect your eligibility for the current run cycle. Awareness of these potential delays is important during early planning.

Figure 2 outlines the conceptual lifecycle for most high explosive experiments at pRad, from proposal to execution. It includes both user responsibilities and internal steps managed by the pRad Team. Your Point of Contact (POC) will guide you through these phases, coordinate internal reviews, and help ensure that safety and operational requirements are met on time.
While this process applies broadly to most HE experiments, some elements—such as classification, safety screening, or shipping approvals—may vary depending on the specifics of your experiment.

Plutonium and Actinide Experiments

A small number of experiments at pRad each year involve plutonium or other special nuclear materials. These experiments follow the same general lifecycle described in this manual but require additional planning, safety reviews, and coordination steps. Users proposing SNM-based experiments should consult the **Actinide User's Manual** for detailed requirements and engage with their Point of Contact (POC) early in the process. Please contact the pRad Capability Leader to obtain the most recent version of this manual.

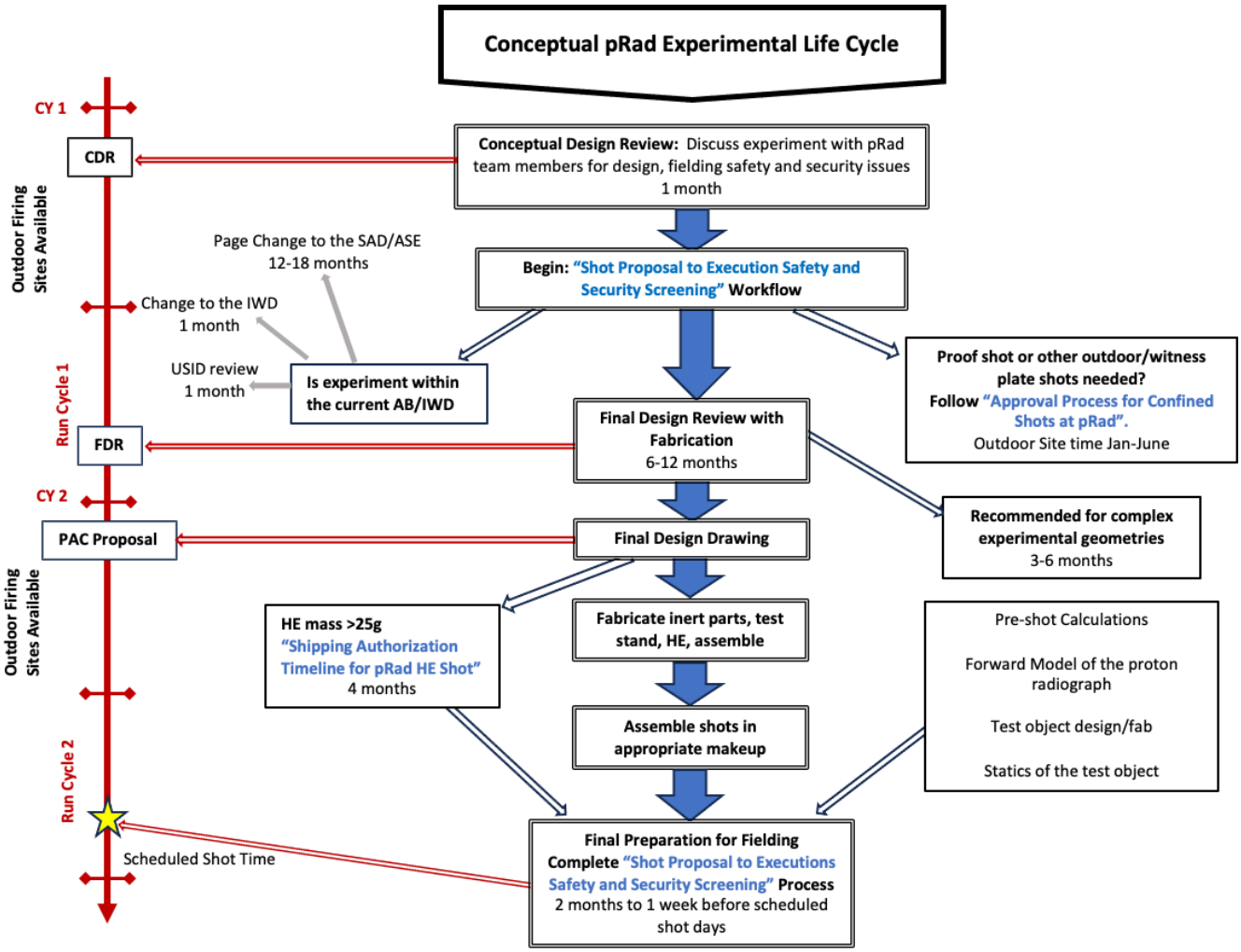

Figure 2. Conceptual pRad Experimental Life Cycle

Key Terms Used in Figure 2

- **CDR – Conceptual Design Review**: An early technical review of the experiment concept, geometry, and feasibility. Typically coordinated between the user, POC, and diagnostics teams.
- **FDR – Final Design Review**: A readiness milestone confirming that all design drawings, diagnostics plans, and interface documents are complete and approved for use.
- **HE PIC – High Explosives Person-in-Charge**: The individual from M-3 responsible for reviewing explosive assemblies and shipping documentation.
- **GY1 / CV1–2**: Internal pRad scheduling and verification milestones used to track fabrication and readiness status. These are tracked by the POC and do not require user action.

These terms are included in Figure 2 and may be referenced in planning discussions. Your POC will help you determine which ones are relevant to your experiment.

Engineering Drawings

Moving high explosives to LANSCE requires special approvals, and engineering drawings are a key part of that process. For most experiments, the High Explosives Person-in-Charge (HE PIC) from M-3 must receive final, released assembly drawings at least two months before the scheduled shot date. Your Point of Contact (POC) will coordinate this review and help determine what's required for your specific design.

To meet Department of Transportation (DOT) and Laboratory shipping requirements, the delivered assembly must exactly match the final approved drawing. Any mismatch between the drawing and the physical hardware may prevent shipment and delay the experiment.

Final drawings must include:

- A drawing title and number
- Signature from a Derivative Classifier (DC), if required
- Independent check and approval from a qualified reviewer
- A complete list of explosive types and masses
- A list of inert materials and masses
- An accurate depiction of the final delivered configuration, including all components (e.g., canisters, pins, probes)

In some cases—such as assemblies with less than 25 grams of HE and standard shipping geometry—reduced documentation requirements may apply. Your POC will coordinate with the M-3 team to determine whether your assembly qualifies for this exception.

If final drawings are not received on time, the pRad Capability Leader may reschedule the shot. If no availability remains in the current run cycle, the experiment may need to be resubmitted in a future proposal cycle.

Shot Assembly & Fiducials

Area C is not a certified explosives assembly area (make-up), so all shots must be fully assembled and inspected offsite before delivery. It is the user's responsibility to coordinate the assembly of their experiment. For users who are unfamiliar with LANL processes or do not have access to qualified assembly resources, M-3 may be available to assist with shot assembly at their designated facilities. If you are considering this option, you must contact M-3 directly to discuss feasibility and scheduling. Support from M-3 is not guaranteed and is subject to their availability. The pRad Team can help direct users to the appropriate contacts but does not coordinate this support.

Although pRad does not perform full shot assembly at Area C, the team can support simple integration tasks, such as installing a detonator or connecting diagnostics, once the experiment arrives on site. These actions are limited to final pre-shot configuration and must be clearly defined by the user in advance. Any work requiring complex assembly, alignment, or rework must be completed prior to delivery. If any components must be assembled on-site at pRad (e.g., due to shipping constraints), users must provide clear written instructions and build criteria in advance. This includes any required markings or visual aids to support correct configuration.

If multiple shots are planned, please number them in priority order for execution (e.g., pRad 1, pRad 2). If your internal shot numbering system differs from your preferred sequence, please provide both for clarity.

pRad does not determine the Conduct of Engineering (CoE) requirements for experimental packages. While the pRad Team will review drawings and verify interfaces, users are responsible for the quality and configuration of the assembled shot, including alignment, tolerances, and functional performance. Any critical inspections or checklists should be performed prior to delivery and included with the package, if applicable.

The pRad Team is responsible for collecting and delivering high-quality diagnostic data—but the value of that data is directly tied to how well the experiment is designed and built. If components are misaligned, improperly assembled, or inconsistent with the intended design, the resulting data may not meet the scientific objectives. Users are strongly encouraged to verify that their package reflects the design intent and measurement goals, and to take full advantage of pre-shot inspection tools and documentation. Even the best diagnostics cannot compensate for a flawed experimental build.

Fiducials are strongly recommended for alignment and verification. Including visual markers for left/right orientation, beam center, and field-of-view edges helps ensure accurate setup and radiographic alignment. Users are responsible for verifying that the assembled experiment matches their specifications. This can be done through pre-shot inspection, photographs taken before the shot enters the vessel, or by reviewing pre-shot radiographs.

Shot Execution & Optimization of Radiography

If you have calculations of your experiment that could be forward-modeled with a proton radiography simulator, please let your POC know. This information can be very helpful in deciding the correct beamline setup and focusing for the features of interest. In lieu of forward modeling, information about the time-dependent densities and materials that you would like to measure is important to convey to the POC. Your POC can also help you determine the shot timing. Shot timing is finalized on the day of the experiment by the EIC with concurrence from the PI.

For multiple experiments in a series, ensure that your POC knows the preferred shot sequence and diagnostics or conditioning for each experiment. Cooling and heating will add significant time to shot execution, usually taking two days total from initial receipt of the experiment to firing. Keep this in mind when prioritizing shots. PDV probes must be ordered in advance, and multiple probes take time to set up. This usually does not pose a significant delay to shot execution if the probe count is ≤ 16, the standard number available at Area C.

What to Expect on Shot Day

Please follow the instructions of your Point of Contact (POC) on shot day. There are restrictions on where personnel may be located, as well as limits on the number of people allowed in specific buildings. Do not expect to bring more than three people to assist or observe on shot day.

The pRad control room is the central location for operational activities. If operational activity requires additional space, personnel who are not directly involved may be asked to leave the control room. They are welcome to wait in Building 898, which is adjacent to the control room.

Cell service at Area C is limited, although a signal can often be found in the parking lot. Wi-Fi is available but has a weak signal in the control room. If you have a LANL computer and are authorized, you may connect to the yellow network using dynamic DHCP. The main phone line for the control room is 505-667-3225. Non-LANL computers may connect to the wired Guest Network; a password can be obtained

from the LANSCE User Office.

Please perform all office or laptop work and make phone calls from Building 898, as non-operational phone calls in the control room can be distracting to ongoing operations.

External Users will have a few steps to complete before accessing the control room:

- ☐ Pick up your badge at the LANL Badge Office, TA 3 Building 261 if you do not already have a DOE Badge.
  External users should consult the LANL Badge Office webpage for the most current badging requirements, hours, and procedures prior to arrival.
- ☐ Pick up dosimetry at the LANSCE Visitor Center, TA 53 Building 1 Lobby or Radiation Protection, TA-53, Building 0003 R-Sector, if you do not already have a TLD and Blueberry Badge and plan on going into the Dome.
- ☐ Coordinate access, training, and visitor requirements through the LANSCE User Office (vsalazar@lanl.gov, 505-667-6797).
- ☐ Complete any required training prior to arrival, as directed by the LANSCE User Office or Training Office.
- ☐ Report to your POC in the Area C parking lot, or an agreed-upon location. Upon arrival, check in with the Experimenter in Charge. You will be given an overview of the area by a team member.

Building 898 has a lunch room with a fridge and microwave, network access, individual male and female restrooms, and a shower. There is only stair access to Building 898; however, accessible ground-floor restrooms are available at Staging Area A.

There is a pRad Beamline Status website at prad-ops.lanl.gov and available on the LANL yellow (internal) network. This lets you know who the EIC is, whether there is HE on site, and where we are in the flow of the workday. Shot setup is usually the longest part of the day. You will be escorted into the Dome to take pre-shot photos of your experiment if it is unclassified and you have a Laboratory approved camera. The pRad Team will also take photos of the shot assembly. The team also has a camera that can take pictures of classified assemblies. All pictures must be taken before the critical lift. This is also the time to inspect your experimental setup and make sure it meets your requirements.

Things for the POC and/or PI to let people know at the POTD meeting:

- The general goals of the experiment and what you want to measure
- Classification and CUI designation and concerns
- Special setup issues with the experiment
- If you would like photos
- Inspection requirements before the shot goes in the vessel
- Any other concerns

Registration and User Agreement

All users who wish to be present for experiments must register with LANSCE. The User Office will contact you by email with instructions for completing the required registration. This registration is mandatory, as it is used to assign your required training.

External users (non-LANL employees) must also have a valid User Agreement in place prior to participation. Depending on the nature of the work, this will be either a Non-Proprietary User Agreement (NPUA) or a Proprietary User Agreement (PUA), established between the user's institution and LANSCE.

Foreign Nationals

If any visitors are not U.S. citizens, a Foreign Visit Request must be submitted and approved before access to LANL can be granted. The User Office will submit the request using the information collected during the online registration process. Approval of Foreign Visit Requests can take up to 60 days from submission, so users should work with the User Office as early as possible. Non-refundable travel arrangements should not be made until the visit has been approved.

Traveling to Los Alamos

Maps and directions to the Lab are at https://www.lanl.gov/resources/maps.php.

Required Training & Dosimetry for Users

Users coming to the Area C who will go into the Line C hallway or Dome require a TLD (Thermo Luminescent Dosimeter) and TED (Track-Etch Dosimeter, a.k.a. Blueberry Badge) that can be picked up at the LANSCE Visitor Desk. Some users may require access when the area is a Limited Area (requiring a security clearance). To have unescorted access to the pRad experimental area, you are required to take online training available via UTrain that can be accessed at the LANSCE training office.

Unescorted Access to Area C Dome	**Training Category**
TA-53 Facility Radiation Protection Requirements (FRPR)	Radiological Safety
General Employee Radiological Training	Radiological Awareness
TA-53 Primary Beam Area Access (PBAA)	Facility-Specific Access Training
LANSCE: Area C Hazard Overview for pRad Ops	Area- and Facility-Specific Access Training
TA-53 Employees/Residents	Facility-Specific Access Training
pRad Required Equipment Review Training	Area- and Facility-Specific Access Training
TA-53, MPF Sectors N and P Building Emergency Plan (available on extrain.lanl.gov)	Area- and Facility-Specific Access Training

If you expect to perform experimental work at Area C, please speak with your technical POC at least 3 months in advance of your shot date, since extensive additional training is required for work on the P-1 pRad IWD. We expect that most users will not be performing hands-on, hazardous work in the experimental area.

Feedback

The pRad Team needs your feedback for continuous improvement, and as an NNSA user facility. So, please complete the user survey after your experiments! You will receive an email from the LANSCE User

Office with the link. You are also welcome to send an email to any of the Team Leaders or the Project Leader with feedback. We will hold your comments in confidence while using them to improve the overall operations and user experience at pRad.