

# Critical Utilities Infrastructure Revitalization

Radiation Safety

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# Beam Operations and Radioactive Hazards

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Specialized high energy machines at SLAC, such as klystrons and accelerators, produce ionizing radiation.

SLAC is committed to keeping radiation doses to the public, workers, and the environment As Low As Reasonably Achievable (ALARA) and far below occupational exposure limits.

The SLAC Radiation Protection department will work with you and the CUIR project to make sure the work can be performed safely by:

- Identifying and characterizing radiological hazards
- Providing radiological training
- Establishing radiological controls for working in and around the Klystron gallery
- Preparing work documents including Radiological Work Permits
- Providing personnel monitoring (personnel and supplemental dosimeters)

# Radiation Protection Department

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**Radiation Protection supports all radiological designs and operations in support of the mission of SLAC**

- Radiation Safety Program development and implementation
- Dosimetry
- Radiological Environmental Protection
- Radiological and Laser Safety Training
- Radiological Work and Dose Control
- Radiation Emergency Preparedness and Response
- Service and Calibration of Radiation Detection Instrumentation
- Decontamination and Decommissioning
- Radioactive Material Management
- Shielding and Safety System Design
- Radiation Transport Code modeling support
- R&D in applied radiation physics in support of the mission of SLAC
- Radioactive Waste Management
- Laser Safety Program development and implementation

← Focus of this presentation

# Outline

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- Radiological Risks when working around the Klystron Gallery
- Radiological Controls
- Radiological Training and Monitoring

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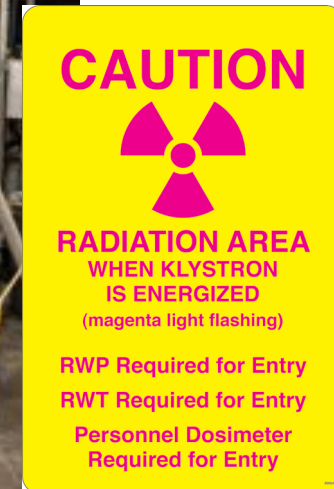
# Radiological Risks when working around the Klystron Gallery

# Klystron Gallery

The Klystron Gallery is posted as a Radiologically Controlled Area (RCA), the areas around the Klystrons and the Klystron Gallery roof are posted as Radiation Areas. Radiological controls (including training) are required to work in these areas.



Klystron Gallery and RCA posting



Klystron Station and Radiation Area posting

# Radiation: Prompt vs. Residual

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Certain machines produce only “prompt” radiation, or radiation that is present when the machine is on and ceases as soon as the machine is shut off.

Higher energy accelerators at SLAC produce ionizing radiation that can activate materials in their vicinity. Radiation due to activation is called “residual” radiation and continues to emit radiation when the machine is off.

For this project, the work may occur during accelerator operations (Beam On) and during down times when the accelerator is off (Beam Off).

- For work during Beam On: both prompt and residual hazards may be present
- For work during Beam Off: only residual hazards are present

# Prompt Sources of Radiation in the Klystron Gallery



**Klystrons**  
Produces prompt X-Rays  
from gaps in shielding



**SLEDs**  
(SLAC Energy Doubler)  
Produces prompt X-Rays



**Penetration Shielding**  
Shielding for penetrations  
Sectors 0 to 10



# Residual Sources of Radiation

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Radioactive material (RAM)  
stored in Sectors 11 to 30



17 potentially radioactive Low Conductivity  
Water (LCW) Systems in the gallery.  
Example: Sector 30 Magnet Resin Bottles

# Occupational Risks in Perspective

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Occupation	Dose (mrem/yr)
Airline flight crew member	300
Nuclear power plant worker	200
Industry and commerce	80
Medical personnel	75
Education and research	72
Government/DOE/Military	60

The radiation doses associated with occupational radiation exposure at SLAC from radiation-generating devices and radioactive materials are very small when compared to those for other occupations.\*

*\*Approximate values based on 2006 recordable doses (NCRP report No. 160)*

*Note: average annual radiation dose from natural occurring and human made sources is 620 mrem/yr*

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# Radiological Controls

# ALARA

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**A**s  
**L**ow  
**A**s  
**R**easonably  
**A**chievable

ALARA is the underlying principle for the radiation protection program for DOE and SLAC. It is not a dose limit but a process that has the objective of attaining doses as far below the applicable limits as is reasonably achievable, taking into account social, technical, economic, practical, and public policy considerations.

# Radiological Controls for Work During Beam On

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- Radiation Area classification for the gallery roof and operating klystrons
- Access to the roof requires Radiological Worker Training (RWT)
- Establish a Routine Area Radiological Work Permit (RWP) for access to klystron gallery roof, sectors 11-30, placed at access points
- Limited access points. Post access points to roof with Radiation Area signs
- Establish a Job Type (RWP) for CUIR project (include cable trays and roof work)
- Establish a daily sign in and out log with names and supplemental dosimeter readings, as part of Job Type RWP
- Monitor and maintain daily and accumulated supplemental dosimeter readings
- Establish a storage location for personnel and supplemental dosimeters (EPDs), where the daily briefings are held
- Zero the EPDs, inspect prior to work for day and log readings (mrem) end of day
- Personnel dosimeters to be stored in a low background location daily

# Radiological Controls for Work During Beam Off

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- Klystron Radiation Areas and roof are de-posted to RCA
- The only occupational exposure is from RAM Storage Areas and LCW System
- GERT Training, Personnel Dosimeter required
- Personnel dosimeters stored in a low background location
- If during downtime or PAMMs, ensure Klystrons are off so no chance of exposure or unexpected Klystron turn on event
- Re-post radiation areas at end of Downtime
- Administrative Controls assurance through project, Area Manager/CM to ensure all personnel are off roof before Klystrons turn on

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# Radiological Training and Monitoring

# Radiological Training requirements

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## Radiological training for GERT Workers:

- ESH Course 115 (1-hour, web-based training)

## Radiological training for Radiological Workers:

- ESH Course 115 (1-hour, web-based training)
- ESH Course 116 (2-hour, web-based training)
- ESH Course 116PRA (1-hour, in person, hands-on practical training)

Radiological training will be provided by SLAC



# Surveys and monitoring

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Radiation Protection performs surveys to characterize the radiation hazards in the Klystron Gallery. Radiological surveys will also be performed in working areas on the Klystron Gallery roof.

Area monitoring dosimeters are also installed in locations along the gallery to estimate exposures to workers during accelerator operations.

# Dosimeters

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Personnel dosimeters will be required for workers who will enter or work around the Klystron Gallery.

In addition to the personnel dosimeter requirement for all workers, EPDs will be required for workers on the roof during accelerator operations.

SLAC will provide storage locations for personnel dosimeters and EPDs.



**Personnel Dosimeter**



**Storage Rack**



**EPD**

*Thank  
You*



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