

License Training Program at Reed College



Stephen Frantz
TRTR 2010

History



Program

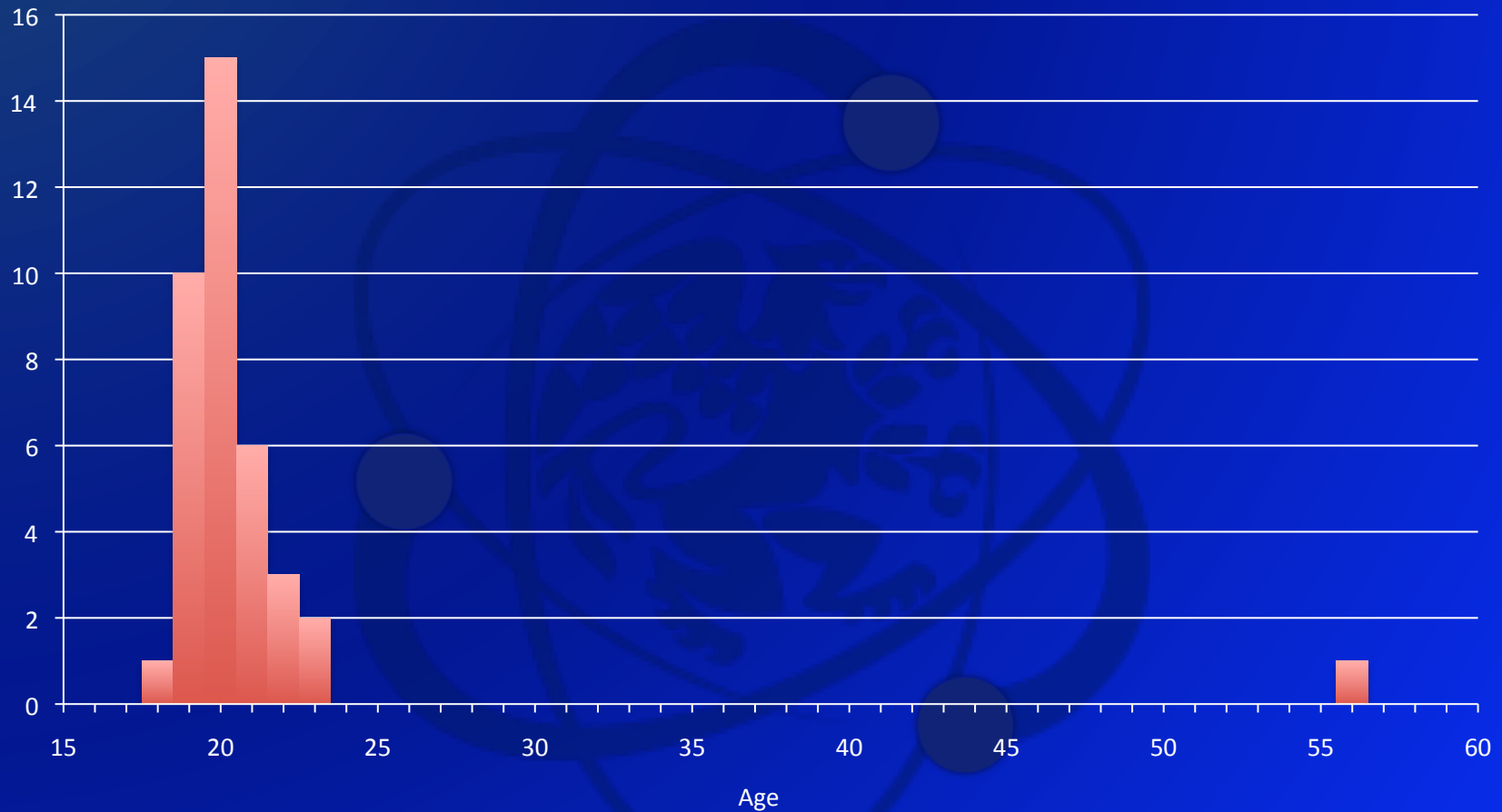


Intangibles

Why License Students?

- To get the work done
- Run primarily by undergraduate students
- Not tied to any academic program
- Training is voluntary extracurricular activity
- Does not show up on their transcript
- Only get paid after they earn a license

Age Distribution

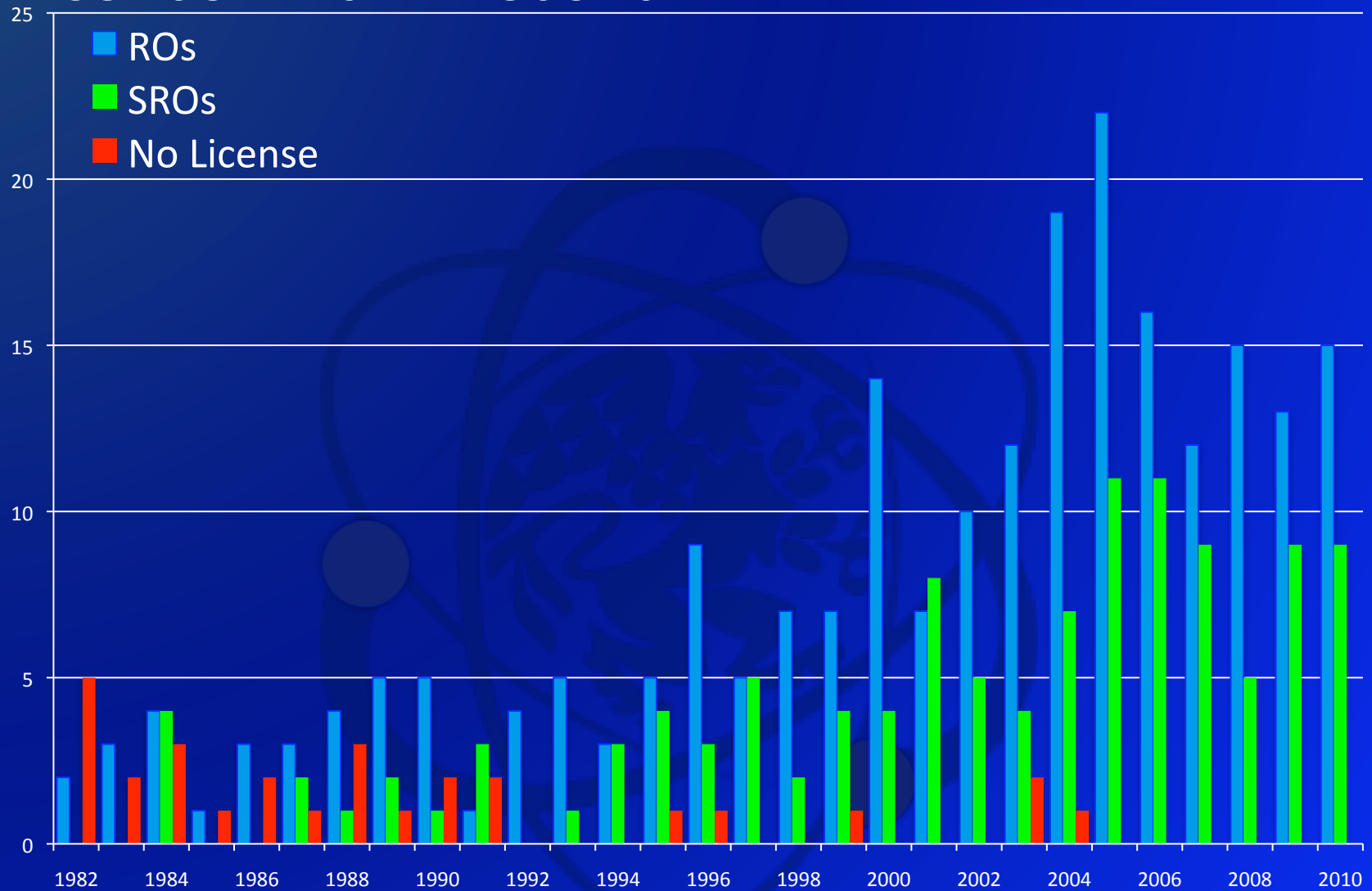


Zero engineering experience
Often start under 18

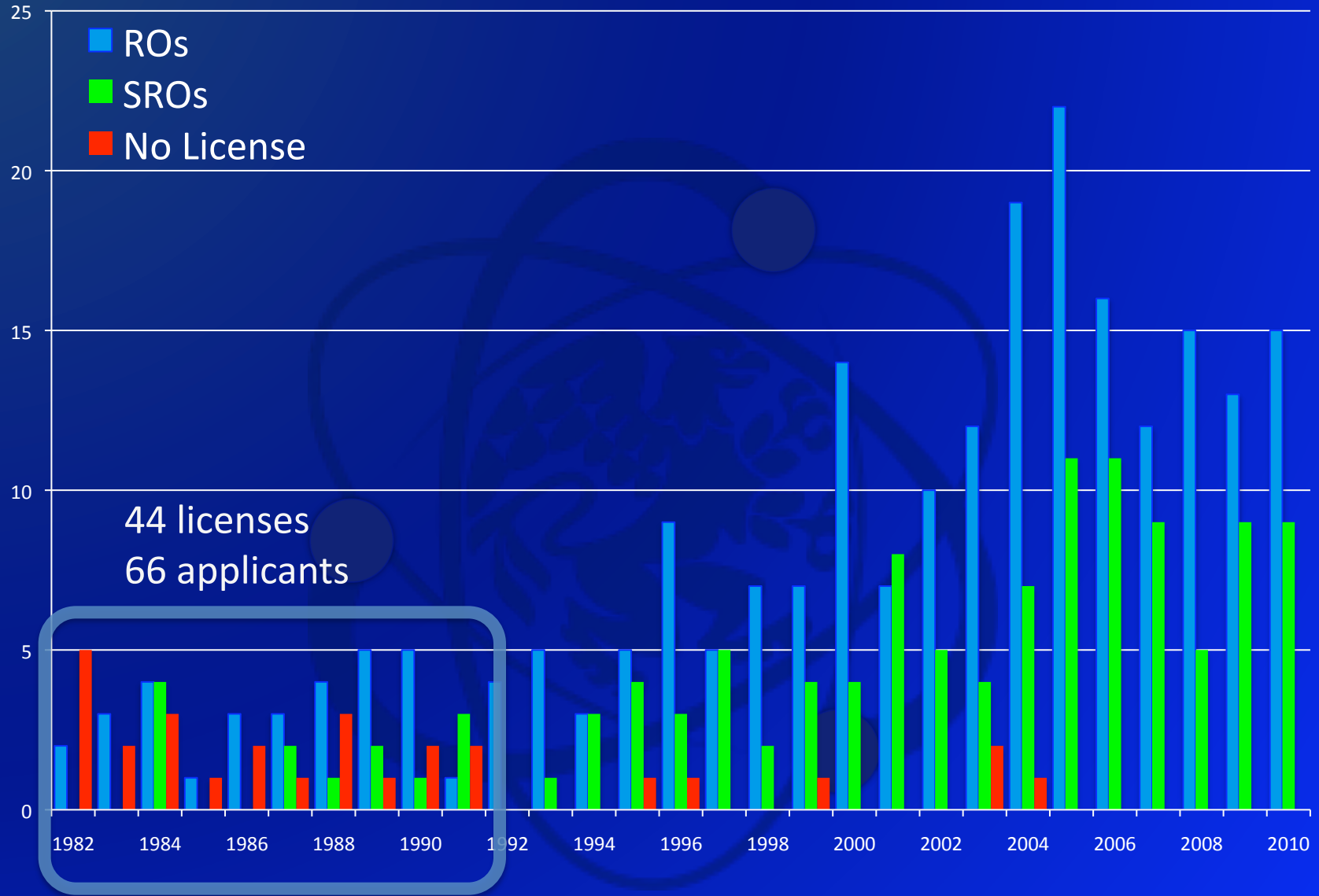
Majors

- Physics
- Mathematics
- Chemistry
- Biology
- Bio-Chem
- Chem-Physics
- Physics-Psychology
- Nuclear Engineering
- Studio Arts
- Classics
- Art History
- Linguistics
- English
- Religion
- Philosophy

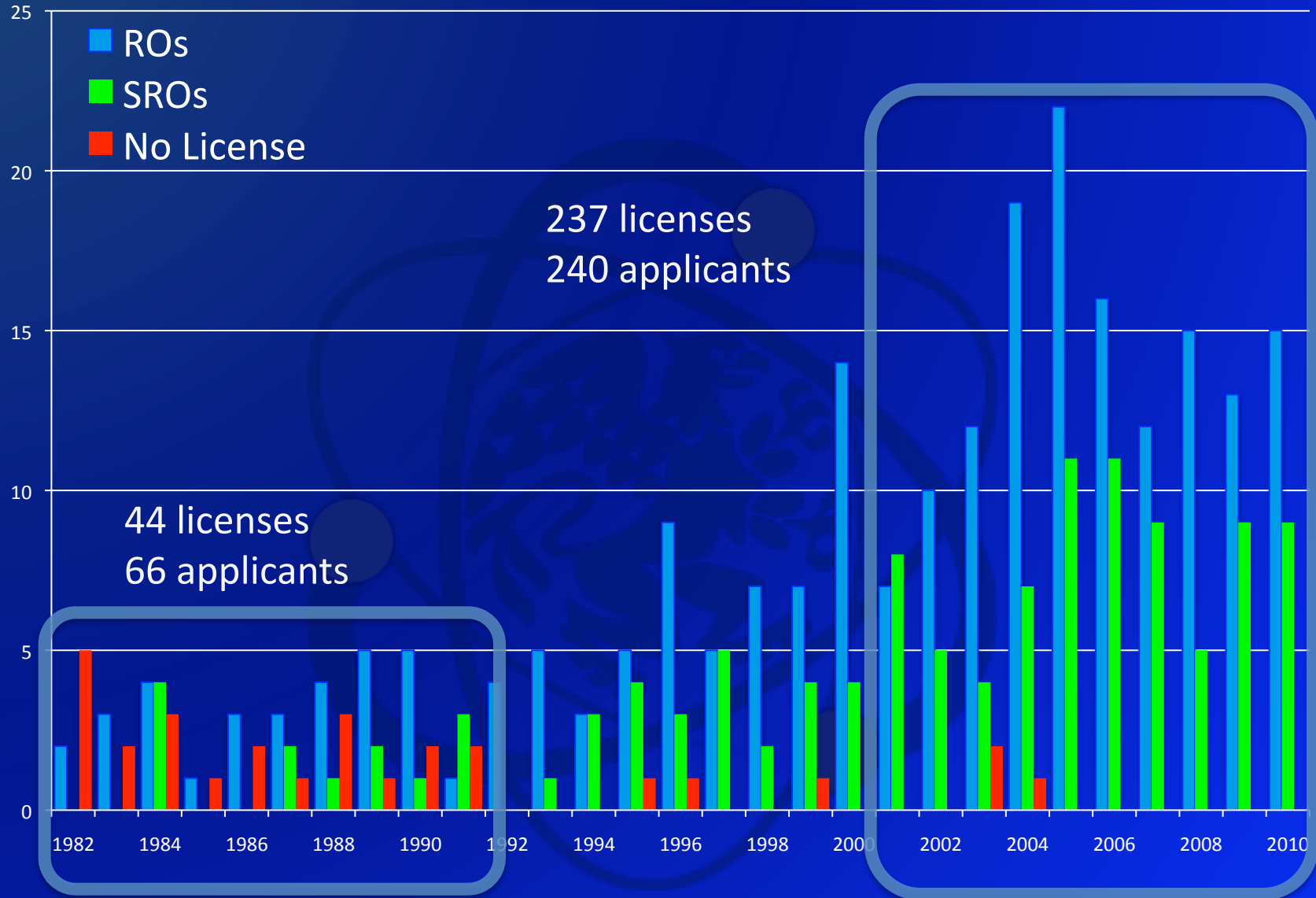
License Exam Results



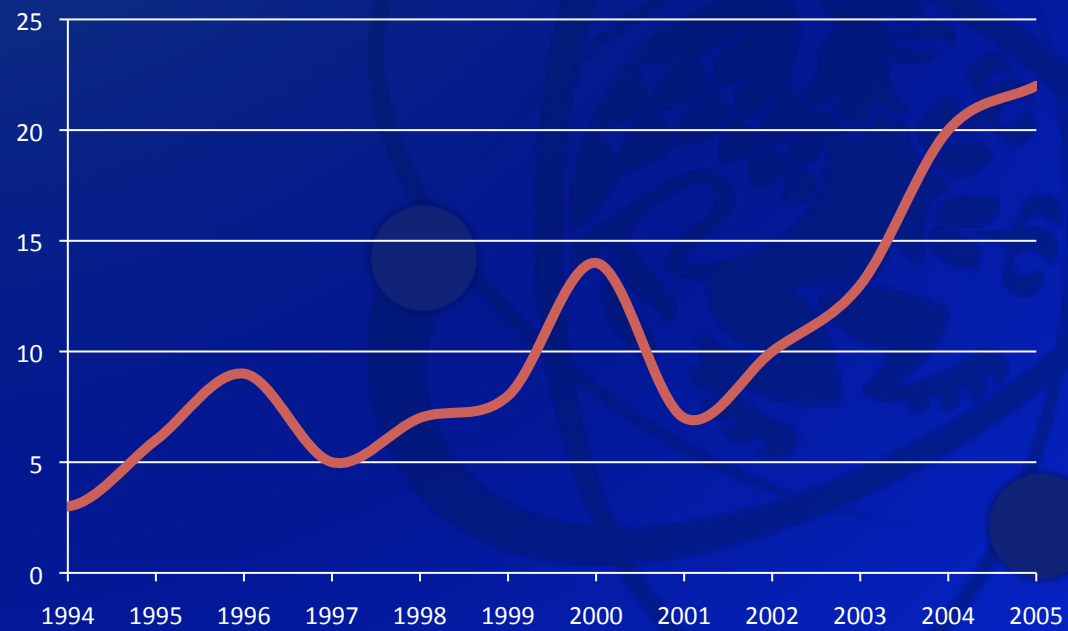
License Exam Results

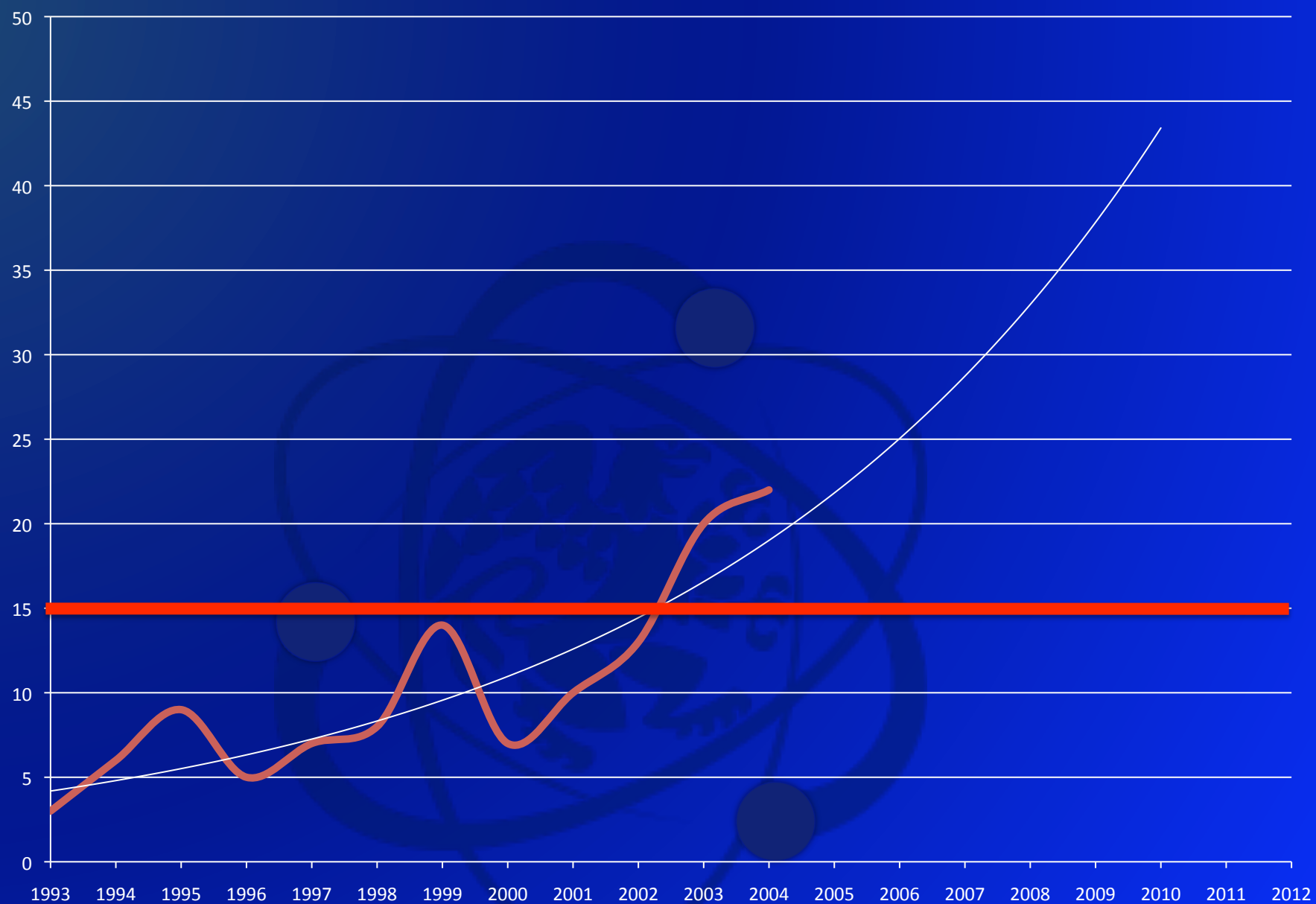


License Exam Results

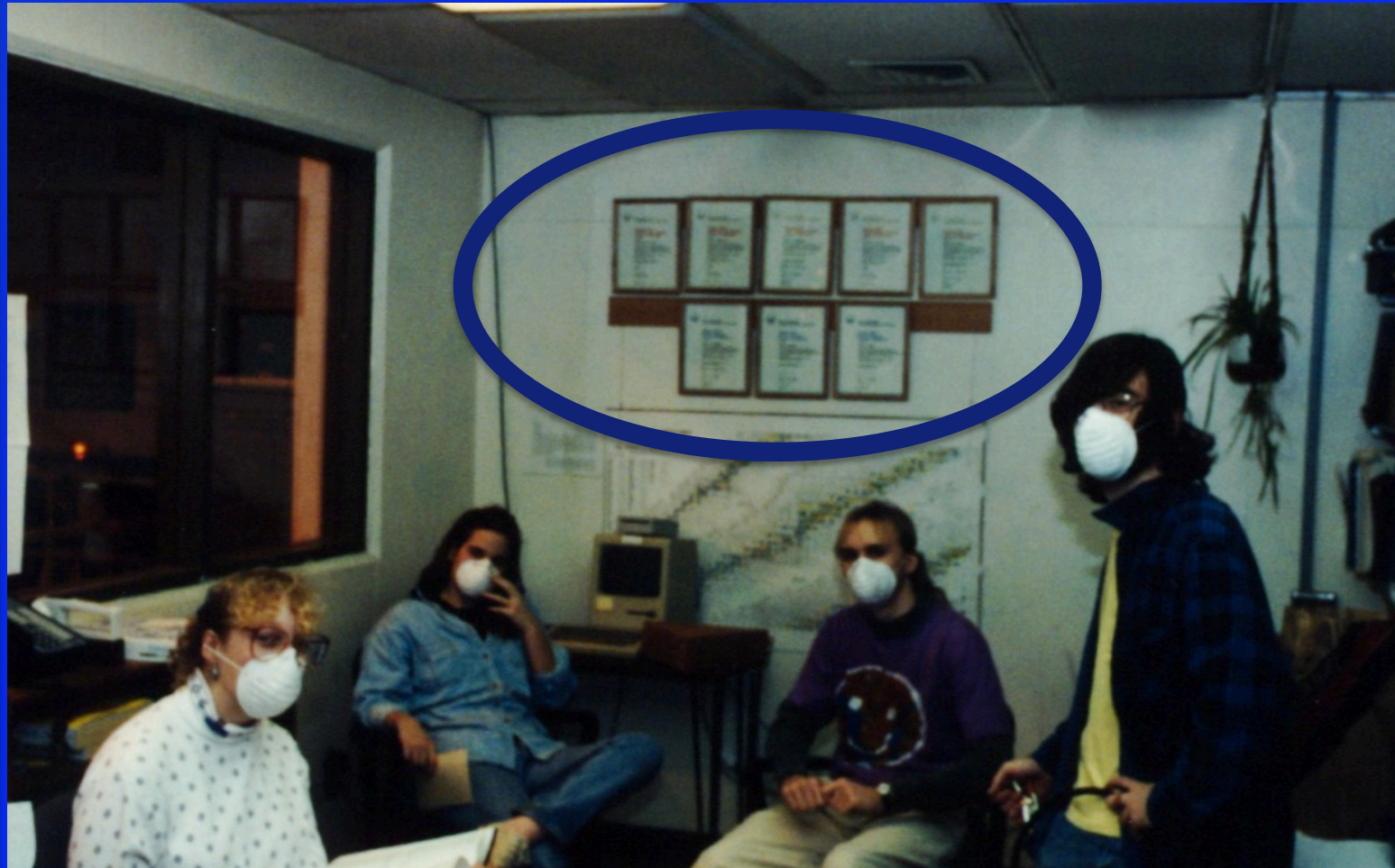


RO Applicants

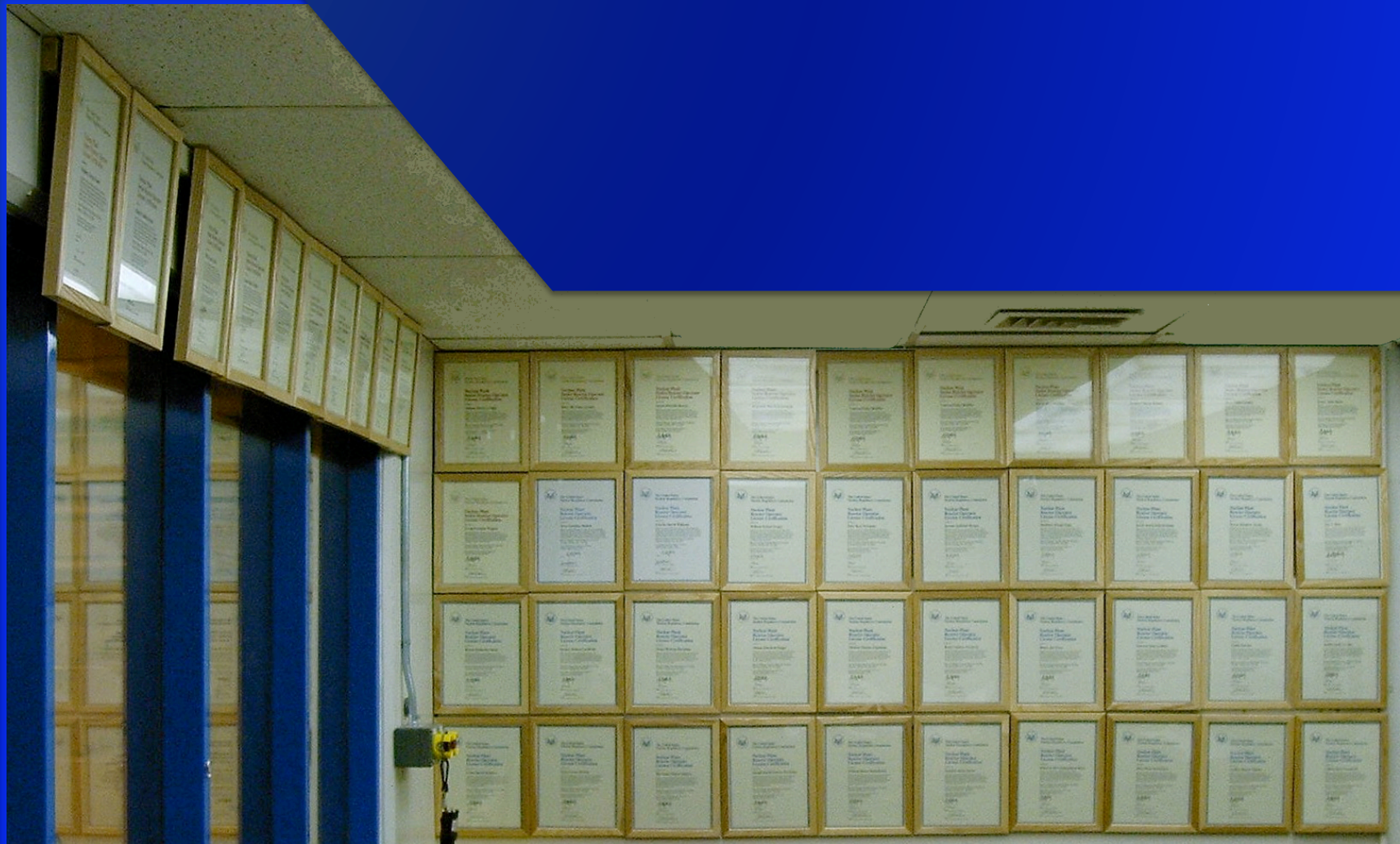




1993



2007





So what the the training
program look like?

Training Program

- Lectures
- Labs
- Training Manual
- Mentors
- Checkoffs
- Operations
- Paideia
- Walkthrough exams
- Written exams
- Online written exams

Grab the Freshmen!

REACTOR

It will keep you going



Join the Program!

- Irradiate Something
- Operate the Reactor
- Meet People
- Get Involved
- Learn Science
- Apply to be an Operator

For more information email solbrigm@reed.edu

Informational Meeting
Tuesday Sept. 7
7:30 pm
Psyc 105

REACTOR:

Splitting the atom
on a daily basis

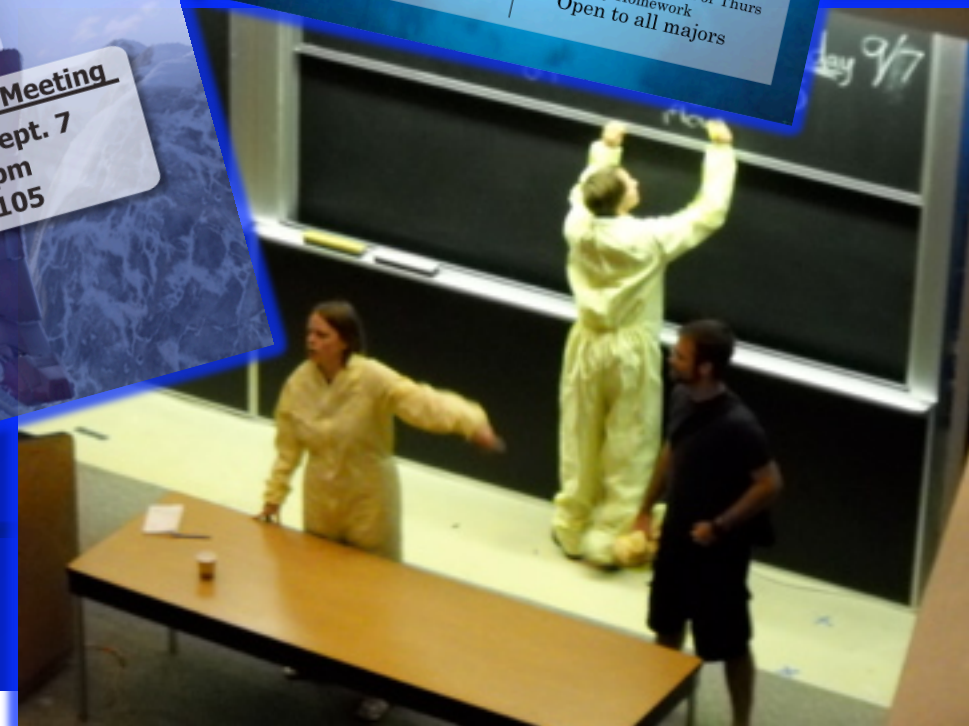
- ~Want to learn about the reactor?
- ~Considering applying to be an operator?
- ~Is your name Steve?
- ~Just want to see what it's like?

Come to the informational meeting:

Tuesday Sept. 7, 7:30 pm
Psyc 105

For more information contact:
Kathleen Conahan: conahaka@reed.edu
Mary Solbrig: solbrigm@reed.edu

Regular Commitment:
Lectures: 7:30 pm Mon
Labs: 7:30 pm Wed or Thurs
Weekly Homework
Open to all majors



Lectures

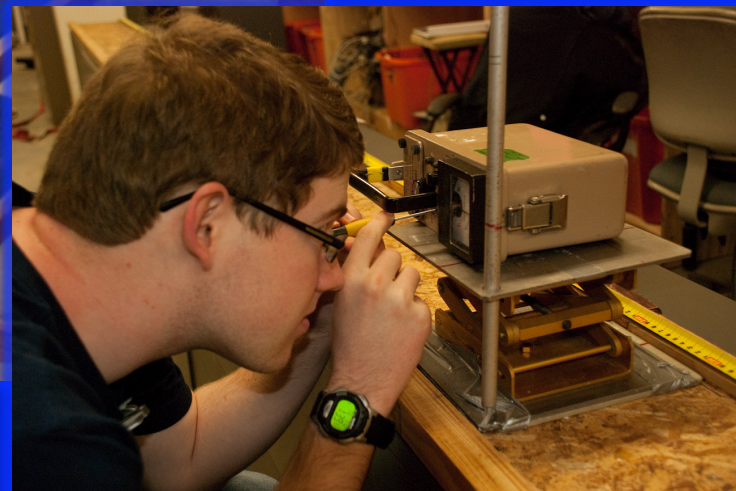
- Power Point
- Topic Matrix
- Homework



Labs



- Theory
- Operating
- 2 Labs



Training Manual



Training Manual Reed Research Reactor

September 2010

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Chapter 6. Neutron Activation Analysis

Figure 6.10 The smaller the crystal, the more likely an annihilation photon is to escape, making this effect dependant upon the size and shape of the germanium crystal.

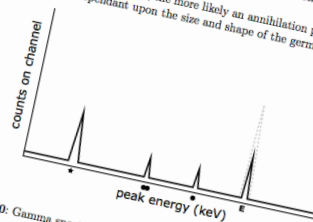


Figure 6.10: Gamma spectrum due to pair production in the detector and shield.

In figure 6.10 the spectrum shows not only single and double escape peaks, but also a large peak at 511 keV, marked (★). This is produced when pair production occurs not in the detector but in the lead shielding surrounding the detector. In analysis, this peak is usually ignored. These two locations for positron annihilation are illustrated in figure 6.11.

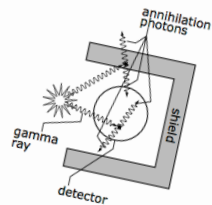


Figure 6.11: Locations of positron annihilation in a gamma-ray detector and its shield.

When the positron produced by pair production in the shield annihilates, two 511 keV photons are produced in the shield. One of these photons can make it into the

145

10.1. Core Excess and Shutdown Margin

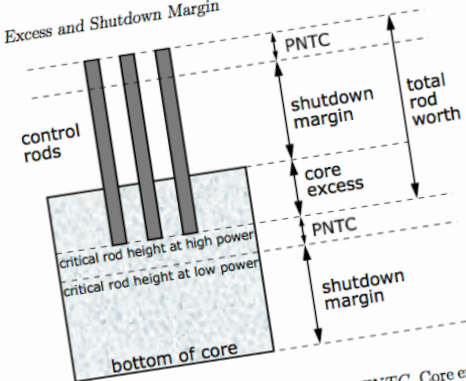


Figure 10.2: Core excess and shutdown margin with PNTC. Core excess is the worth of the rods still in the core; shutdown margin is the worth of the rods out of the core minus PNTC. PNTC decreases the core excess but does not change the shutdown margin.

to add positive \$1.68 reactivity to compensate. On a reactor scram, the rods will fall in and insert negative \$8.75, but temperature defect will disappear and add a positive \$1.68 reactivity. The shutdown margin will still be \$8.75 - \$1.68 = \$7.07, the same as example 10.1. PNTC does not change the shutdown margin.

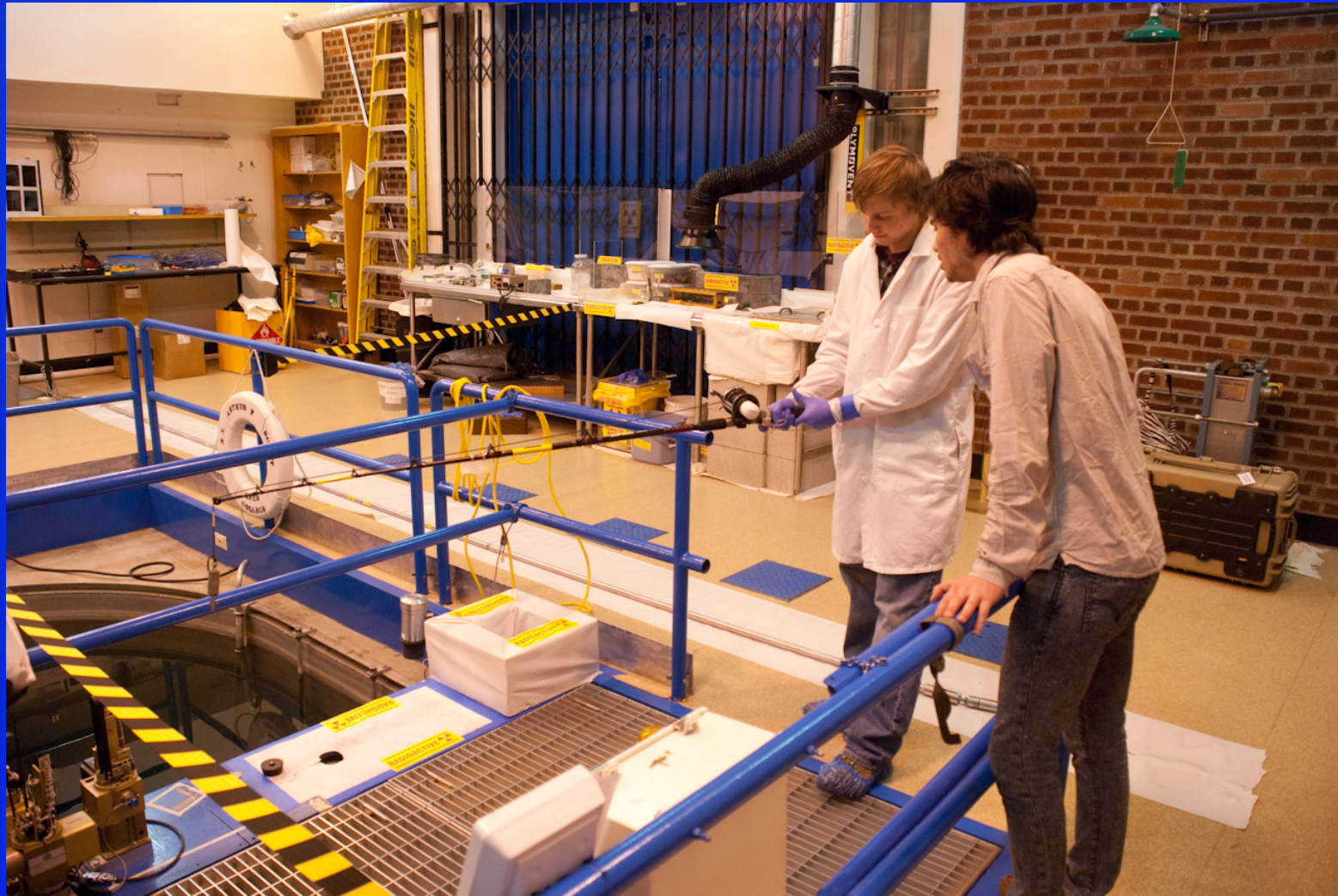
If, however, core reactivity changes in a manner that does not automatically "reset" during a shutdown, this will affect the shutdown margin. This can be accomplished by fission product poisons such as xenon (explained later in this chapter), fuel burn-up, loading experiments, etc. In that case, the negative reactivity is not automatically removed during a shutdown when the rods are inserted and power decreases. Thus these effects will increase the shutdown margin and decrease the core excess as shown in figure 10.3.

A very useful equation to relate core excess, shutdown margin, PNTC, and total rod worth (TRW) is

$$TRW = k_{ex} + SDM + PNTC \quad (10.5)$$

Equation (10.5) tells us that the total worth of the control rods will either be in the core to control k_{ex} or withdrawn enough to bring the reactor critical (SDM), or withdrawn a little more to compensate for PNTC. In equation (10.5), the TRW is known from our semiannual measurements and does not change on a regular basis, k_{ex} is measured as the worth of the control rods still in the core, PNTC can be estimated

Mentor Program



Checkoffs

- Clear Guidelines
- Strict Deadlines

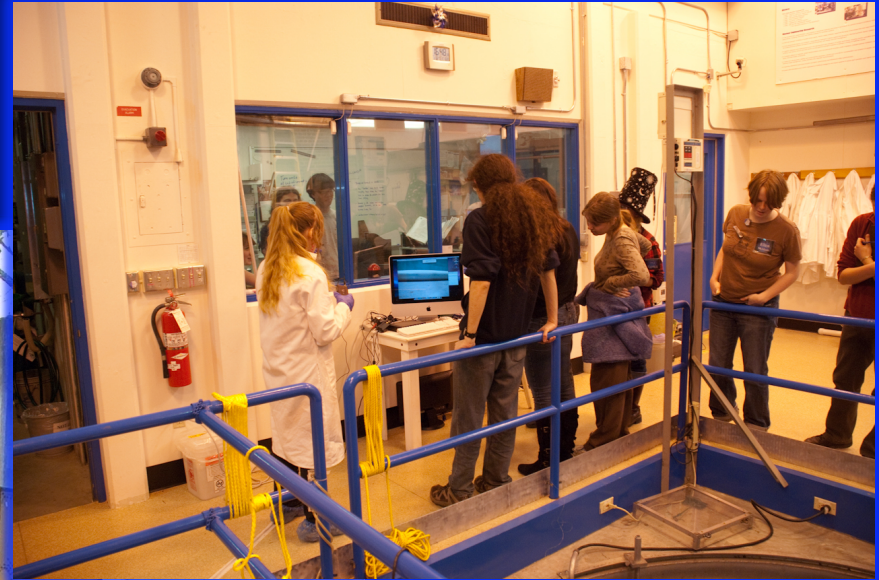


Going to the reactor

Initiative



Paideia



Walkthroughs



- One hour, Weekly
- Theory, System, Procedures, Emergency

Written Exams

- Weekly
- $\geq 80\%$

1. The return water from the primary coolant system is ejected from an angled nozzle, which causes a swirling motion in the pool. Which one of the following is the primary purpose for this design?
 - a. Increase the heat transfer rate due to increase convective flow.
 - b. Decrease the activation rate of O-16 to N-16 due to decrease time in the core.
 - c. Increase the transport time for N-16 to reach the surface of the pool.
 - d. Break up O-16.
2. Which of the following statements best describes how a proportional counter functions?
 - a. Some of the ions from primary ionization are collected. No secondary ionizations take place.
 - b. All of the ions from primary ionization are collected. No secondary ionizations take place.
 - c. All of the ions from primary ionization along with some ions from secondary ionization are collected.
 - d. So many secondary ions are produced that the number of ions collected is the same for any initial ionizing event.
3. Prior to performing the Startup Checklist, how far back is the reactor operator required to review the Main Logbook?
 - a. 8 hours.
 - b. 48 hours or to the last log entry for that operator whichever occurs first.
 - c. 7 days or until the last log entry for that operator whichever occurs first.
 - d. 30 days or to the last log entry for that operator whichever occurs first.
4. During the weekly checks of the primary coolant system, you obtain a conductivity reading of 3.0 micromho/cm. The primary system had been operating for 15 minutes prior to taking the reading. Which one of the following actions should you perform next?
 - a. Allow the primary system to operate for another 30 minutes, then take another reading.
 - b. Allow the primary system to operate for another 60 minutes, then take another reading.
 - c. Inform the supervisor; make preparations to replace the primary filters.
 - d. Inform the supervisor; make preparations to change the resin in the demineralizers.
5. Which ONE of the following is the absolute MAXIMUM STEADY-STATE power level allowed by TECHNICAL SPECIFICATIONS?
 - a. 230 Kilowatts
 - b. 250 Kilowatts

Online Exams

Random

IRIS
IRIS Home - Departments - Directories - Resources - Personal Info

Reactor Home
Accounts
Checkoffs
Certifications
Event History
Exam Bank
Requalifications
Event Management
Job Management
Certificate Management
Checkoff Management
Exam Management
Requal Management
Reactor Website

Reactor Test

Section A

1. Which one of the following describes "Excess Reactivity"? Excess reactivity is:

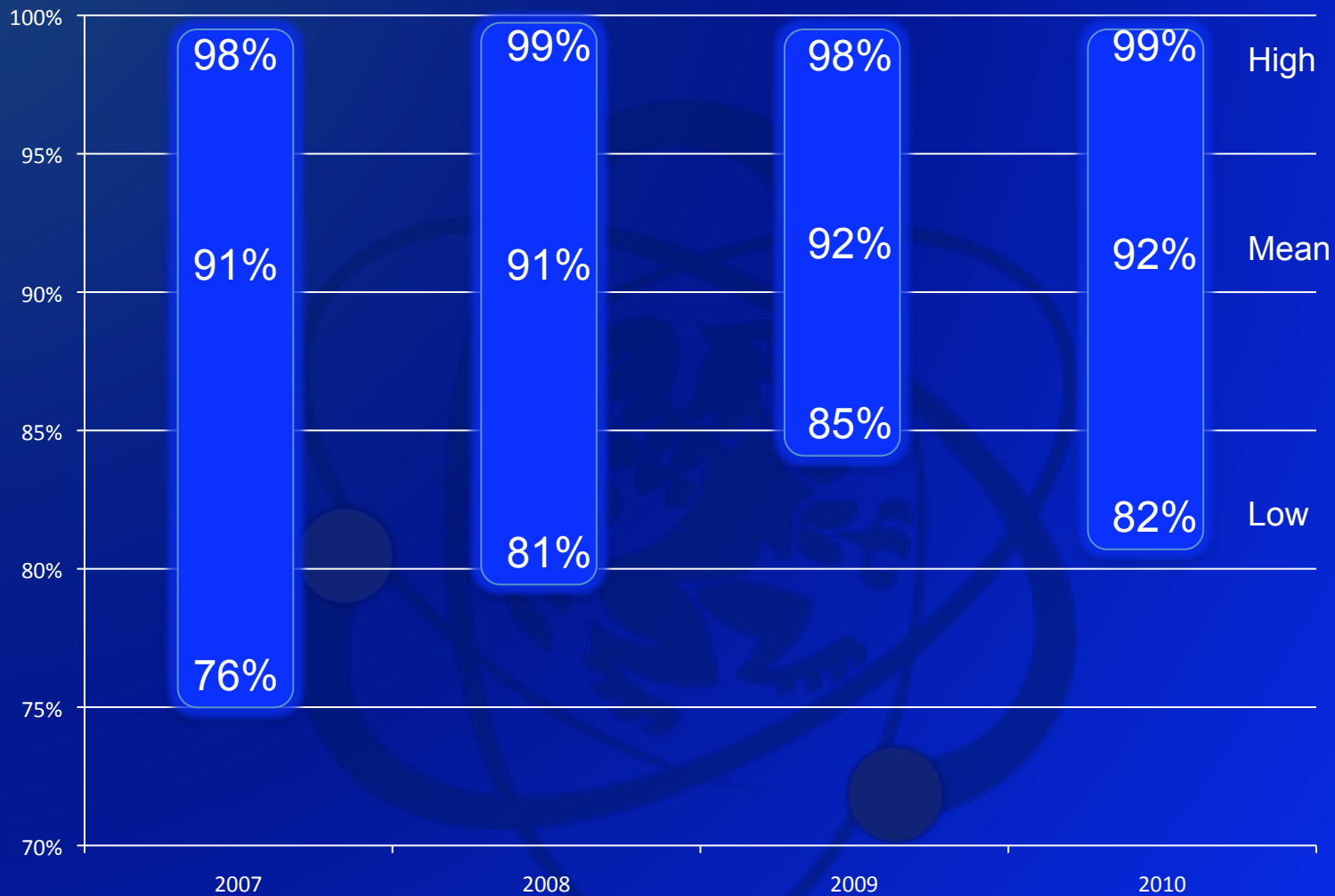
- ☐ A. the maximum reactivity by which the reactor can be shutdown with one control rod fully withdrawn
- ☐ B. a measure of the additional fuel loaded to overcome fission product poisoning.
- ☐ C. a measure of remaining control rod worth with the reactor exactly critical.
- ☐ D. the combined control rod negative reactivity worth required to keep the reactor shutdown.

2. Which one of the following statements concerning reactivity values of equilibrium (at power) xenon and peak (after shutdown) xenon is correct? Equilibrium xenon is _____ of power level; peak xenon is _____ of power

☐ A. INDEPENDENT INDEPENDENT
☐ B. INDEPENDENT DEPENDENT
☐ C. DEPENDENT INDEPENDENT
☐ D. DEPENDENT DEPENDENT

operating for 3 weeks at 230 kW, when a loss of cooling

NRC Written Scores



Intangibles

- Culture
- Community
- Student run program





Welcome to



Reed College

Take a tour of the Reactor

Come to Seminar Lectures

Attend Labs Regularly

Training Manual \$15 - Cheap

Start Getting Checkoffs

Read some Documentation

Read your Training Manual

Come to the Reactor to Help Out

Fall Break

Earn Your "B" Key

Keep Reading Documentation

Work on Checkoffs

Get some Δ's

Earn Entry List "A" Status

Winter Break

Get Housing

Participate in E-Drill

1/2 of all Checkoffs Done?

Pass Radioactive Materials Handling Exam

Get a Reactor Mentor

FULL DISCLOSURE MEETING

Take Practice NRC Exams

Do Practice Walk-Throughs with Stephen

Physical Examination

Submit your License Application Information

Have All Checkoffs Done!

Make Decision

MAR. 15

Sign Your License Application

?

CRAM

Renn Payne

NRC Exam

Fail a Part

Decide

Retake a Part

NRC Exam

Pass 3 sections and Walk-Through

Pass 3 sections and Walk-Through

MAY 1



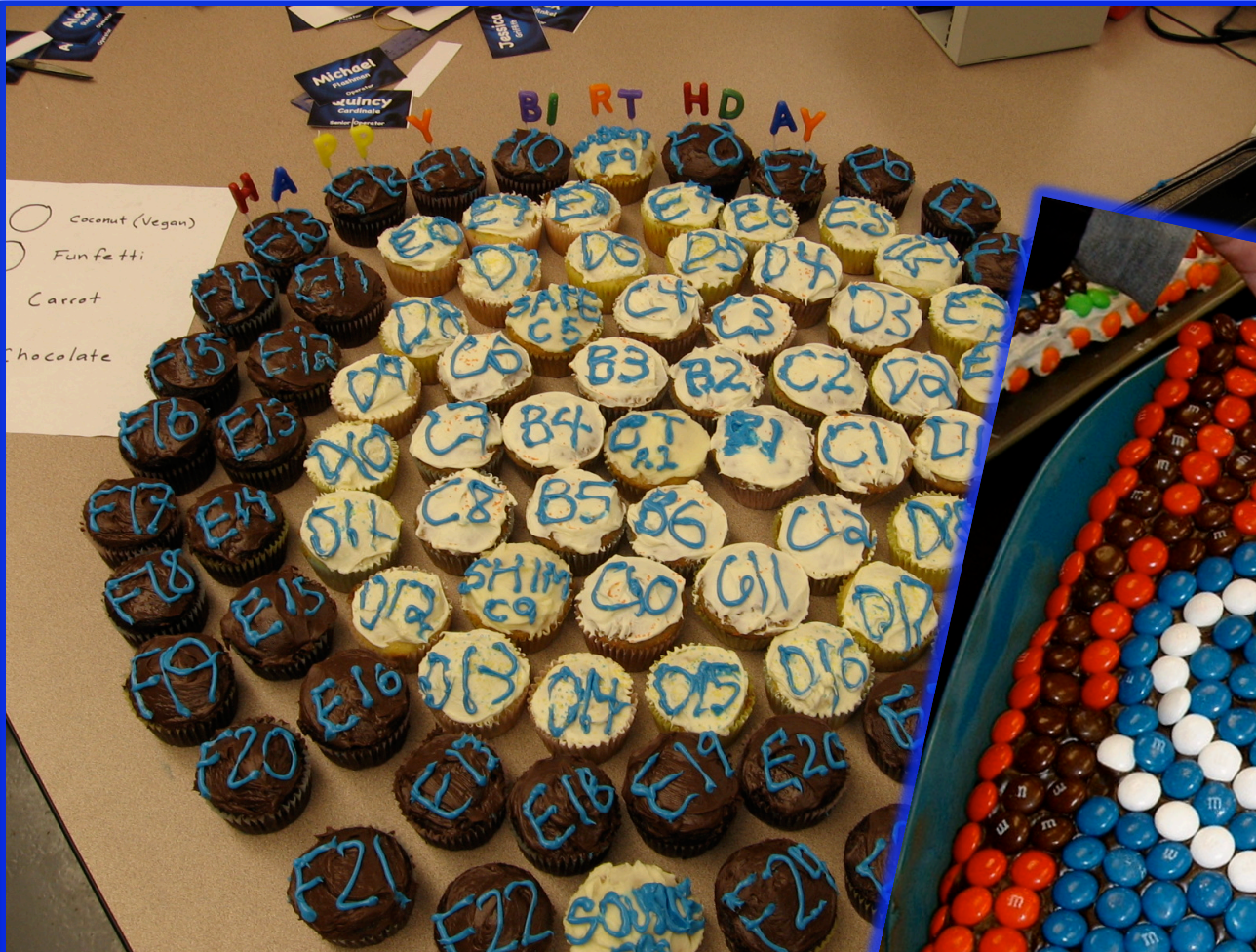
The Path to an Operator's License

Congratulations!

You are now Licensed to Operate the Reed College Reactor




Palda Maintenance Weeks







What Works

- Online Exam Bank
 - Weekly Walkthrough
 - Checkoffs
 - Individual Motivation
 - Very High Standards
- 
- A faint, dark blue watermark is visible in the background. It consists of a circular crest or seal on the left, featuring a lion and some text, and a series of overlapping elliptical orbits on the right, with small dark circles at their intersections, resembling a diagram of atomic orbits or a celestial system.

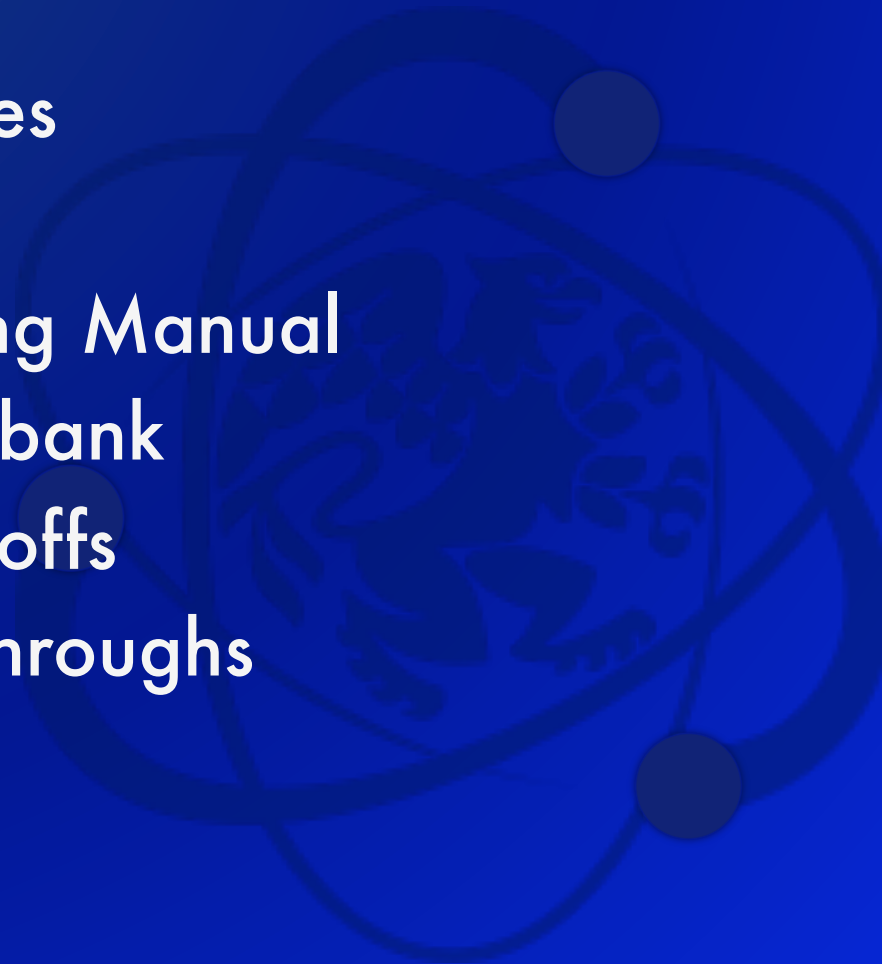
Not So Good

- Mentor Program
- Selection Process



Is it Transferable?

- Yes:
 - Lectures
 - Labs
 - Training Manual
 - Exam bank
 - Checkoffs
 - Walkthroughs
- But...



Intangibles

- The culture and community have taken years to develop.
- Students run the training program and do all the operating.
- Operators and Trainees make up 5% of the student body. Critical mass?
- Is this transferrable?

Continuity

- In July 2011 the Director will retire and Associate Director goes to grad school.
- A student run program may ensure some continuity, but without consistent staff oversight it may take a bump.
- We'll see...

Questions

