APPLICATION FOR NEW LICENSE
SPECIAL NUCLEAR MATERIALS

Submitted to
Director, Fuel Facility Licensing Directorate Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

by

Office of Radiation and Nuclear Safety
Rensselaer Polytechnic Institute
110 8th Street
Troy, NY 12180-3590

Revision 3
March 27, 2012

1) 10 CFR 70.22(a)(1) Name of Applicant

Office of Radiation and Nuclear Safety
Rensselaer Polytechnic Institute
110 8th Street
Troy, NY 12180-3590

Peter F. Caracappa, Ph.D., CHP
Radiation Safety Officer
NES 1-19
US Citizen

Yaron Danon, Ph.D.
Director, Linear Accelerator Laboratory
NES 1-9
Citizen of Israel

Curtis Powell, SHRM
Vice-President, Division of Human Resources
Gurley Building
21 Union Street
Troy, NY 12180
US Citizen

David V. Rosowsky, Ph.D.. P.E., F. ASCE
Dean, School of Engineering
JEC 3018
US Citizen

2) 10 CFR 70.22(a)(2) Activity and location for which Special Nuclear Material License is requested

Rensselaer Polytechnic Institute is requesting permission to possess a total of 64 SPERT F-1 fuel pins containing uranium enriched to 4.81 weight percent U-235, each containing 35.2 grams U-235, at its Linear Accelerator facility on its campus for the purpose of demonstrating methods to assay spent nuclear fuel for fissile material inventory.

RPI possesses and uses Special Nuclear Material for a variety of teaching and research purposes under License #1035 from the New York State Department of Health. The Special Nuclear Material inventory consists mainly of Plutonium-Beryllium sources that are used to produce neutrons and uranium enriched in U-235 used for nuclear cross-section measurements. RPI is requesting that all special nuclear material possessed at the RPI LINAC be transferred to this newly requested SNM license.

RPI also possesses and uses Special Nuclear Material in the form of SPERT F-1 fuel pins at the

Walthousen Laboratory, which is a licensed critical assembly operating under NRC license CX-22. The material covered under this license request will be obtained through transfer of excess unused fuel pins from the CX-22 license to this newly requested SNM license.

The LINAC Laboratory facility is physically located at
3021 Tibbets Ave,
Troy, NY 12180.

A diagram of the facility location and floor plan is included in Appendix A. The primary location for storage of the special nuclear materials when not in use will be in the location labeled “Hot Cell”, and the material will be used in the Lead Slowing Down Spectrometer, in the area labeled “Target Room.” Two PuBe sources associated with this license may be used in other experimental areas within the boundaries of the facility as required.

3) 10 CFR 70.22 (a)(3) Requested duration of license is for <u>10 years</u>.

4) 10 CFR 70.22(a)(4) Description of Special Nuclear Material

A. Description of Material

1) The material requested under this license consists of 64 SPERT (F-1) fuel pins qualified by the DOE (EGG-NTA-766, R. R. Hobbins) for use in a non-power reactor assembly. Each fuel pin is made up of sintered UO_2 pellets, encased in a stainless steel tube, capped on both ends with a stainless steel cap and held in place with a chromium-nickel spring. An aluminum oxide (Al_2O_3) insulator between the fuel pellets and stainless steel caps on each end of the rod is installed. Gas gaps to accommodate fuel expansion are also provided at both the upper end and around the fuel pellets. Figure 1 depicts a single fuel pin and its pertinent dimensions. Tables 1 through 3 provide detailed compositions of the fuel pins.

2) Two PuBe sources currently possessed under NYSDOH License #1035 will be transferred to this license:
   - Source #MRC-330 (50g element/47g isotope)
   - Source #963-S-55 (96g element/91g isotopes)

   Both items consist of a plutonium-beryllium matrix in doubly encapsulated steel

3) A set of 195 uranium metal disks and a 12 in^2 metal foil, enriched in U-235 (64g element/60g isotope).

Table 1: Measurements and Specifications for SPERT (F-1) Fuel

	Argonne Requalification Data	Phillips Idaho Specifications
Clad OD (in.)	0.4656±0.0007	0.463-0.468
Clad ID (in.)		0.4255-0.4265
Clad Length (in.)	41 5/8	
Weld regions OD (in.)	0.4726±0.0015	0.463-0.468
Fill gas	He + H_2, 0.6 - 3.3 psig	He, 1 psig
UO_y density (g/cm^3), ρ	10.078±0.0037	>9.97 g/cm^3 mean ±0.10 g/cm^3
UO_y diameter (in.)	0.4200±0.001	0.4025-0.4195
UO_y stack length (in.)	35.982±0.01	35.938-36.062
UO_y composition		
w/o U233	0.0003±0.0005	
w/o U234	0.0253±0.0005	
w/o U235	4.8074±0.001	2-5
w/o U236	0.0468±0.0005	
w/o U238	95.1202±0.002	
w/o U in oxide, W	87.916±0.018	
[illegible]	2.041±0.003	2.00-2.02
Ca (ppmw)	38±(3-10%)	<100
Cr (ppmw)	13±(3-10%)	<500
Fe (ppmw)	66±(3-10%)	<1200
Mg (ppmw)	10±(3-10%)	<20
Ni (ppmw)	10±(3-10%)	<300
Impurity $\Sigma_{athermal}$ (cm-1)	0.00006 (calculated)	<0.0010
SS304 Composition		
w/o Co	0.084±(3-10%)	<0.05
w/o Cr	18.60±(1-5%)	ASTM A-269-62T
w/o Cu	0.17±(1-5%)	<0.50
w/o Fe	68.9±(1-5%)	ASTM A-269-62T
w/o Mu	1.06±(1-5%)	ASTM A-269-62T
w/o Mo	0.20±(1-5%)	0.50
w/o Ni	9.56±(1-5%)	ASTM A-269-62T
w/o B	-----	<0.005

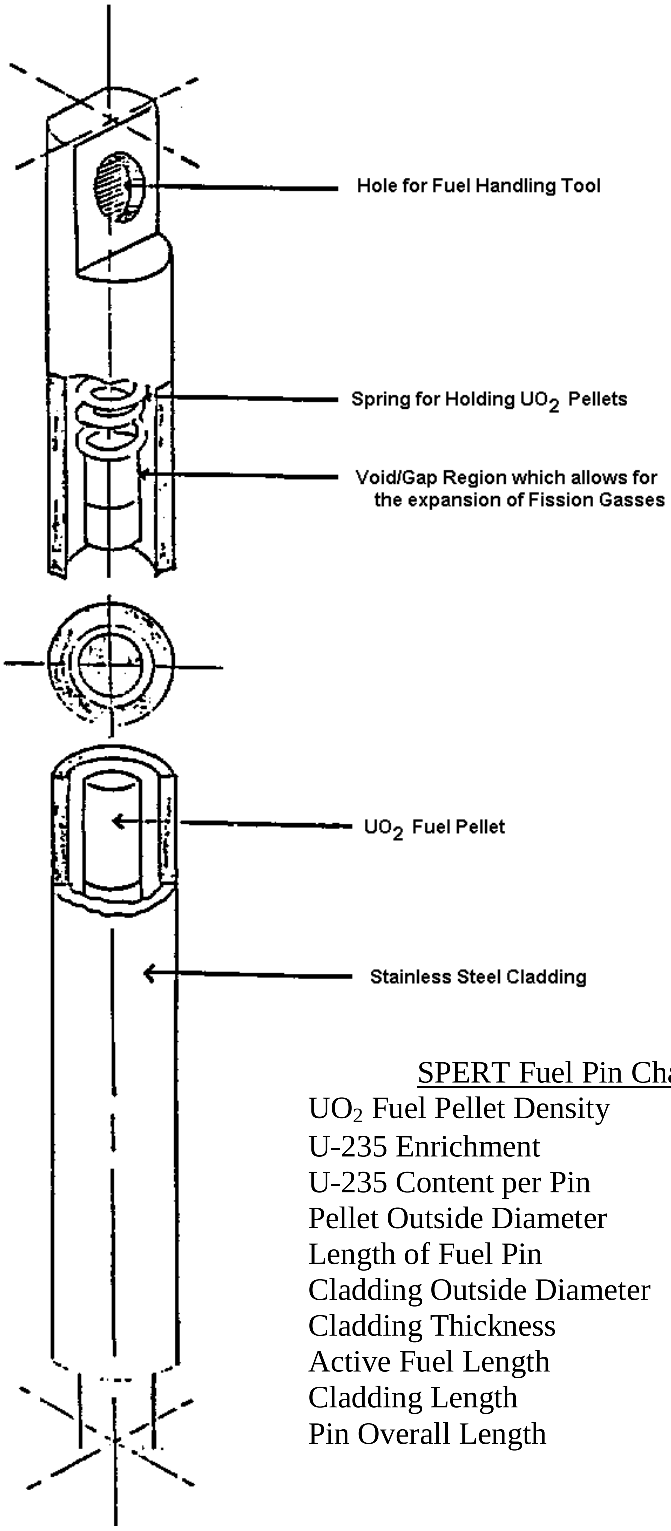
Table 2: Composition of Uranium Oxide Fuel

	c_j (w/f)	x_j (a/f)	Concentrations C_j (1/bcm)
U233	0.000003	0.000003	0.00000007±160%
U234	0.000253	0.000257	0.00000577±2%
U235	0.048074	0.048659	0.00109131±0.047%
U236	0.000468	0.000472	0.00001058±1.1%
U238	0.951202	0.950609	0.02132011±0.043%
O			0.04577310±0.15%
Fe			0.00000742±(3–10%)

Table 3: Composition of Stainless Steel Clad

	c_j (w/f)	x_j (a/f)	Concentrations C_j (1/bcm)	Atom fraction
Fe	.70326*	.0125926	.0591497	Fe 0.693188
Cr	.1860	.0035772	.0168027	Cr 0.200983
Ni	.0956	.0016289	.0076512	Ni 0.091513
Mn	.0106	.0001929	.0009063	Mn 0.010840
Mo	.0020	.0000209	.0000977	Cu 0.001503
Cu	.0017	.0000268	.0001257	Mo 0.001171
Co	.00084	.0000143	.0000669	Co 0.000802

*The measured value is 0.689; the value 0.70326 makes $\sum_j c_j = 1$.



SPERT Fuel Pin Characteristics

UO_2 Fuel Pellet Density	10.08 gm/cm^3
U-235 Enrichment	4.81±0.15 w/o
U-235 Content per Pin	35.2 gm
Pellet Outside Diameter	0.420 in
Length of Fuel Pin	41.75 in
Cladding Outside Diameter	0.466 in
Cladding Thickness	0.020 in
Active Fuel Length	36.00 in
Cladding Length	41.62 in
Pin Overall Length	41.75 in

Figure 1: SPERT Fuel Pin

B. Usage

The material under this license will be used with the lead slowing down spectrometer that is associated with the RPI Linear Accelerator Lab, a 100 MeV electron accelerator. A lead slowing down spectrometer (LSDS) is a large cube of high purity lead with a pulsed fast neutron source in its center. Because of the low absorption cross section of lead, neutrons can have successive scattering interactions without absorption and will slow down in energy. The slowing down process is such that at a given slowing-down time after the initial neutron pulse, the neutron energy spectrum will have a Gaussian distribution with some mean energy, and energy resolution of about 30% (FWHM). Because a single neutron can pass through the same location several times, the slowing-down process creates a high neutron flux in the lead.

To assay used fuel with a lead slowing down spectrometer, a fuel pin or assembly is inserted into the sample chamber within the lead cube which is surrounded by fast neutron detectors (as shown in Figure 2). Following the neutron pulse, neutrons which have been slowed to energies below 100 keV induce fission in the fuel. The fast fission neutrons escape the fuel and some are detected by the surrounding fast neutron detectors thereby recording the fission rate of the fuel as a function of the slowing down time. Data is collected for duration of about 2 ms after the neutron pulse, and is repeated as needed to obtain required statistical precision (approximately several thousand neutron pulses). The interrogating neutron flux is correlated with the slowing down time and thus the time dependent fission rate in the fuel will follow the fission cross sections of the fuel composition. The fast neutron detectors record the fission rate and this signal can be used to infer the fuel composition.

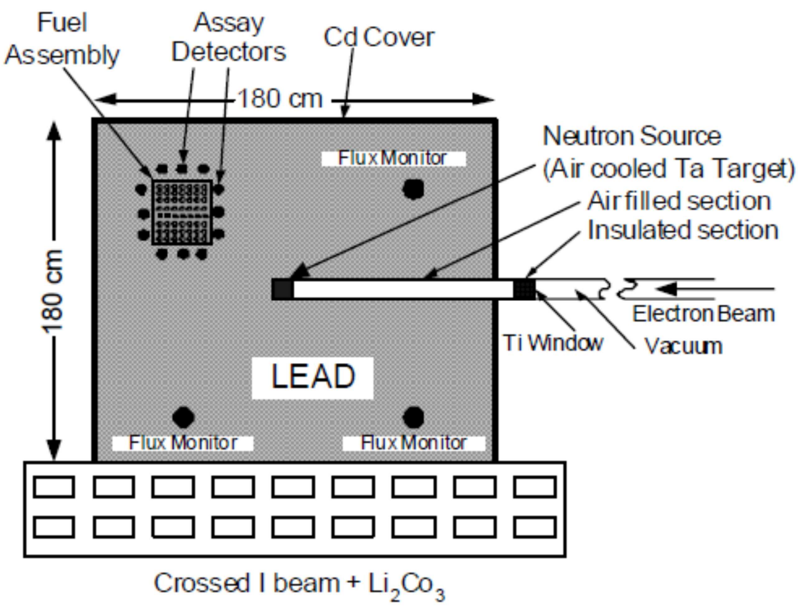


Fig. 2. Schematic of Lead Slowing Down Spectrometer (LSDS)

In addition to the purpose described above, the PuBe sources under this license may be used as a source of neutrons for calibrating, testing, demonstrating, or verifying the operation of various neutron detectors at the facility.

5) 10 CFR 70.22(a)(6) Technical Qualifications of Applicant

I. Administrative Structure

Staff qualifications for responsible utilization of licensed special nuclear materials in the LINAC include the administration of a nuclear reactor operating license and a state radioactive materials license. The administrative structure consists of a Radiation and Nuclear Safety Committee, Radiation Safety Officer, Laboratory Director, and Laboratory Staff. Laboratory staff includes Technical Manager, research associates, technicians, and student research assistants. A diagram of the administrative structure is included in Appendix A.

II. Radiation and Nuclear Safety Committee

The Radiation and Nuclear Safety Committee (RNSC) is established as a condition of New York State Department of Health Radioactive Materials License #1035. Appointments to the RNSC are made by the Vice President of Human Resources on behalf of the President of the Institute. All changes to the membership of the RNSC must be approved by the New York State Department of Health through amendment to the license. Current membership of the RNSC consists of 8 faculty members in various disciplines of science and engineering, a representative of the Division of Administration, a Management Representative, and the Radiation Safety Officer.

This requested Special Nuclear Materials License will adopt the campus RNSC for oversight of its radiation protection program.

The Committee is responsible for:

- Ensuring that all individuals who work with or in the vicinity of radioactive material have sufficient training and experience to enable them to perform their duties safely and in accordance with Department regulations and the conditions of this license.
- Ensuring that all use of radioactive material is conducted in a safe manner and in accordance with Department regulations and the conditions of the license.

The committee's duties include:

1. Setting Institute policies for radiation and nuclear safety.
2. Giving such advice and assistance as may be requested by the RSO.
3. Giving approval to reactivate an operation involving radiation if such an operation has been stopped by the RSO.
4. Evaluating the Institute's overall radiation safety program and the effectiveness of the administration of this program on an annual basis. Evaluation results should be presented in a brief written annual report to the Vice President of Human Resources.
5. Reviewing the adequacy of the training and experience of Authorized Users to possess and use radioactive material and radiation sources under the Institute licenses.
6. Monitoring the institution's program to maintain individual and collective doses as low as reasonably achievable (ALARA), and review, with the assistance of the Radiation Safety

Officer, occupational radiation exposure records of all personnel working with radioactive materials.

7. Participating in an annual review of the Radiation Safety Program, in conjunction with the Radiation Safety Officer.
8. Being familiar with all pertinent New York State Health Department regulations, the terms of the license, and information submitted in support of the request for the license and its amendments.
9. Establishing a program to ensure that all individuals whose duties may require them to work in the vicinity of radioactive material (e.g., security and housekeeping personnel) are properly instructed as required by Section 16.13, New York State Sanitary Code (10 NYCRR 16).
10. Reviewing and approving all requests for use of radioactive material within the institution.
11. Proscribing any special conditions that will be required during a proposed use of radioactive material such as requirements for bioassays, physical examinations of users, and special monitoring procedures.
12. Recommending remedial action to correct any deficiencies identified in the radiation safety program.
13. Maintaining written records of all Committee meetings, actions, recommendations, and decisions.

III. Radiation Safety Officer and the Office of Radiation and Nuclear Safety

The Radiation Safety Officer acts as the delegated authority of the Radiation and Nuclear Safety Committee, reporting to the Director of Environmental Health and Safety.

The Office of Radiation and Nuclear Safety was established to facilitate implementation of Institute policy and procedures on radiation safety. The Radiation Safety Officer is the head of the Office, which may also include part-time student workers and/or staff time from the Department of Environmental Health and Safety. The Office has the necessary instrumentation for surveillance of sources of ionizing radiation on campus and provides a periodic appraisal and radiation surveys for Rensselaer's radiation installations.

The RSO has the authority to stop an operation of any kind if a radiation hazard to personnel exists, if the Institute's property is endangered, or if neglect of the Institute policies is observed.

A. Duties of the Radiation Safety Officer and Office of Radiation and Nuclear Safety

The Radiation Safety Officer shall:

- Supervise radiation control activities.
- Have the authority to halt operations involving radioactive material or radiation machines if unsafe or unacceptable conditions exist.
- Determine compliance with policies issued by the Committees and by Federal, State and Local agencies.
- Carry out the policies and recommendations concerning radiation and nuclear safety established by the Radiation and Nuclear Safety Committee throughout the Institute.

- Investigate all proposals for the use of radioactive material and radiation-producing devices and conditions of their use and transmit such proposals to the Radiation and Nuclear Safety Committee with recommendations for approval or disapproval.
- Prepare an annual report for the radiation safety program to be presented to the Radiation and Nuclear Safety Committee.
- Keep the Radiation and Nuclear Safety Committee informed of any significant changes in government regulations on radiation safety, licensing and registration, and provide the committee with copies of relevant documents.
- Control acquisition and transfers of radioactive materials to individuals on and off campus and ensure that individual and institutional possession limits are not exceeded.
- Maintain accountability records for all special nuclear materials.
- Prepare license amendments, permit applications and maintain timely renewals of licenses and permits.
- Register all radiation producing machines with NYSDOH.
- Respond to emergencies and supervise decontamination or other response activities.
- Manage the programs for providing radiation safety training to individual users, ancillary workers and Public Safety personnel.

Additionally, it shall be the responsibility of the Office of Radiation and Nuclear Safety to:

- Maintain radiation dosimetry records of all persons issued personnel monitors and maintain records of bioassay results.
- Maintain a registry of all campus facilities subject to the radiation safety program.
- Maintain records of radioisotope procurement and disposal
- Assist users in the storage, use and disposal of radioactive material at the laboratory level.
- Perform periodic inspections of laboratories using radiation producing equipment and/or radioactive material and make recommendations for improvement of conditions to conform to Institute policies.
- Coordinate the radioactive waste management program, including receipt of waste, decay-in-storage, burial, incineration and disposal through commercial vendors.
- Calibrate radiation survey instruments for Authorized Users when required.
- Perform leak tests on sealed sources as required by State regulations.
- Receive, inspect and distribute incoming shipments of radioactive materials.

B. Qualifications of the Radiation Safety Officer

Qualifications of the Radiation Safety Officer require a master’s degree or higher in health physics, nuclear engineering, or a related discipline, or Bachelor’s Degree in a technical discipline with extensive additional experience, three years of professional experience in radiation safety, preferably in an academic or research environment, and appropriate professional certifications. Preferred knowledge, skills, and abilities include:

- Working knowledge of applicable Federal, state and local regulations
- Demonstrated oral and written communication skills
- Planning, organizing and effective time management skills
- Ability to analyze and interpret financial and other data

- Excellent interpersonal and communication skills
- Ability to work effectively under pressure and meet established goals and objectives
- Ability to anticipate and solve problems

A summary of the qualification and experience of the current Radiation Safety Officer is included in Appendix A.

IV. Laboratory Administration

A. Duties of the Laboratory Director

Daily activities of the laboratory are managed and directed by the Laboratory Director whose responsibility it is to direct and supervise the operation of the LINAC and other laboratory activities either directly or by delegation to the Laboratory staff.

B. Qualifications of the Laboratory Director

The position of Laboratory Director requires a Ph.D. degree in nuclear engineering or a related field with appropriate experience. Knowledge of accelerator facility operation, radiation detection systems, data acquisition and analysis systems, electronic and mechanical measuring equipment and utilization of computer equipment are required skills. The Laboratory Director is generally a faculty member in the nuclear engineering program.

A summary of the qualification and experience of the current Laboratory Director is included in Appendix A.

V. Laboratory Staff

A. Technical Manager

Duties of the Technical Manager include oversight of technical operations and supervision of technical staff. Qualifications for the laboratory supervisor are a Bachelors degree in Electrical Engineering or equivalent experience pending professional qualifications review board approval, and 2 years minimum engineering or equivalent experience. An advanced degree can substitute for job experience pending review. The required knowledge, skills, and abilities include:

- Engineering/technical skills and experience with microwave RF systems, traveling wave RF accelerators, accelerator applications, waveguide systems, which vacuum systems, high voltage power supplies and distribution, high power RF amplifier systems utilizing klystron amplifiers and cavity systems, high power high voltage pulse systems and circuit design.
- Experience with both ionizing and non-ionizing radiation, radiation shielding and safety practices, radiation monitoring and measurements systems and New York State rules and regulations as they pertain to linear accelerator’s safe and proper operation.

B. Technical Staff

The technical staff consists of technicians with specialties in high-voltage electrical equipment, mechanical and vacuum systems, and materials and fabrication. Qualifications include an associates degree or equivalent in Engineering or a related field, and must have a working knowledge of the operation of general machine shop tools including drill press, lathe, milling machine, band saw and an array of hand power tools. The required knowledge, skills, and abilities include:

- Ability to read and understand electronic and electrical drawings and blue prints.
- Working knowledge of vacuum leak testing, mechanical vacuum pumps, diffusion pumps and vac-ion pumping systems.
- Planning, organizing and effective time management skills
- Ability to analyze and interpret technical and other data
- Excellent interpersonal and communication skills
- Ability to work effectively under pressure and meet established goals and objectives
- Ability to anticipate and solve problems
- Ability to work independently

C. Research Staff

Post-doctoral researchers are employed as projects warrant. These researchers have completed doctoral degrees in nuclear engineering, physics, or related disciplines, and are supervised by the Laboratory Director.

Student researchers may be involved in LINAC research projects, supervised by faculty and research staff.

6) 10 CFR 70.22(a)(7) Facilities and Equipment for Handling Special Nuclear Material

I. Areas of Storage and Use

All storage and use of the material described in this license will be limited to the LINAC laboratory building. Storage of the material will be in the area of the building designated the ‘hot cell’ which was designed for remote handling of high-activity materials, but which is no longer used for that purpose, and is instead mainly a secure storage area. The hot cell consists of thick concrete walls and is accessed through a two-foot thick rolling concrete door that is secured with a combination lock. The fuel pins will be stored in cadmium-lined steel tubes with a maximum of 15 pins per tube. This configuration was analyzed in the SAR for CX-22 to satisfy criticality safety requirements under the condition of complete flooding of the fuel storage vault.

The licensed material will be used in the LSDS, which is located in the ‘target room’ of the LINAC facility. The target room is surrounded by a minimum eight-foot thick concrete wall, and is also below an exterior earthen barrier. The target room entrance is directly adjacent to the entrance of the hot cell.

II. Shields, Equipment, and Handling Devices

The low specific activity and negligible fission product inventory in the licensed material does not require additional shielding or equipment during storage or handling. During use in the LSDS, personnel are not permitted in the vicinity of the licensed material due to the very high radiation levels produced by the LINAC itself.

The integrity of the fuel pins should not be compromised as a result of the operations described, and there is no expected release of SNM. There will be no mechanical handling of the fuel pins, and the history of manual fuel handling as part of the CX-22 license indicates negligible likelihood of fuel pin damage.

III. Measuring and Monitoring Devices

Personnel monitoring devices are required for all persons working the laboratory. Minimum dosimetry requirements for all personnel include film badges (or equivalent) capable of detecting gamma radiation, x-radiation, and energetic beta radiation. Personnel assigned duties using neutron sources, in the neutron time-of-flight measurement stations, or handling any special nuclear material are provided personnel dosimetry that is additionally capable of detecting fast and thermal neutrons. Dosimetry services are provided by Mirion dosimetry or another NVLAP-accredited vendor as required.

Portable radiation monitors utilized in the facility shall have the capability to detect alpha, beta, gamma, and neutron radiation. Operational parameters should include the ability to detect alpha particles above 4 MeV, beta particles above 100 keV, gamma and x-radiation above 7 keV, and neutrons over the energy range of 0.025 eV (thermal) to about 10 MeV.

The Office of Radiation and Nuclear Safety shall maintain and calibrate these portable radiation detection instruments, or radiation detection instruments with equivalent performance characteristics (i.e., range, sensitivity, type of radiation detected) or have the means for the instruments to be calibrated. Instrument calibration is performed at Rensselaer in compliance with New York State Department of Health Radioactive Materials License #1035 and the New York State regulations that are analog to 10 CFR 20. Most instrument calibrations are performed by a qualified third party, but Rensselaer maintains the capability to perform in-house calibrations when necessary using established procedures including standards that are traceable to NIST.

Area monitoring of ambient radiation levels will be available in the vicinity of the storage location for the requested material. The previously accepted analysis of fuel storage under the CX-22 license and the criticality analysis presented in this application demonstrate that the effective k-value in all storage and use locations will be no greater than 0.9, and based on these analyses and the operating history of the RCF, we request this license contain an exemption to the requirements in 10 CFR 70.24(a) for criticality monitoring.

IV. Radioactive Waste Disposal

No radioactive waste will be generated under the conditions of this license. All of the licensed material will be returned to NRC license CX-22 or NYSDOH license #1035 at the termination of this license, and is not considered a waste product. Any incidental materials, such as laboratory gloves or other trash that may become slightly contaminated during the use of licensed material will be maintained under the conditions of NYSDOH License #1035 and disposed of accordingly. The Office of Radiation and Nuclear Safety maintains provisions for the collection and disposal of low level radioactive waste.

V. Fire Safety Systems

A map of the LINAC facility is included in Appendix A-1.

Fire Safety Systems at the LINAC are maintained by the Office of Environmental Health and Safety and the Life Safety Shop at Rensselaer. Fire risk is minimized in areas of storage and use through 1) facility design features, 2) fire detection and alarm, and 3) administrative controls.

1) Facility design features:
    - The areas of storage and use are constructed of thick concrete (min. 8 feet thick in target room and 2 feet thick in hot cell storage area). These construction features are primarily for the radiation protection associated with the accelerator machine.
    - Emergency lighting systems are available throughout the facility.
    - During LINAC operation, the LINAC target room is exhausted at a rate of 25,000 cfm to prevent the buildup of possible air contaminants.
2) Fire detection and alarm: Heat sensors throughout the facility are tied in to a centralized alarm panel, which reports alarms to campus Public Safety dispatcher. Any fire signal causes an interruption to the LINAC beam.
3) Administrative controls: Accumulation of combustibles, particularly in the LINAC target room are minimized to reduce the risk of local fires.

The electrical equipment in the LINAC facility is heavily grounded, but there is no specific lightning protection system.

There is no excessive combustible loading identified in most of the fire areas of the LINAC. The one unique fire area is the equipment rooms for the drivers of the accelerator itself, which contain high voltage equipment, and large banks of capacitors and power supplies. This area is protected by a CO_2 fire suppression system to mitigate the impact of any fire that may develop in that area. Neither storage nor use areas feature storage or use of combustible hazardous chemicals.

Inspection, testing, and maintenance of fire safety systems is managed by the Life Safety Shop. Inspection and testing scheduled are dictated by New York State regulations and prevailing fire codes.

7) 10 CFR 70.22(a)(8) Safety procedures to protect health and minimize danger to life or property

Procedures are applied to establish safe conduct of activities with radioactive material and radiation sources. The procedures in effect satisfy various requirements of federal USNRC licenses for special nuclear materials and state licenses for radioactive materials. Procedures are reviewed by staff, researchers and students during initial training as radiation workers and at regular intervals following initial training. The laboratory staff may draft procedures and minor changes may be approved by the Laboratory Director and/or Radiation Safety Officer. Procedures are periodically reviewed by the Radiation and Nuclear Safety Committee.

I. Monitoring Procedures

A. Access to the laboratory areas is controlled by an electronic card key system and staff personnel
B. Personnel dosimetry badges are required in all areas except the entrance hallway, staff offices connected to the entrance hallway, and the NEEP Laboratory, at all times
C. Dosimeters are required for all visitors in all areas except those noted in (B). Group tours may use one dosimeter for up to 10 individuals under the conditions specified in the RPI Radiation Safety Manual.
D. Status of special nuclear material is verified by physical inventory on a quarterly basis.
E. Facilities that handle loose radioactive materials are monitored monthly for removable radioactive contamination. Although the operations described under this license application do not necessarily fall under that definition, there may be such work at the LINAC facility, and so the entire facility is on a monthly monitoring schedule. The maximum action guideline for removable contamination is generally taken to be 100 dpm/100 cm2 for alpha emitters and 1000 dpm/100 cm2 for beta/gamma emitters, which corresponds to the New York State standard for clean areas and/or release of material or facilities. In practice, loose contamination is maintained ALARA, and any unexpected contamination is investigated and remediated.
F. Although the long operating history with this material in conjunction with the CX-22 license suggests a very low likelihood of release of SNM, in the case of any accidental release, bioassay procedures will be performed in conformance with the recommendations of NRC Reg Guide 8.9.

II. Operating Procedures

A. Routine use of material covered under this license includes loading and unloading of the test assembly in the LSDS. Transfer procedures are consistent with the core loading and unloading procedures specified in the CX-22 license.

B. A survey of neutron and gamma radiation levels during loading and unloading will be made and a portable radiation monitor with alarm will be continuously active or a monitor available at all times during fuel transfer.

III. Emergency Procedures

Emergency response procedures are dictated by the RPI Radiation Safety Manual, in accordance with the requirements of New York State Department of Health regulations and New York State Department of Health radioactive material license #1035.

An emergency plan for responding to the radiological hazards of an accidental release of special nuclear material, under 10 CFR 70.22(i)(1)(ii) is not required, based upon the following analysis:

> The NRC evaluated the impact of a fuel element failure in the fuel conversion SER for CX-22, dated July 7, 1987. At this time, the NRC designated the maximum hypothetical accident as a fuel handling accident that resulted in the instantaneous release of all of the available volatile fission products that have accumulated in the free volume (gap) between the fuel and the cladding, following an extended run (24 hours) at full license power (100 W). A release of this material from a 15-m stack was calculated to result in a maximum total thyroid inhalation dose commitment offsite less than 3 x 10^{-4} mrem.
>
> The operating conditions for the fuel elements under this license will be significantly below the conditions analyzed above. The maximum total fission power in the experimental assembly has been calculated to be 1.02 W (based upon an MCNP model of the accelerator and LSDS, assuming electron beam current at 130% of maximum beam current to account for accumulated uncertainties). The maximum credible run time for this experiment is 10 hours, with expected run times much shorter than that.
>
> Based upon this analysis, the condition in 10 CFR 70.22(i)(1)(i) is satisfied.

IV. Transportation Procedures

RPI plans to transport the fuel pins from the Walthousen Laboratory to the LINAC (and back) using Type A containers under the conditions specified in 10 CFR 71.22. Documentation of the RPI Quality Assurance was approved by the NRC under Approval Number 0953, Rev. 0, expiring March 31, 2022.

V. Training Program

All staff and students must complete a formal training program before obtaining unsupervised access to the LINAC or performing experiments utilizing radioactive materials or radiation producing equipment. The training program is in accordance with New York State regulations, and is consistent with the requirements of 10 CFR 19.12. The training program consists of material on radiation interactions, radiation hazards, dose measurements, and laboratory procedures. Experiments are performed with the supervision of laboratory staff. Staff personnel are trained to handle materials by a combination of formal classroom education and laboratory training by other qualified staff, depending on the nature of responsibility required.

In addition, those that are designated duties associated with special nuclear material covered under this license, or whose work duties include areas involving the storage and use of special nuclear material covered under this license will be required to complete an additional training component on nuclear criticality safety. This training will be required before beginning work, and at least annually thereafter. The nuclear criticality safety training module will cover at a minimum the following topics:

- Nuclear theory of the fission chain reaction
- Criticality characteristics
- Factors affecting criticality
- Criticality prevention
- Emergency response procedures

VI. As Low As Reasonably Achievable (ALARA) Program

The 'as low as reasonably achievable' goal of a radiation safety program is supported by the procedures of the Office of Radiation and Nuclear Safety, the Radiation and Nuclear Safety Committee, and the LINAC laboratory. Many experiments performed on a routine basis and do not represent significant radiation doses. New experiments are reviewed by the Radiation Safety Officer for potential radiation dose and other safety impacts. Handling of the material covered by this license is expected to result in negligible additional radiation dose.

An overview of quarterly radiation dose monitoring results is presented to the Radiation and Nuclear Safety Committee at its regular meetings. The Radiation Safety Officer automatically begins an ALARA investigation for any individual with a reported dose in excess of 10% of his or her permitted dose (pro-rated over the monitoring period), and may instigate an investigation of any monitoring result that appears in the RSO's judgment to be outside of historical trends for that individual or position. The reports of these investigations are reviewed by the Radiation and Nuclear Safety Committee.

VII. Fire Safety Procedures

Oversight of fire safety controls is provided by the Office of Environmental Health and Safety. As an educational institution in the State of New York, the LINAC facility (along with all university facilities) is inspected annually by, and against the standards of, the New York State Office of Fire Prevention and Control. Although RPI believes that this results in operations substantially in compliance with NFPA 45 and/or NFPA 801, it does not explicitly measure its operations against those standards. The campus is also required to publish an annual fire safety report, the most recent version of which can be found at http://www.rpi.edu/dept/hr/docs/FirereportCY09.pdf. All facilities at RPI, including the LINAC, are inspected annually by

Fire alarms are monitored by the campus Public Safety operation, which are tied to the City of Troy Fire Department. The City of Troy engages a full-time fire department with mutual aid ties to surrounding municipalities. Members of the Troy Fire Department periodically review the LINAC facility (with on-site visit) to prepare for fire-fighting and rescue activities.

Staff and other users of the LINAC facility are instructed to evacuate the building in case of emergency, and are not trained in the use of fire extinguishers or other mitigative equipment. As an accelerator facility, safe shutdown in an emergency can be obtained by cutting the power to the machine using a clearly labeled “Emergency Stop” button. Power is also cut to the machine in the event of activation of any alarm.

8) 10 CFR 70.22(a)(8) Financial Qualifications

Rensselaer Polytechnic Institute is a private university operating continuously since 1824. The audited consolidated financial statements for fiscal years ending 2008 and 2009 are included in Appendix A-6.

9) 10 CFR 70.53 and 70.54, Material Control and Accountability

A Material Control and Accountability plan is not required for this license, as the total material possessed would be less than one effective kilogram of special nuclear material.

10) 10 CFR 73, Physical Protection of Plants and Materials

Since the material covered under this application is for less than 10 kg of special nuclear material of low strategic significance, no physical security plan is required, as specified in 10 CFR 70.22(k).

Compliance with general physical protection requirements in 10 CFR 73.40 is satisfied as the access to the LINAC building is limited by electronic card access, and the licensed material will be subject to a second level of limited access protection during storage (combination padlock) and use (key lock).

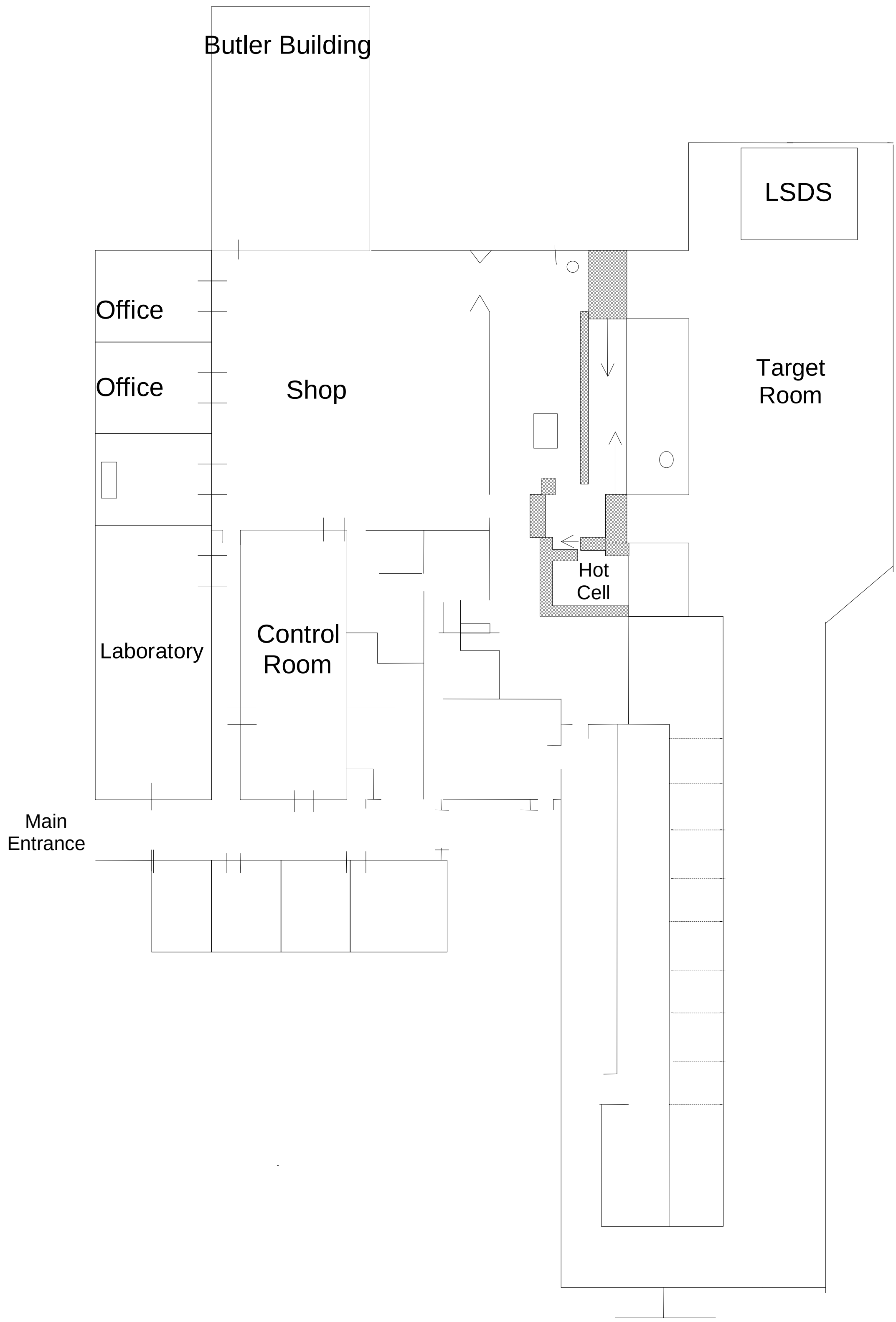
11) 10 CFR 70.25, Financial Assurance and Recordkeeping for Decommissioning

At the conclusion of this work, all material possessed under this license will be returned to the reactor operating license CX-22, which has a currently approved decommissioning funding plan and financial assurance mechanism (approved November 2010). Any costs of disposal or return of the material to the federal government will be covered under that license. The remainder of the facility will continue to be licensed for use under New York State Department of Health License #1035 after the termination of this license, and all decommissioning activities will be under that jurisdiction.

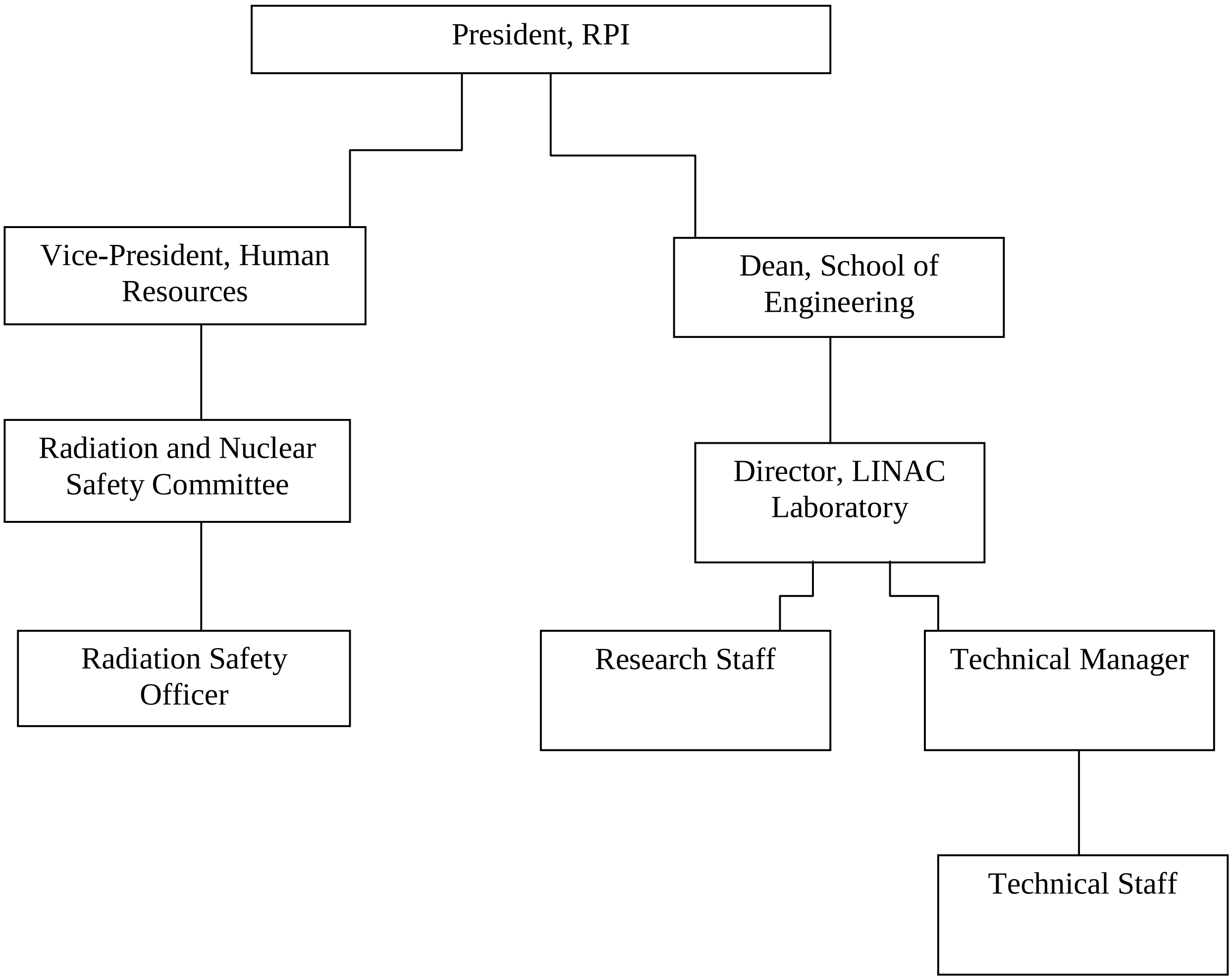
The Office of Radiation and Nuclear Safety has a fully implemented Health Physics monitoring and survey program in accordance with NYSDOH License #1035 and New York State Sanitary Code Part 16, which are compatible with the requirements of 10 CFR 20 that includes documentation of spills or other contamination events. All contamination events and personnel radiation exposure records are retained for the lifetime of the facility and materials license. The HP program is inspected on a triennial basis by the New York State Department of Health.

Appendix A

A-1 Floor plan of LINAC laboratory



A-2 Diagram of Administrative Structure



A-3 Summary of Qualifications of current Radiation Safety Officer

Peter F. Caracappa, Ph.D., CHP

EDUCATION

B.S. in Engineering Physics, Rensselaer Polytechnic Institute, Troy, NY, 1998
M.S. in Nuclear Engineering, Rensselaer Polytechnic Institute, Troy, NY 2001
M.A. in Public Policy Analysis, University at Albany, State University of New York, 2003
Ph.D. in Nuclear Engineering and Sciences, Rensselaer Polytechnic Institute, Troy, NY, 2006

PROFESSIONAL APPOINTMENTS

2001-2003	Radiation Safety Officer, University at Albany, State University of New York
2003-2007	Research Associate, Nuclear Engineering and Engineering Physics, RPI
2003-	Institute Radiation Safety Officer, RPI
2007-	Clinical Assistant Professor, Nuclear Engineering and Engineering Physics, RPI
2009-	Advisory Faculty, Nuclear Engineering Technology, Excelsior College

TEACHING EXPERIENCE

1. Nuclear Instrumentation and Measurement (2 semesters)
2. Applied Atomic and Nuclear Physics (4 semesters)
3. Radiological Engineering and Laboratory (8 semesters)
4. Nuclear Engineering and Engineering Physics Laboratory (7 semesters)
5. Radiation Shielding
6. Introduction to Nuclear Engineering and Engineering Physics (6 semesters)
7. Independent Study in Practical Radiation Safety

PROFESSIONAL REGISTRATIONS

Certified Health Physicist, American Board of Health Physics (2005, renewed 2009)
Intern Engineer, State of New York (2002)

RECENT PRINCIPAL PUBLICATIONS

1. **Caracappa PF**, Trumbull TH, Haley TC, Huguet M, Ji W, Danon Y, Sones BA, Gillich DJ. Making the Most of Hands-On Learning—An Integrated Course at
2. Rensselaer. ANS Winter Meeting, 2010.
3. Han B, Zhang J, Na YH, **Caracappa PF**, Xu XG. Modeling And Monte Carlo Organ Dose Calculations For Workers Walking On Ground Contaminated With Cs-137 And Co-60 Gamma Sources. Radiation Protection Dosimetry (in press)
4. **Caracappa PF**, Gu J, Xu XG. Organ-Specific Adjustment Factors for Calculating Dose from Any CT Scanner. AAPM Annual Meeting, 2010.
5. Marsh D, **Caracappa PF**. Dose Uncertainty Estimate From Tissue Composition Variation. HPS Annual Summer Meeting, 2010.
6. Na YH, Zhang B, Zhang J, **Caracappa PF**, Xu XG. Deformable adult human phantoms for radiation protection dosimetry: anthropometric data representing size distributions of adultworker populations and software algorithms. Phys. Med. Biol. 55 (2010) 3789-3811.
7. Liu H, Gu J, **Caracappa PF**, Xu XG. Comparison of two types of adult phantoms in terms of organ doses from diagnostic CT procedures. Phys. Med. Biol. 55 (2010) 1441-1451.

8. Zhang JY, Na YH, **Caracappa PF**, Xu XG. RPI-AM and RPI-AF, a pair of mesh-based, size-adjustable adult male and female computational phantoms using ICRP-89 parameters and their calculations for organ doses from monoenergetic photon beams. Phys. Med. Biol. 54 (2009) 5885-5908.
9. **Caracappa P**, Gu J, Xu X G. Methods of Assessing the Dose to the Red Bone Marrow for Diagnostic and Therapeutic Procedures. Med. Phys. 36(6): 2748, 2009.
10. **Caracappa P**, Gu J, Zhang J, Xu X. The Impact of the new ICRP-103 Recommendations on the Assessment of Effective Doses from CT Procedures. Med. Phys. 36(6): 2727, 2009.
11. Gu J, Bednarz B, **Caracappa PF**, Xu XG. The development, validation and application of a multi-detector CT (MDCT) scanner model for assessing organ doses to the pregnant patient and her fetus using Monte Carlo methods. Phys. Med. Biol. 54 (2009) 2699-2717.
12. Ding A.P.,Gu J.W.,Liu H.K., **Caracappa P**. and Xu X.G. A Software Package for Reporting Multidector CT (MDCT) Doses. International Conference on Advances in Mathematics, Computational Methods, and Reactor Physics, 2009.
13. Gu J.W., **Caracappa P**. and Xu X.G. Multidetector CT (MDCT) modeling for organ dose assessments of various patient phantoms. International Conference on Advances in Mathematics, Computational Methods, and Reactor Physics. 2009.
14. **Caracappa PF**, Chao TC, Xu XG. A Study Of Predicted Bone Marrow Distribution On Calculated Marrow Dose From External Radiation Exposures Using Two Sets Of Image Data For The Same Individual. Health Phys. 96(6):661– 674; 2009.
15. **Caracappa P.F**., Miller S., Marsh D. Activation of Air in Linear Accelerator Facilities. HPS Annual Summer Meeting 2008.
16. **Caracappa, PF**. Styles of Nuclear Engineering Education. ANS Annual Meeting, June 2007.

PROFESSIONAL SOCIETY MEMBERSHIP

- American Nuclear Society (ANS) (96 –) ;
  - Education and Training Division, Executive Committee (06-09), Program Chair (07-08), Vice Chair (10-11)
  - Radiation Protection and Shielding Division
  - Young Members Group, Executive Committee (05-06 & 07-10), Chair (10-11)
  - Student Sections Committee Chair (03-06)
- Health Physics Society (HPS) (96-)
  - Northeastern New York Chapter President (06-08)

AWARDS AND HONORS

Health Physics Society Graduate Fellowship, 2000-2001
National Academy for Nuclear Training INPO Fellowship, 1998-1999
L. David Walthousen Award (RPI), 1998
Max Yeater Award (RPI), 1998
Alpha Nu Sigma, Nuclear Engineering Honor Society, 1997

INSTITUTIONAL SERVICE

Advisor, RPI Student Section of the American Nuclear Society (04-)

A-4 Summary of Qualifications of current Director of LINAC Laboratory

Dr. Yaron Danon

Professor, Director, Gaerttner LINAC Laboratory
Department Mechanical, Aerospace and Nuclear Engineering
Rensselaer Polytechnic Institute (RPI), NES Bldg. 1-9
110 8th St., Troy, NY 12180

Phone:518-276-4008
Fax: 518-276-4832
Email: danony@rpi.edu
Web www.rpi.edu/~danony

EDUCATION

Ph.D., Nuclear Engineering and Science, Rensselaer Polytechnic Institute, 1993.
M.Sc., Nuclear Engineering and Science, Rensselaer Polytechnic Institute, 1990.
B.Sc., Nuclear Engineering (major) and Computer Applications (minor), Ben-Gurion University, 1988.

PROFESSIONAL EXPERIENCE

2010 – Present	Professor and Associate Director Gaerttner LINAC laboratory, Mechanical, Aerospace and Nuclear Engineering department, Rensselaer Polytechnic Institute,
2008 – Present	Chief Scientist, *i-Nalysis* - Pocket XRF.
2008 – Present	Founder and Chief Scientist. *Science Enterprise Group* (a consulting firm)
2007 – Present	Director Gaerttner LINAC Laboratory - Mechanical Aerospace and Nuclear Engineering Department, Rensselaer Polytechnic Institute, Troy, NY 12180
2005 – 2010	Associate Professor and Associate Director Gaerttner LINAC laboratory, Mechanical, Aerospace and Nuclear Engineering department, Rensselaer Polytechnic Institute,
2005 – 2007	Associate Director Gaerttner LINAC Laboratory_– Mechanical Aerospace and Nuclear Engineering Department, Rensselaer Polytechnic Institute, Troy, NY
2000 – 2005	Assistant Professor, Mechanical, Aerospace and Nuclear Engineering department, Rensselaer Polytechnic Institute
1994 - 2000	Senior Research Scientist, Nuclear Research Center Negev (NRCN), Physics Department, Beer-Sheva, Israel
1998 - 2000	Consultant, Cable Testing and Evaluation (CaSE) Technologies Ltd. Omer, Israel
1992 - 1994	Consulting Los Alamos National Laboratory.
1993 - 1994	Postdoctoral Research, Rensselaer Polytechnic Institute

SELECTED RELEVANT JOURNAL ARTICLES

G Leinweber, DP Barry, JA Burke, NJ Drindak, RC Block, Y Danon, BE Moretti, "Resonance Parameters and Their Uncertainties Derived from Epithermal Neutron Capture and Transmission Measurements of Elemental Molybdenum", Nuclear Science And Engineering, **164**, 287-303, (2010)

C. Romano, Y. Danon, R. Block, J. Thompson, E. Blain, E. Bond, "Fission Fragment Mass And Energy Distributions As A Function of Neutron Energy Measured In A Lead Slowing Down Spectrometer", Phys. Rev. C 81, 014607 (2010).

Y. Danon , R. C. Block, M. J. Rapp, and F. J. Saglime, G. Leinweber, D. P. Barry, N. J. Drindak and J. G. Hoole, Beryllium and Graphite High Accuracy Total Cross-Section Measurements in the Energy Range from 24 keV to 900 keV, Nuclear Science And Engineering, 161, 321–330, (2009)

D. Rochman, R.C. Haight, J.M. O'Donnell, S.A. Wender, D.J. Vieira, E.M. Bond, T.A. Bredeweg, J.B. Wilhelmy, T. Granier, T. Ethvignot, M. Petit, Y. Danon, and C. Romano, "Cross Section Measurements for ^{239}Pu(n,f) and ^{6}Li(n,alpha) with a Lead Slowing-Down Spectrometer", Nuclear Instruments and Methods in Physics Research Section A, Volume 564, Issue 1, Pages 400-404, (2006).

Catherine Romano , Yaron Danon, Robert C. Haight, Stephen A. Wender, David J. Vieirab, Evelyn M. Bond, Robert S. Rundberg, Jerry B. Wilhelmy, John M. O'Donnell, Andre F. Michaudon, Todd A. Bredeweg, Dimitri Rochman, Thierry Granier and Thierry Ethvignot, "Measurements of (n,α) cross-section of small samples using a lead-slowing-down-spectrometer", Nuclear Instruments and Methods in Physics Research Section A, Volume 562, Issue 2 , 23 June 2006, Pages 771-773, (2006)

SELECTED RELEVANT REFEREED PROCEEDINGS

Y. Danon, R. Block, J. Harvey, "Production of Mo-99 Using 30-MeV Electrons and a Mo-100 Target" Transactions of the American Nuclear Society and Embedded Topical Meeting Isotopes for Medicine and Industry, Volume **103**, TANSAO 103, 1–1190, Riviera Hotel, Las Vegas, Nevada, November 7–11, 2010

Y. Danon, R. Block (emeritus), C. Romano, J. Thompson, "Fission Physics and Cross Section Measurements with a Lead Slowing Down Spectrometer", Invited, International Conference on Nuclear Data for Science and Technology (ND2010), Korea, 26-30 April, 2010

Y. Danon, E. Liu, D. Barry, T. Ro, R. Dagan, "Benchmark Experiment of Neutron Resonance Scattering Models In Monte Carlo Codes", International Conference on Mathematics, Computational Methods & Reactor Physics (M&C 2009), Saratoga Springs, New York, May 3-7, 2009, on CD-ROM, American Nuclear Society, LaGrange Park, IL (2009).

C. Romano, Y. Danon and D. Beller, "Fuel Assembly Self Shielding of Interrogation Neutrons In A Lead Slowing-Down Spectrometer", Proc. of the Sixth ANS Intl. Top. Mtg on Nucl. Plant Inst., Control, and Human-Machine Interface Tech. (NPIC&HMIT 2009), American Nuclear Society, LaGrange Park, IL, 2009 (ISBN: 978-0-89448-067-6, on CD-ROM), 2009.

Y. Danon, R.C. Block, Catherine Romano, "Measurements of fission fragment properties using RPI's Lead Slowing-Down Spectrometer", Proceedings of the International Conference on Nuclear Data for Science and Technology, April 22-27, 2007, Nice, France, editors O. Bersillon, F. Gunsing, E. Bauge, R. Jacqmin, and S. Leray, EDP Sciences, pp 371-374, 2008

SYNERGETIC ACTIVITIES

Chair, Measurements Committee, US Cross Section Evaluation Working Group (CSEWG).
Member, Nuclear Data Advisory Group (NDAG) for the Nuclear Criticality Safety Program (NCSP)
Executive Committee, Northeastern New York Chapter of the American Nuclear Society.
Member, American Nuclear Society

TEACHING

Physics of Nuclear Reactors
Nuclear Engineering and Engineering Physics Laboratory
Introduction to Nuclear Engineering and Engineering Physics
Radiation Technologies and Applications

Supervising 8 PhD students and 1 Ms student

Appendix A-5
Criticality Safety Analysis of SNM Storage and Use

Introduction

The following is an analysis of the criticality safety associated with the storage and use of special nuclear material associated with the proposed special nuclear material license. The material covered by the license application includes:

- 2252.8 g of U-235 in 64 fuel elements, enriched to 4.81% of uranium
- 146 g Pu in two PuBe neutron sources
- 60 g U-235 in uranium metal, enriched to 93% of uranium

In addition to the material contained in the 64 fuel elements, criticality analysis is performed assuming a hypothetical addition of either 200 g Pu or 350 g U-235, which corresponds to the maximum quantity of SNM that is licensable by the New York State Department of Health, and represents the maximum quantity of SNM that could be theoretically obtained without circumventing state licensing rules.

Criticality under accident conditions is also analyzed. An accident may results in rearrangement of fuel either due to mechanical deformation or excess heat that leads to melting. The limiting case for criticality is taken to be a spherical arrangement surrounded by an infinite reflector.

Criticality Safety Analysis for Storage of Special Nuclear Material

The criticality safety analysis for the special nuclear material under this license is derived from the storage of the same nuclear fuel material under the CX-22 license and the Safety Analysis Report for that license previously accepted by the Nuclear Regulatory Commission.

The fuel elements for the CX-22 license are stored in cadmium lined steel tubes, containing no more than 15 fuel elements per tube. A sufficient number of these storage tubes will be transferred to the LINAC along with the fuel elements to replicate the storage conditions of the RCF. The CX-22 SAR determined that for an infinite array of fuel elements stored in these cadmium-lined steel tubes and submerged fully in water the k-eff would not exceed 0.9.

The additional materials included in the license application will be stored separately from the 64 fuel elements, and those items are not separately capable of forming a critical mass.

Criticality Safety Analysis for Use of Special Nuclear Material

Criticality calculations have been performed using the MCNP code (MCNP5, v. 1.51). The ENDF/B 7 cross-section libraries were used for all calculations. Prior to executing all calculations, the MCNP installation was validated using the MCNP criticality benchmarks set delivered with RSICC MCNP5 (VALIDATION_CRITICALITY).

A series of 18 criticality cases have been explicitly performed to verify subcriticality under typical and hypothetical accident conditions. The MCNP input files associated with a select set of these calculations are included for validation. The description of each case is included in the description column of Table 1 below. In general:

- Cases 1 and 2 represent the normal intended operation of the LSDS, both with the full array of 64 fuel pins, and with 12 of those pins removed and replaced by the PuBe source containing the greater quantity of plutonium

- Cases 3 and 4 represent the normal intended arrangement of fuel or fuel and plutonium under the condition that the LSDS becomes flooded with water
- Case 5 represents the limiting case of deformation of the fuel by either mechanical or thermally induced means, where the entire heavy metal content of all 64 fuel elements and the PuBe source becomes formed into a sphere that is submerged in an infinite water reflector.
- Cases 6 through 18 represent hypothetical accident conditions involving the fuel assembly array not contained in the LSDS, but submerged in an infinite water reflector. It begins with the fuel assembly as designed, and then with the pitch of the assembly increased to the optimal (highest k) value obtained by iterative calculation. Added to this optimal-pitch fuel assembly are materials possessed under the license application ("PuBe source" or "uranium discs"), and quantities of either 200 g Pu or 350 g U-235 hypothetically enhancing the inventory of either the center pins in the array or evenly distributed throughout all pins in the array.

A summary of the calculated k_{eff} values is included in Table 1 below. To assure subcriticality, no value of k_{eff} in any of the considered scenarios exceeds a value of 0.9 (the maximum k_{eff} found was 0.85). This was deemed acceptable as it was the standard that the NRC applies to the maximum accident condition addressed in the CX-22 reactor license.

Conclusion

The material included under this license application has been determined to remain sub-critical under all normal storage and use conditions and under hypothetical accident conditions. This material may be safely stored and used under the conditions specified in the license application.

Table 1: Summary of Criticality Calculations

Case	Description	K_{eff}	Input file
Experimental setups:			
1	Fuel assembly (64 pins) in LSDS	0.10(5)	
2	Fuel assembly (52 pins) + PuBe source in LSDS, PuBe source in center (replaces 12 pins)	0.09(2)	
Entire LSDS in water:			
3	Same as 1, but entire LSDS submerged water	0.73(2)	case3.inp
4	Same as 2, but entire LSDS submerged water	0.71(6)	case4.inp
Spherical arrangement of HM :			
5	heavy metal of 64 fuel pin + PuBe source as sphere and reflected by water	0.50(6)	case5.inp
FA cases in water:			
6	Fuel assembly in water, infinite reflected	0.63(9)	case6.inp
7	Fuel assembly in water, infinite reflected, optimal pitch with highest k (2.75 cm)	0.79(5)	
8	64 fuel pins + PuBe source in water, infinite reflected	0.67(1)	
9	64 fuel pins + PuBe source + 10 U-235 discs in water, infinite reflected	0.67(2)	
10	Fuel assembly (64 pins) in water, infinite reflected; optimal pitch; cylindrical arrangement of fuel pins; additional center pin: 350 g U-235	0.81(7)	
11	Same as 10, but 4 additional center pins containing a total mass of 350 g U-235	0.84(7)	
12	Same as 10, but 9 additional center pins containing a total mass of 350 g U-235	0.85(6)	
13	Fuel assembly (64 pins) in water, infinite reflected (optimal pitch, cylindrical arrangement of fuel pins); additional center pin: 200 g Pu-239	0.81(5)	
14	Same as 13, but 4 additional center pins containing a total mass of 200 g Pu-239	0.83(8)	
15	Same as 13, but 9 additional center pins containing a total mass of 200 g Pu-239	0.85(3)	
17	Fuel assembly (64 pins) in water, infinite reflected (optimal pitch, cylindrical arrangement of fuel pins); total amount of 350 g U-235 added to the 64 fuel pins	0.82(7)	case17.inp
18	Fuel assembly (64 pins) in water, infinite reflected (optimal pitch, cylindrical arrangement of fuel pins); total amount of 200 g Pu-239 added to the 64 fuel pins	0.82(5)	case18.inp

The MCNP output file associated with each case contains a summary of the KCODE calculation such as the following (generated for case 3):

```
 ------------------------------------------------------------------------------------------------------------------------------------
|                                                                                                                                    |
| the final estimated combined collision/absorption/track-length keff = 0.73220 with an estimated standard deviation of 0.00254     |
|                                                                                                                                    |
| the estimated 68, 95, & 99 percent keff confidence intervals are 0.72966 to 0.73474, 0.72714 to 0.73726, and 0.72549 to 0.73891 |
|                                                                                                                                    |
| the final combined (col/abs/tl) prompt removal lifetime = 2.1962E-04 seconds with an estimated standard deviation of 8.3769E-07 |
|                                                                                                                                    |
| the average neutron energy causing fission = 1.7179E-01 mev                                                                        |
| the energy corresponding to the average neutron lethargy causing fission = 3.4045E-07 mev                                          |
|                                                                                                                                    |
| the percentages of fissions caused by neutrons in the thermal, intermediate, and fast neutron ranges are:                          |
|         (<0.625 ev):  80.71%         (0.625 ev - 100 kev):  12.99%          (>100 kev):   6.31%                                   |
|                                                                                                                                    |
| the average fission neutrons produced per neutron absorbed (capture + fission) in all cells with fission = 1.5723E+00              |
| the average fission neutrons produced per neutron absorbed (capture + fission) in all the geometry cells = 7.2621E-01              |
|                                                                                                                                    |
| the average number of neutrons produced per fission = 2.431                                                                        |
|                                                                                                                                    |
 ------------------------------------------------------------------------------------------------------------------------------------
```

The following cases are included for validation:

case3.inp

```
LSDS SPERT fuel assembly 8 x 8
c
c
c     /____________________ /
c    |     V               |
c    |   /___ /            |
c    |  |     |            |
c    |  |     | /          |
c   z|  |_____|/           |
c    |           s         |
c    |                     |   /
c    |                     |  /
c    |                     | / y
c    |_____________________|/
c            x
c
c cell cards
99  0 999                               $VOID
98  99 -1  1 -999
1   1 -11.34  -1     14               $Lead rest
c
100  1 -11.34  -1 13 -14  -15           $lead zone 5a
110  1 -11.34  -1 12 -13  -15           $lead zone 4a
120  1 -11.34  -1 11 -12  -15           $lead zone 3a
130  1 -11.34  -1 10 -11  -15           $lead zone 2a
140  1 -11.34  -1 3  -10  -15           $lead zone 1a
101  1 -11.34  -1 13 -14  -16 15        $lead zone 5b
111  1 -11.34  -1 12 -13  -16 15        $lead zone 4b
121  1 -11.34  -1 11 -12  -16 15        $lead zone 3b
131  1 -11.34  -1 10 -11  -16 15        $lead zone 2b
141  1 -11.34  -1 3  -10  -16 15 #300 #301   $lead zone 1b
102  1 -11.34  -1 13 -14   16           $lead zone 5c
112  1 -11.34  -1 12 -13   16           $lead zone 4c
122  1 -11.34  -1 11 -12   16           $lead zone 3c
132  1 -11.34  -1 10 -11   16           $lead zone 2c
142  1 -11.34  -1 3  -10   16           $lead zone 1c
c
300   99 -1          -230    trcl=(-36.5 0 52.5)             $ detector in lead center
301   99 -1          -230    trcl=(-33.5 0 52.5)             $ detector in lead right
c
2  99 -1          -3 4 #400
```

```
3   4  -2.7    (-4 5):-6:-7:-8:-9                    $ Al Box
5  99 -1           -5 #3  17 -18 #8                      $ space for PuBe
6  99 -1           -5 #3 -17                             $ below pins
7  99 -1           -5 #3  18                             $ above pins
8  99 -1           -200 #3 fill=1  trcl=(-43.0024 51.73 35.9976)
9  99 -1           -201  u=1 lat=1  $ fuel
                      fill= 0:7 0:0 0:7
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
c
c 242 5  -2.7    -240 241 17 -18 trcl=(-32.5 0 46.5)   $ Detector Pipe
c 243 5  -2.7    -240 241 17 -18 trcl=(-40.5 0 46.5)   $ Detector Pipe
c 244 5  -2.7    -240 241 17 -18 trcl=(-32.5 0 40.5)     $ Detector Pipe
c 245 5  -2.7    -240 241 17 -18 trcl=(-40.5 0 40.5)     $ Detector Pipe
c 250 5  -2.7    -302 303 17 -18 trcl=(-36.5 0 38.5)     $ PuBe Pipe
c
c
206   53 -8.0         -202 203 -205         u=2  trcl=(0.8128 0 0.8128) $plug
207   54 -3.9         -203 204 -208         u=2  trcl=(0.8128 0 0.8128) $spacer
208   53 -8.0         -203 213 -205 208     u=2  trcl=(0.8128 0 0.8128) $cladding
209   55 -17.8e-5     -204 206 -208 207     u=2  trcl=(0.8128 0 0.8128) $gap (He)
210   52 -10.078      -204 206 -207         u=2  trcl=(0.8128 0 0.8128)
                                            vol=5230.848  $Fuel
212   54 -3.9         -206 210 -208         u=2  trcl=(0.8128 0 0.8128) $insulator
213   53 -8.0         -210 211 -208         u=2  trcl=(0.8128 0 0.8128) $spacer
214   56 -1.0         -211 212 -208         u=2  trcl=(0.8128 0 0.8128) $spring
215   53 -8.0         -212 213 -208         u=2  trcl=(0.8128 0 0.8128) $plug
216   57 -4.11        -213 214 -205         u=2  trcl=(0.8128 0 0.8128) $top of pin
217   99 -1                 205:-214:202         u=2  trcl=(0.8128 0 0.8128)
c
400  1 -11.34 -400 trcl=(-44 0 35.0)                $ additional brick

c cube Surface Cards
999  SO  400
1    BOX  -90   -90 -90 180 0 0  0 180 0  0 0 180
3    BOX  -44    -90 35    15   0 0 0 145 0 0 0 15   $ Assay port
4    BOX  -43.65 -55 35.25 14.5 0 0 0 110 0 0 0 14.5 $ box out
5    BOX  -43.35 -55 35.55 13.9 0 0 0 110 0 0 0 13.9 $ box in
6    BOX  -43.35 -55 35.55  0.6 0 0 0 110 0 0 0  0.6 $ Al corner
7    BOX  -43.35 -55 49.45  0.6 0 0 0 110 0 0 0 -0.6 $ Al corner
8    BOX  -29.45 -55 35.55 -0.6 0 0 0 110 0 0 0  0.6 $ Al corner
9    BOX  -29.45 -55 49.45 -0.6 0 0 0 110 0 0 0 -0.6 $ Al corner
c
10   C/Y  -36.5  42.5  12
11   C/Y  -36.5  42.5  20
12   C/Y  -36.5  42.5  30
13   C/Y  -36.5  42.5  40
14   C/Y  -36.5  42.5  50
15   PY  -30
16   PY   30
17   PY   -53.0225
18   PY    53.0225
19   PZ   50
c
c fuel pin
c 201  BOX  0 -53.0225 0  1.6256 0 0  0 171.78 0  0 0 1.6256
200  RPP     0 13.0048 -103.46 0  0 13.0048
201  RPP     0 1.6256 -103.46 0  0 1.6256
c
C     Pin stuff
202   py       0.0
203   py      -0.9         $top of bottom plug
204   py      -1.22        $Top of bottom spacer
205   cy       0.59182     $clad O.D.
206   py     -92.66        $top of fuel region
```

```
207   cy       0.5334      $Fuel pellet radius
208   cy       0.54102     $Gap radius
c     Upper pin stuff
210   py      -92.98
211   py      -93.3
212   py      -98.38
213   py     -100.28
214   py     -103.46
c
c
230  RCC  0  -10. 0  0  20. 0    1.25       $ detector 1 hole
240  CY    1.5875                     $ detector pipe outside
241  CY    1.37668                    $ detector pipe inside
302  CY   1.905                       $ Source Pipe
303  CY   1.8161                      $ Source Pipe
c
400  BOX 0 -90 0  5.08 0 0 0 30.48 0 0 0 15 $ Lead Brick
c
c

c Material specifications
c lead
M1      82204 -1.37808E-02
        82206 -2.39555E-01
        82207 -2.20743E-01
        82208 -5.25921E-01
         1001 -2E-6   $ 2 ppm H2
c
c fuel 4.807 w% / 4.868 at% enrichment
C     fuel
m52    92233 0.0000009855 $ 0.000003*0.32854
      92234 0.0000844348 $ 0.000257*0.32854
      92235 0.0159864279 $ 0.048659*0.32854
      92236 0.0001550709 $ 0.000472*0.32854
      92238 0.3123130809 $ 0.950609*0.32854
      8016  0.67146
      nlib=70c
C
C     stainless steel
m53    26056  0.69500    24052  0.19000    28058  0.09500    25055  0.02000
      nlib=70c
C
C     Al2O3 Spacers
m54    13027  0.4        8016   0.6
      nlib=70c
C
C     Gas Plenum
m55    1001  0.5         2004  0.5
      nlib=70c
C
C     Spring Region
m56    26056  0.69500   24052  0.19000    28058  0.09500     25055  0.02000
      nlib=70c
C
C     Top of pin (SS comp=SS*0.674)
m57    26056  0.46843 $ 0.69500*0.674
      24052  0.12806 $ 0.19000*0.674
      28058  0.06403 $ 0.09500*0.674
      25055  0.01348 $ 0.02000*0.674
      nlib=70c
c
c
M4      $ PuBe13 source
        13027          9.8087E-01
        14028          5.3259E-03
        14029          2.7044E-04
        14030          1.7827E-04
        29063          8.2391E-04
        29065          3.6723E-04
        12024          8.7856E-03
        12025          1.1122E-03
```

```
       12026          1.2246E-03
       24050          4.5181E-05
       24052          8.7126E-04
       24053          9.8794E-05
       24054          2.4592E-05
       nlib=70c
c
M5     $ Aluminum 6061
       13027          -97.375
       14028          -0.55338
       14029          -0.02802
       14030          -0.0186
       26054          -0.0203
       26056          -0.32102
       26057          -0.0077
       26058          -0.00098
       29063          -0.1901625
       29065          -0.0848375
       25055          -0.075
       12024          -0.7899
       12025          -0.1
       12026          -0.1101
       24050          -0.00869
       24052          -0.167578
       24053          -0.019002
       24054          -0.00473
       30000          -0.125
       22046          -0.006
       22047          -0.005475
       22048          -0.05535
       22049          -0.004125
       22050          -0.00405
       nlib=70c
c
M40   94239.70c 93.6       $ Weapon Pu9 detector
      94240.70c 5.9
      95241.70c 0.4        $ Pu241 decayed to Am241
      94242.70c 0.1
c
m99   8016.70c 1
      1001.70c 2
mt99      lwtr.10t
c
c
c source specification etc.
c
MODE N
c
prdmp j 2E3 j 4 2e3
print -128
c
c sources
c
kcode 100 0.1   50 1000
ksrc 0 0 0
c
c
c WEIGHT WINDOW USE
c
IMP:N         0 1 1
              1 1 1 1 1
              1 1 1 1 1
              1 1 1 1 1
              1 10r 1 9r
c
c
c
```

case4.inp

```
LSDS SPERT fuel assembly 8 x 8
c
c     /____________________ /
c    |      V               |
c    |   /___ /             |
c    |  |    |              |
c    |  |    | /            |
c   z|  |____|/             |
c    |           s          |
c    |                      |   /
c    |                      |  /
c    |                      | / y
c    |______________________|/
c                x
c
c cell cards
99  0 999                                $VOID
98  99 -1  1 -999
1   1 -11.34  -1     14                $Lead rest
c
100  1 -11.34  -1 13 -14  -15           $lead zone 5a
110  1 -11.34  -1 12 -13  -15           $lead zone 4a
120  1 -11.34  -1 11 -12  -15           $lead zone 3a
130  1 -11.34  -1 10 -11  -15           $lead zone 2a
140  1 -11.34  -1 (3 30)  -10  -15           $lead zone 1a
101  1 -11.34  -1 13 -14  -16 15        $lead zone 5b
111  1 -11.34  -1 12 -13  -16 15        $lead zone 4b
121  1 -11.34  -1 11 -12  -16 15        $lead zone 3b
131  1 -11.34  -1 10 -11  -16 15        $lead zone 2b
141  1 -11.34  -1 (3 30)  -10  -16 15 #300 #301   $lead zone 1b
102  1 -11.34  -1 13 -14   16           $lead zone 5c
112  1 -11.34  -1 12 -13   16           $lead zone 4c
122  1 -11.34  -1 11 -12   16           $lead zone 3c
132  1 -11.34  -1 10 -11   16           $lead zone 2c
142  1 -11.34  -1 (3 30)  -10   16           $lead zone 1c
c
300   99 -1          -230    trcl=(-36.5 0 52.5)             $ detector in lead center
301   99 -1          -230    trcl=(-33.5 0 52.5)             $ detector in lead right
c
2   99 -1          (-3: -30) 4 #400
3   4  -2.7    (-4 5):-6:-7:-8:-9                   $ Al Box
4   99 -1          -5 #3  17 -18
                  #250 #251 #252 #253 #254 #255
                              fill=1                $ fill with pins
5   99 -1          -5 #3 -17                            $ below pins
6   99 -1          -5 #3  18                            $ above pins
7   99 -1          -201 u=1 lat=1 trcl=(-35.6872 51.73 43.3128)    $ fuel
                fill= -5:4 0:0 -5:4
               8 8 8 8 8 8 8 8 8 8
               8 2 2 2 2 2 2 2 2 8
               8 2 2 2 2 2 2 2 2 8
               8 2 2 2 8 8 2 2 2 8
               8 2 2 8 8 8 8 2 2 8
               8 2 2 8 8 8 8 2 2 8
               8 2 2 2 8 8 2 2 2 8
               8 2 2 2 2 2 2 2 2 8
               8 2 2 2 2 2 2 2 2 8
               8 8 8 8 8 8 8 8 8 8
c
250 5  -2.7    -302 303 17 -18 trcl=(-36.5 0 42.5)        $ PuBe Pipe
251 5  -2.7       -301 300     trcl=(-36.5 0 42.5)        $ PuBe Cladding
252 0             -300 299     trcl=(-36.5 0 42.5)        $ PuBe gap
253 50  -16.65    -299 298     trcl=(-36.5 0 42.5)        $ Ta cladding
254 0             -298 297     trcl=(-36.5 0 42.5)        $ gap
255 40  -4.01414       -297    trcl=(-36.5 0 42.5)        $ PuBe powder
c
206   53 -8.0         -202 203 -205         u=2   $plug
207   54 -3.9         -203 204 -208         u=2   $spacer
```

```
208   53 -8.0         -203 213 -205 208     u=2   $cladding
209   55 -17.8e-5     -204 206 -208 207     u=2   $gap (He)
210   52 -10.078      -204 206 -207         u=2   $Fuel
212   54 -3.9         -206 210 -208         u=2   $insulator
213   53 -8.0         -210 211 -208         u=2   $spacer
214   56 -1.0         -211 212 -208         u=2   $spring
215   53 -8.0         -212 213 -208         u=2   $plug
216   57 -4.11        -213 214 -205         u=2   $top of pin
217   99 -1                205:-214:202         u=2
220   99 -1                204                  u=8
221   99 -1               -204                  u=8
c
400  1 -11.34 -400 trcl=(-44 0 35.0)                $ additional brick

c cube Surface Cards
999  SO  400
1    BOX  -90   -90 -90 180 0 0  0 180 0  0 0 180
3    BOX  -44    -90 35    15   0 0 0 145 0 0 0 15   $ Assay port
30   BOX  -41.5  -90 32    10   0 0 0 100 0 0 0 3    $ Lower Detector
4    BOX  -43.65 -55 35.25 14.5 0 0 0 110 0 0 0 14.5 $ box out
5    BOX  -43.35 -55 35.55 13.9 0 0 0 110 0 0 0 13.9 $ box in
6    BOX  -43.35 -55 35.55  0.6 0 0 0 110 0 0 0  0.6 $ Al corner
7    BOX  -43.35 -55 49.45  0.6 0 0 0 110 0 0 0 -0.6 $ Al corner
8    BOX  -29.45 -55 35.55 -0.6 0 0 0 110 0 0 0  0.6 $ Al corner
9    BOX  -29.45 -55 49.45 -0.6 0 0 0 110 0 0 0 -0.6 $ Al corner
c
10   C/Y  -36.5  42.5  12
11   C/Y  -36.5  42.5  20
12   C/Y  -36.5  42.5  30
13   C/Y  -36.5  42.5  40
14   C/Y  -36.5  42.5  50
15   PY  -30
16   PY   30
17   PY   -51.73
18   PY    51.73
19   PZ   50
c
c fuel pin
c 201  BOX  0 -53.0225 0  1.6256 0 0  0 171.78 0  0 0 1.6256
201  RPP     -0.8128 0.8128 -103.46 0  -0.8128 0.8128
c
C     Pin stuff
202   py       0.0
203   py      -0.9         $top of bottom plug
204   py      -1.22        $Top of bottom spacer
205   cy       0.59182     $clad O.D.
206   py     -92.66        $top of fuel region
207   cy       0.5334      $Fuel pellet radius
208   cy       0.54102     $Gap radius
c     Upper pin stuff
210   py      -92.98
211   py      -93.3
212   py      -98.38
213   py     -100.28
214   py     -103.46
c
c
230  RCC  0  -10. 0  0  20. 0    1.25       $ detector 1 hole
240  CY    1.5875                     $ detector pipe outside
241  CY    1.37668                    $ detector pipe inside
c
297  RCC  0  -3.500 0  0  7.0 0   1.25       $ PuBe Source
298  RCC  0  -3.74 0  0  7.48 0   1.4       $ gap
299  RCC  0  -3.82  0  0  7.64  0 1.48       $ Ta cladding
300  RCC  0  -3.9  0  0  7.8 0    1.54       $ PuBe air
301  RCC  0  -4.15 0  0  8.3 0    1.79       $ PuBe Cladding
302  CY   1.905                       $ Source Pipe
303  CY   1.8161                      $ Source Pipe
c
304  RCC 0 -12 0  0 24 0    1.2
c
```

```
400  BOX 0 -90 0  5.08 0 0 0 30.48 0 0 0 15 $ Lead Brick
c
c

c Material specifications
c lead
M1     82204 -1.37808E-02
       82206 -2.39555E-01
       82207 -2.20743E-01
       82208 -5.25921E-01
        1001 -2E-6   $ 2 ppm H2
       nlib=70c
c
c fuel 4.807 w% / 4.868 at% enrichment
C     fuel
m52    92233 0.0000009855 $ 0.000003*0.32854
      92234 0.0000844348 $ 0.000257*0.32854
      92235 0.0159864279 $ 0.048659*0.32854
      92236 0.0001550709 $ 0.000472*0.32854
      92238 0.3123130809 $ 0.950609*0.32854
      8016  0.67146
      nlib=70c
C
C     stainless steel
m53    26056  0.69500    24052  0.19000    28058  0.09500    25055  0.02000
      nlib=70c
C
C     Al2O3 Spacers
m54    13027  0.4        8016   0.6
      nlib=70c
C
C     Gas Plenum
m55    1001  0.5         2004  0.5
      nlib=70c
C
C     Spring Region
m56    26056  0.69500   24052  0.19000    28058  0.09500     25055  0.02000
      nlib=70c
C
C     Top of pin (SS comp=SS*0.674)
m57    26056  0.46843 $ 0.69500*0.674
      24052  0.12806 $ 0.19000*0.674
      28058  0.06403 $ 0.09500*0.674
      25055  0.01348 $ 0.02000*0.674
      nlib=70c
c
c
M4     $ PuBe13 source
       13027          9.8087E-01
       14028          5.3259E-03
       14029          2.7044E-04
       14030          1.7827E-04
       29063          8.2391E-04
       29065          3.6723E-04
       12024          8.7856E-03
       12025          1.1122E-03
       12026          1.2246E-03
       24050          4.5181E-05
       24052          8.7126E-04
       24053          9.8794E-05
       24054          2.4592E-05
       nlib=70c
c
M5     $ Aluminum 6061
       13027          -97.375
       14028          -0.55338
       14029          -0.02802
       14030          -0.0186
       26054          -0.0203
       26056          -0.32102
       26057          -0.0077
```

```
       26058           -0.00098
       29063           -0.1901625
       29065           -0.0848375
       25055           -0.075
       12024           -0.7899
       12025           -0.1
       12026           -0.1101
       24050           -0.00869
       24052           -0.167578
       24053           -0.019002
       24054           -0.00473
       30000           -0.125
       22046           -0.006
       22047           -0.005475
       22048           -0.05535
       22049           -0.004125
       22050           -0.00405
       nlib=70c
c
M40     $ PuBe13 source
        94239.70c   -84.24
        94240.70c    -5.31
        94242.70c    -0.09
        95241.70c    -0.36   $ Pu241 decayed to Am241
        4009.70c    -48.46
c
c
M50   73181    1
      nlib=70c
c
m99   8016.70c 1
      1001.70c 2
mt99      lwtr.10t
c
c
c source specification etc.
c
MODE N
prdmp j 1E3 j 4 j
print -128
c
c sources
c
kcode 100 0.1   50 1000
ksrc 0 0 0
c
c WEIGHT WINDOW USE
c
IMP:N         0 1 44r
c
```

case5.inp

```
SPERT fuel material + PuBe source as sphere
c cell cards
99  0 2                IMP:N 0               $VOID
1   1 -19.05  -1       IMP:N 1               $sphere
2   2 -1.0     1 -2    IMP:N 1               $water
c

c surfaces
1  SO  8.349
2  SO  400

c materials
m1
        92233     -1.3619E-01
        92234     -1.1718E+01
        92235     -2.2281E+03
```

```
        92236     -2.1705E+01
        92238     -4.4086E+04
        94239     -9.0000E+01
        nlib=70c
c
m2    8016.70c 1
      1001.70c 2
mt2   lwtr.10t
c source specification etc.
c
MODE N
kcode 1000 0.4   50 400
ksrc 0 0 0
c
print -128
```

case6.inp

```
SPERT fuel assembly 8 x 8
c
c
c cell cards
99  0 999                               $VOID
98  99 -1  200 -999
8  99 -1           -200 fill=1
9  99 -1           -201  u=1 lat=1  $ fuel
                      fill= 0:7 0:0 0:7
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
c
c
c
206   53 -8.0         -202 203 -205         u=2  trcl=(0.8128 0 0.8128) $plug
207   54 -3.9         -203 204 -208         u=2  trcl=(0.8128 0 0.8128) $spacer
208   53 -8.0         -203 213 -205 208     u=2  trcl=(0.8128 0 0.8128) $cladding
209   55 -17.8e-5     -204 206 -208 207     u=2  trcl=(0.8128 0 0.8128) $gap (He)
210   52 -10.078      -204 206 -207         u=2  trcl=(0.8128 0 0.8128)
                                            vol=5230.848  $Fuel
212   54 -3.9         -206 210 -208         u=2  trcl=(0.8128 0 0.8128) $insulator
213   53 -8.0         -210 211 -208         u=2  trcl=(0.8128 0 0.8128) $spacer
214   56 -1.0         -211 212 -208         u=2  trcl=(0.8128 0 0.8128) $spring
215   53 -8.0         -212 213 -208         u=2  trcl=(0.8128 0 0.8128) $plug
216   57 -4.11        -213 214 -205         u=2  trcl=(0.8128 0 0.8128) $top of pin
217   99 -1                 205:-214:202         u=2  trcl=(0.8128 0 0.8128)
c

c Surface Cards
999  SO  400
c
c fuel pin
200  RPP     0 13.0048 -103.46 0  0 13.0048
201  RPP     0 1.6256 -103.46 0  0 1.6256
c
C     Pin stuff
202   py       0.0
203   py      -0.9         $top of bottom plug
204   py      -1.22        $Top of bottom spacer
205   cy       0.59182     $clad O.D.
206   py     -92.66        $top of fuel region
207   cy       0.5334      $Fuel pellet radius
208   cy       0.54102     $Gap radius
c     Upper pin stuff
210   py      -92.98
```

```
211   py      -93.3
212   py      -98.38
213   py     -100.28
214   py     -103.46
c
c
230  RCC  0  -10. 0  0  20. 0    1.25       $ detector 1 hole
240  CY    1.5875                     $ detector pipe outside
241  CY    1.37668                    $ detector pipe inside
302  CY   1.905                       $ Source Pipe
303  CY   1.8161                      $ Source Pipe
c
c
c

c Material specifications
c lead
M1     82204 -1.37808E-02
       82206 -2.39555E-01
       82207 -2.20743E-01
       82208 -5.25921E-01
        1001 -2E-6   $ 2 ppm H2
c
c fuel 4.807 w% / 4.868 at% enrichment
C     fuel
m52    92233 0.0000009855 $ 0.000003*0.32854
      92234 0.0000844348 $ 0.000257*0.32854
      92235 0.0159864279 $ 0.048659*0.32854
      92236 0.0001550709 $ 0.000472*0.32854
      92238 0.3123130809 $ 0.950609*0.32854
      8016  0.67146
      nlib=70c
C
C     stainless steel
m53    26056  0.69500    24052  0.19000    28058  0.09500    25055  0.02000
      nlib=70c
C
C     Al2O3 Spacers
m54    13027  0.4        8016   0.6
      nlib=70c
C
C     Gas Plenum
m55    1001  0.5         2004  0.5
      nlib=70c
C
C     Spring Region
m56    26056  0.69500   24052  0.19000    28058  0.09500     25055  0.02000
      nlib=70c
C
C     Top of pin (SS comp=SS*0.674)
m57    26056  0.46843 $ 0.69500*0.674
      24052  0.12806 $ 0.19000*0.674
      28058  0.06403 $ 0.09500*0.674
      25055  0.01348 $ 0.02000*0.674
      nlib=70c
c
c
M4     $ PuBe13 source
       13027          9.8087E-01
       14028          5.3259E-03
       14029          2.7044E-04
       14030          1.7827E-04
       29063          8.2391E-04
       29065          3.6723E-04
       12024          8.7856E-03
       12025          1.1122E-03
       12026          1.2246E-03
       24050          4.5181E-05
       24052          8.7126E-04
       24053          9.8794E-05
       24054          2.4592E-05
```

```
       nlib=70c
c
M5     $ Aluminum 6061
       13027          -97.375
       14028          -0.55338
       14029          -0.02802
       14030          -0.0186
       26054          -0.0203
       26056          -0.32102
       26057          -0.0077
       26058          -0.00098
       29063          -0.1901625
       29065          -0.0848375
       25055          -0.075
       12024          -0.7899
       12025          -0.1
       12026          -0.1101
       24050          -0.00869
       24052          -0.167578
       24053          -0.019002
       24054          -0.00473
       30000          -0.125
       22046          -0.006
       22047          -0.005475
       22048          -0.05535
       22049          -0.004125
       22050          -0.00405
       nlib=70c
c
M40   94239.70c 93.6       $ Weapon Pu9 detector
      94240.70c 5.9
      95241.70c 0.4        $ Pu241 decayed to Am241
      94242.70c 0.1
c
m99   8016.70c 1
      1001.70c 2
mt99      lwtr.10t
c
c
c
c
c source specification etc.
c
MODE N
c
prdmp j 2E3 j 4 2e3
print -128
c
c sources
c
kcode 10000 0.1   50 400
ksrc 12.3 -40 1
c sdef ERG=D1 tme=d2
c SP1 -2 0.46                          $Source distribution
c si2   -4.9 4.9
c sp2    0    1
c
c
c WEIGHT WINDOW USE
c
IMP:N         0 1 13r
c
c Tallies
c
c
```

case17.inp

```
SPERT fuel assembly 8 x 8
c
c
c cell cards
99  0 999                                $VOID
98  99 -1  200 -999
8  99 -1           -200 fill=1
9  99 -1           -201  u=1 lat=1  $ fuel
                      fill= 0:7 0:0 0:7
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
c
c
c
206   53 -8.0         -202 203 -205         u=2  trcl=(0.8128 0 0.8128) $plug
207   54 -3.9         -203 204 -208         u=2  trcl=(0.8128 0 0.8128) $spacer
208   53 -8.0         -203 213 -205 208     u=2  trcl=(0.8128 0 0.8128) $cladding
209   55 -17.8e-5     -204 206 -208 207     u=2  trcl=(0.8128 0 0.8128) $gap (He)
210   52 -1.014491E+01    -204 206 -207         u=2  trcl=(0.8128 0 0.8128)
                                            vol=5230.848  $Fuel
212   54 -3.9         -206 210 -208         u=2  trcl=(0.8128 0 0.8128) $insulator
213   53 -8.0         -210 211 -208         u=2  trcl=(0.8128 0 0.8128) $spacer
214   56 -1.0         -211 212 -208         u=2  trcl=(0.8128 0 0.8128) $spring
215   53 -8.0         -212 213 -208         u=2  trcl=(0.8128 0 0.8128) $plug
216   57 -4.11        -213 214 -205         u=2  trcl=(0.8128 0 0.8128) $top of pin
217   99 -1                 205:-214:202         u=2  trcl=(0.8128 0 0.8128)
c

c Surface Cards
999  SO  400
c
c fuel pin
200  RPP     0 22 -103.46 0  0 22
201  RPP     0 2.75 -103.46 0  0 2.75
c
C     Pin stuff
202   py       0.0
203   py      -0.9         $top of bottom plug
204   py      -1.22        $Top of bottom spacer
205   cy       0.59182     $clad O.D.
206   py     -92.66        $top of fuel region
207   cy       0.5334      $Fuel pellet radius
208   cy       0.54102     $Gap radius
c     Upper pin stuff
210   py      -92.98
211   py      -93.3
212   py      -98.38
213   py     -100.28
214   py     -103.46
c
c
230  RCC  0  -10. 0  0  20. 0    1.25       $ detector 1 hole
240  CY    1.5875                     $ detector pipe outside
241  CY    1.37668                    $ detector pipe inside
302  CY   1.905                       $ Source Pipe
303  CY   1.8161                      $ Source Pipe
c
c
c

c Material specifications
c lead
M1     82204 -1.37808E-02
```

```
       82206 -2.39555E-01
       82207 -2.20743E-01
       82208 -5.25921E-01
        1001 -2E-6   $ 2 ppm H2
c
c fuel 4.807 w% / 4.868 at% enrichment
C     fuel
m52
      92233    -1.361852E-01
      92234    -1.171809E+01
      92235    -2.578142E+03
      92236    -2.170544E+01
      92238    -4.408618E+04
      8016     -6.368628E+03
      nlib=70c
C
C     stainless steel
m53    26056  0.69500    24052  0.19000    28058  0.09500    25055  0.02000
      nlib=70c
C
C     Al2O3 Spacers
m54    13027  0.4        8016   0.6
      nlib=70c
C
C     Gas Plenum
m55    1001  0.5         2004  0.5
      nlib=70c
C
C     Spring Region
m56    26056  0.69500   24052  0.19000    28058  0.09500     25055  0.02000
      nlib=70c
C
C     Top of pin (SS comp=SS*0.674)
m57    26056  0.46843 $ 0.69500*0.674
      24052  0.12806 $ 0.19000*0.674
      28058  0.06403 $ 0.09500*0.674
      25055  0.01348 $ 0.02000*0.674
      nlib=70c
c
c
M4     $ PuBe13 source
       13027          9.8087E-01
       14028          5.3259E-03
       14029          2.7044E-04
       14030          1.7827E-04
       29063          8.2391E-04
       29065          3.6723E-04
       12024          8.7856E-03
       12025          1.1122E-03
       12026          1.2246E-03
       24050          4.5181E-05
       24052          8.7126E-04
       24053          9.8794E-05
       24054          2.4592E-05
       nlib=70c
c
M5     $ Aluminum 6061
       13027          -97.375
       14028          -0.55338
       14029          -0.02802
       14030          -0.0186
       26054          -0.0203
       26056          -0.32102
       26057          -0.0077
       26058          -0.00098
       29063          -0.1901625
       29065          -0.0848375
       25055          -0.075
       12024          -0.7899
       12025          -0.1
       12026          -0.1101
```

```
       24050          -0.00869
       24052          -0.167578
       24053          -0.019002
       24054          -0.00473
       30000          -0.125
       22046          -0.006
       22047          -0.005475
       22048          -0.05535
       22049          -0.004125
       22050          -0.00405
       nlib=70c
c
M40   94239.70c 93.6       $ Weapon Pu9 detector
      94240.70c 5.9
      95241.70c 0.4        $ Pu241 decayed to Am241
      94242.70c 0.1
c
m99   8016.70c 1
      1001.70c 2
mt99      lwtr.10t
c
c
c
c
c source specification etc.
c
MODE N
c
prdmp j 2E3 j 4 2e3
print -128
c
c sources
c
kcode 10000 0.1   50 400
ksrc 12.3 -40 1
c sdef ERG=D1 tme=d2
c SP1 -2 0.46                            $Source distribution
c si2   -4.9 4.9
c sp2    0    1
c
c
c WEIGHT WINDOW USE
c
IMP:N         0 1 13r
c
c Tallies
c
c
```

case18.inp

```
SPERT fuel assembly 8 x 8
c
c
c cell cards
99  0 999                              $VOID
98  99 -1  200 -999
8  99 -1           -200 fill=1
9  99 -1           -201  u=1 lat=1  $ fuel
                      fill= 0:7 0:0 0:7
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
                      2 2 2 2 2 2 2 2
c
```

```
c
c
206   53 -8.0         -202 203 -205         u=2  trcl=(0.8128 0 0.8128) $plug
207   54 -3.9         -203 204 -208         u=2  trcl=(0.8128 0 0.8128) $spacer
208   53 -8.0         -203 213 -205 208     u=2  trcl=(0.8128 0 0.8128) $cladding
209   55 -17.8e-5     -204 206 -208 207     u=2  trcl=(0.8128 0 0.8128) $gap (He)
210   52 -1.007800E+01    -204 206 -207         u=2  trcl=(0.8128 0 0.8128)
                                        vol=5230.848  $Fuel
212   54 -3.9         -206 210 -208         u=2  trcl=(0.8128 0 0.8128) $insulator
213   53 -8.0         -210 211 -208         u=2  trcl=(0.8128 0 0.8128) $spacer
214   56 -1.0         -211 212 -208         u=2  trcl=(0.8128 0 0.8128) $spring
215   53 -8.0         -212 213 -208         u=2  trcl=(0.8128 0 0.8128) $plug
216   57 -4.11        -213 214 -205         u=2  trcl=(0.8128 0 0.8128) $top of pin
217   99 -1                 205:-214:202         u=2  trcl=(0.8128 0 0.8128)
c

c Surface Cards
999  SO  400
c
c fuel pin
200  RPP     0 22 -103.46 0  0 22
201  RPP     0 2.75 -103.46 0  0 2.75
c
C     Pin stuff
202   py       0.0
203   py      -0.9         $top of bottom plug
204   py      -1.22        $Top of bottom spacer
205   cy       0.59182     $clad O.D.
206   py     -92.66        $top of fuel region
207   cy       0.5334      $Fuel pellet radius
208   cy       0.54102     $Gap radius
c     Upper pin stuff
210   py      -92.98
211   py      -93.3
212   py      -98.38
213   py     -100.28
214   py     -103.46
c
c
230  RCC  0  -10. 0  0  20. 0    1.25       $ detector 1 hole
240  CY    1.5875                     $ detector pipe outside
241  CY    1.37668                    $ detector pipe inside
302  CY   1.905                       $ Source Pipe
303  CY   1.8161                      $ Source Pipe
c
c
c

c Material specifications
c lead
M1     82204 -1.37808E-02
       82206 -2.39555E-01
       82207 -2.20743E-01
       82208 -5.25921E-01
        1001 -2E-6   $ 2 ppm H2
c
c fuel 4.807 w% / 4.868 at% enrichment
C     fuel
m52
      92233    -1.361852E-01
      92234    -1.171809E+01
      92235    -2.228142E+03
      92236    -2.170544E+01
      92238    -4.408618E+04
      8016     -6.368628E+03
      94239    -2.000000E+02
      nlib=70c
C
C     stainless steel
m53    26056  0.69500    24052  0.19000    28058  0.09500    25055  0.02000
      nlib=70c
```

```
C
C     Al2O3 Spacers
m54    13027  0.4        8016   0.6
      nlib=70c
C
C     Gas Plenum
m55    1001  0.5         2004  0.5
      nlib=70c
C
C     Spring Region
m56    26056  0.69500   24052  0.19000    28058  0.09500     25055  0.02000
      nlib=70c
C
C     Top of pin (SS comp=SS*0.674)
m57    26056  0.46843 $ 0.69500*0.674
      24052  0.12806 $ 0.19000*0.674
      28058  0.06403 $ 0.09500*0.674
      25055  0.01348 $ 0.02000*0.674
      nlib=70c
c
c
M4     $ PuBe13 source
       13027          9.8087E-01
       14028          5.3259E-03
       14029          2.7044E-04
       14030          1.7827E-04
       29063          8.2391E-04
       29065          3.6723E-04
       12024          8.7856E-03
       12025          1.1122E-03
       12026          1.2246E-03
       24050          4.5181E-05
       24052          8.7126E-04
       24053          9.8794E-05
       24054          2.4592E-05
       nlib=70c
c
M5     $ Aluminum 6061
       13027          -97.375
       14028          -0.55338
       14029          -0.02802
       14030          -0.0186
       26054          -0.0203
       26056          -0.32102
       26057          -0.0077
       26058          -0.00098
       29063          -0.1901625
       29065          -0.0848375
       25055          -0.075
       12024          -0.7899
       12025          -0.1
       12026          -0.1101
       24050          -0.00869
       24052          -0.167578
       24053          -0.019002
       24054          -0.00473
       30000          -0.125
       22046          -0.006
       22047          -0.005475
       22048          -0.05535
       22049          -0.004125
       22050          -0.00405
       nlib=70c
c
M40   94239.70c 93.6       $ Weapon Pu9 detector
      94240.70c 5.9
      95241.70c 0.4        $ Pu241 decayed to Am241
      94242.70c 0.1
c
m99   8016.70c 1
      1001.70c 2
```

```
mt99      lwtr.10t
c
c
c
c
c source specification etc.
c
MODE N
c
prdmp j 2E3 j 4 2e3
print -128
c
c sources
c
kcode 10000 0.1   50 400
ksrc 12.3 -40 1
c sdef ERG=D1 tme=d2
c SP1 -2 0.46                             $Source distribution
c si2   -4.9 4.9
c sp2    0    1
c
c
c WEIGHT WINDOW USE
c
IMP:N         0 1 13r
c
c Tallies
c
c
```

Appendix A-6
Consolidated Financial Statements for Rensselaer Polytechnic Institute

Rensselaer Polytechnic Institute

Consolidated Financial Statements

For the Years Ended
June 30, 2009 and 2008

Rensselaer Polytechnic Institute

Consolidated Financial Statements

For the Years Ended
June 30, 2009 and 2008

Contents

PRICEWATERHOUSECOOPERS

PricewaterhouseCoopers LLP
677 Broadway
Albany NY 12207
Telephone (518) 462 2030
Facsimile (518) 427 4499

Report of Independent Auditors

To The Board of Trustees
Rensselaer Polytechnic Institute

In our opinion, the accompanying consolidated statements of financial position and the related consolidated statements of activities and cash flows present fairly, in all material respects, the financial position of Rensselaer Polytechnic Institute and its affiliates ("Rensselaer") at June 30, 2009 and June 30, 2008, and the change in their net assets and their cash flows for the years then ended in conformity with accounting principles generally accepted in the United States of America. These financial statements are the responsibility of the Rensselaer's management. Our responsibility is to express an opinion on these financial statements based on our audits. We conducted our audits of these statements in accordance with auditing standards generally accepted in the United States of America. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements, assessing the accounting principles used and significant estimates made by management, and evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

PricewaterhouseCoopers LLP

September 23, 2009

Rensselaer Polytechnic Institute
Consolidated Statements of Financial Position
At June 30, 2009 and June 30, 2008
(in thousands of dollars)

Assets	*2009*	*2008*
Cash and cash equivalents (Note B)	$ 2,720	$ 4,068
Accounts receivable, net (Note B)		
Student related and other	8,635	8,395
Research, training and other agreements (Note E)	27,886	21,832
Contributions receivable, net (Note D)	37,859	39,120
Contributions from external remainder trusts (Note H)	7,783	9,374
Inventories (Note B)	2,050	2,492
Prepaid expenses and other assets	7,443	8,297
Deposits with bond trustees (Note K)	2,138	77,106
Student loans receivable, net (Note B)	33,246	31,683
Investments, at market (Note H)	616,552	807,865
Land, buildings and equipment, net (Note J)	743,356	651,206
Total assets	$ 1,489,668	$ 1,661,438

Liabilities		
Accounts payable and accrued expenses	$ 47,745	$ 53,982
Short term borrowings (Note K)	16,010	-
Deferred revenue	20,752	20,625
Liability on interest rate swap agreements (Notes B and H))	50,684	32,413
Split interest agreement obligations (Note F)	7,599	10,431
Other liabilities	8,890	8,384
Pension liability (Note L)	89,069	43,470
Accrued postretirement benefits (Note L)	13,555	12,446
Refundable government loan funds	26,427	26,012
Capital Leases payable (Note M)	19,946	83
Long-term debt (Note K)	653,957	619,941
Total liabilities	$ 954,634	$ 827,787

Net Assets		
Unrestricted	187,664	467,904
Temporarily restricted	90,694	117,348
Permanently restricted	256,676	248,399
Total net assets	535,034	833,651
Total liabilities and net assets	$ 1,489,668	$ 1,661,438

The accompanying notes are an integral part of these consolidated financial statements.

Rensselaer Polytechnic Institute
Consolidated Statement of Activities
For The Year Ended June 30, 2009, with comparative June 30, 2008 totals
(in thousands of dollars)

	Unrestricted	*Temporarily Restricted*	*Permanently Restricted*	*Total June 30, 2009*	*Total June 30, 2008*
Operating Revenue:					
Student related revenue:					
Student tuition and fees, net					
Undergraduate	$ 106,028	$ -	$ -	$ 106,028	$ 94,242
Graduate	35,402			35,402	31,715
Education for working professionals	19,883			19,883	18,622
Fees	1,573			1,573	1,533
Auxiliary services	44,409			44,409	41,339
Student related revenue	207,295	-	-	207,295	187,451
Gifts	22,160	2,581		24,741	33,560
Grants and contracts:					
Direct:					
Federal	49,919			49,919	49,081
State	17,053			17,053	14,132
Private	7,089			7,089	5,418
Indirect	17,312			17,312	15,036
Grants and contracts	91,373	-	-	91,373	83,667
Investment return:					
Dividends and interest	7,393	813		8,206	12,585
Realized accumulated gains used to meet spending policy	19,555	2,559		22,114	18,585
Endowment spending for Rensselaer Plan initatitives	30,900			30,900	38,339
Interest on student loans	114			114	114
Investment return	57,962	3,372	-	61,334	69,623
Rensselaer Technology Park	4,698			4,698	4,248
Other	8,926	51		8,977	11,633
Net assets released from restrictions	15,586	(15,586)		-	-
Total operating revenue	408,000	(9,582)	-	398,418	390,182
Operating Expense:					
Instruction	135,565			135,565	131,395
Research:					
Sponsored	93,076			93,076	86,417
Unsponsored	13,719			13,719	15,897
Student services	13,032			13,032	12,853
Institutional and academic support	92,241			92,241	92,845
Externally funded scholarships and fellowships	15,526			15,526	13,702
Auxiliary services	27,935			27,935	26,179
Rensselaer Technology Park	3,623			3,623	3,861
Defined benefit pension and postretirement	9,662			9,662	12,587
Total operating expenses	404,379	-	-	404,379	395,736
Change in net assets from operating activities	3,621	(9,582)	-	(5,961)	(5,554)
Non-operating:					
Realized and unrealized gains (losses), net of spending policy	(205,834)	(14,841)	(219)	(220,894)	(70,367)
Realized and unrealized gains (losses), interest rate swaps	(25,788)			(25,788)	(23,239)
Adjustment for pension and postretirement benefits liability	(51,109)			(51,109)	(5,889)
Life income and endowment gifts		(5)	9,197	9,192	14,866
Loss on extinguishment of debt				-	(4,800)
Change in value of life income contracts		(2,226)	(701)	(2,927)	(874)
Gain (loss) on disposal of fixed assets	(1,130)			(1,130)	(813)
Change in net assets from non-operating activities	(283,861)	(17,072)	8,277	(292,656)	(91,116)
Change in net assets	(280,240)	(26,654)	8,277	(298,617)	(96,670)
Net assets at beginning of year	467,904	117,348	248,399	833,651	930,321
Net assets at end of year	$ 187,664	$ 90,694	$ 256,676	$ 535,034	$ 833,651

The accompanying notes are an integral part of these consolidated financial statements.

Rensselaer Polytechnic Institute
Consolidated Statement of Activities
For The Year Ended June 30, 2008
(in thousands of dollars)

	Unrestricted	Temporarily Restricted	Permanently Restricted	Total June 30, 2008
Operating Revenue:				
Student related revenue:				
Student tuition and fees, net				
Undergraduate	$ 94,242	$ -	$ -	$ 94,242
Graduate	42,945			42,945
Education for working professionals	7,392			7,392
Fees	1,533			1,533
Auxiliary services	41,339			41,339
Student related revenue	187,451	-	-	187,451
Gifts	21,639	11,921		33,560
Grants and contracts:				
Direct:				
Federal	49,081			49,081
State	14,132			14,132
Private	5,418			5,418
Indirect	15,036			15,036
Grants and contracts	83,667	-	-	83,667
Investment return:				
Dividends and interest	11,451	1,134		12,585
Realized accumulated gains used to meet spending policy	16,684	1,901		18,585
Endowment spending for Rensselaer Plan initatitives	38,339			38,339
Interest on student loans	114			114
Investment return	66,588	3,035	-	69,623
Rensselaer Technology Park	4,248			4,248
Other	11,557	76		11,633
Net assets released from restrictions	13,172	(13,172)		-
Total operating revenue	388,322	1,860	-	390,182
Operating Expense:				
Instruction	131,395			131,395
Research:				
Sponsored	86,417			86,417
Unsponsored	15,897			15,897
Student services	12,853			12,853
Institutional and academic support	92,845			92,845
Externally funded scholarships and fellowships	13,702			13,702
Auxiliary services	26,179			26,179
Rensselaer Technology Park	3,861			3,861
Defined benefit pension and postretirement	12,587			12,587
Total operating expenses	395,736	-	-	395,736
Change in net assets from operating activities	(7,414)	1,860	-	(5,554)
Non-operating:				
Realized and unrealized gains (losses), net of spending policy	(69,098)	(1,812)	543	(70,367)
Realized and unrealized gains (losses), interest rate swaps	(23,239)			(23,239)
Adjustment for pension and postretirement benefits liability	(5,889)			(5,889)
Life income and endowment gifts		3,508	11,358	14,866
Loss on extinguishment of debt	(4,800)			(4,800)
Change in value of life income contracts		(744)	(130)	(874)
Gain (loss) on disposal of fixed assets	(813)			(813)
Change in net assets from non-operating activities	(103,839)	952	11,771	(91,116)
Change in net assets	(111,253)	2,812	11,771	(96,670)
Net assets at beginning of year	579,157	114,536	236,628	930,321
Net assets at end of year	$ 467,904	$ 117,348	$ 248,399	$ 833,651

The accompanying notes are an integral part of these consolidated financial statements.

Rensselaer Polytechnic Institute
Consolidated Statements of Cash Flows
For the years ended June 30, 2009 and 2008
(in thousands of dollars)

	2009	2008
Cash flow from operating activities:		
Total change in net assets	$ (298,617)	$ (96,670)
Adjustments to reconcile change in net assets to net cash provided by (used in) operating activities:		
Depreciation and amortization	34,054	29,015
Accretion expense	380	336
Loss on disposal of assets	1,130	813
Uncollectible contributions writeoff	545	2,045
Loan forgiveness	-	(3,660)
Loss on extinguishment of debt	-	4,800
Provision for uncollectible accounts and loans	37	(184)
Realized and unrealized (gains) losses on investments	167,879	13,443
Unrealized loss on interest rate swap	18,271	20,481
Contributions of equipment and other capital items	(184)	(112)
Receipt of contributed securities	(2,987)	(3,429)
Contribution restricted for long term investment	(9,192)	(14,866)
Change in value from external trusts	1,591	(3,282)
Changes in operating assets and liabilities:		
Accounts receivable	(6,474)	(1,972)
Contributions receivable	716	(7,616)
Inventories	442	(27)
Prepaid expense and other assets	657	(22)
Accounts payable and accrued expenses	668	(1,051)
Change in pension liability	45,599	(1,628)
Present value of split interest agreements, net of terminations	(2,832)	(2,312)
Deferred revenue	633	6,932
Accrued postretirement benefits	1,109	(1,244)
Net cash used in operating activities	(46,575)	(60,210)
Cash flow from investing activities:		
Proceeds from sale of investments	199,335	217,314
Purchase of investments	(172,914)	(199,810)
Additional student loans granted	(5,619)	(8,162)
Student loans paid	4,199	4,006
Deposit with bond trustees	74,968	(55,176)
Proceeds from sale of land, building, and equipment	827	75
Purchase of land, building, equipment	(112,267)	(98,375)
Net cash used in investing activities	(11,471)	(140,128)
Cash flow from financing activities:		
Contributions restricted for endowments	9,192	14,866
Payment of annuity obligations	(1,301)	(1,434)
Proceeds from issuance of bonds	-	141,795
Proceeds from loans/line of credit	261,293	241,065
Repayment of debt/line of credit	(212,901)	(199,017)
Deferred financing costs	-	(805)
Government loan funds	415	326
Net cash provided by financing activities	56,698	196,796
Net decrease in cash and cash equivalents	**(1,348)**	**(3,542)**
Cash and cash equivalents at beginning of the year	4,068	7,610
Cash and cash equivalents at end of year	**$ 2,720**	**$ 4,068**
Non cash investing activities		
Gifts of equipment and other capital items	$ 184	$ 112
Contributed securities	2,987	3,429
Seller financed debt	1,598	-
Capital Leases	19,899	-
(Decrease) increase of capital assets included in accounts payable	(5,984)	5,522
Supplemental disclosures of cash flow information		
Cash paid during the year for interest	$ 18,780	$ 21,389

The accompanying notes are an integral part of these consolidated financial statements.

Rensselaer Polytechnic Institute
Notes to the Consolidated Financial Statements
For the Years Ended June 30, 2009 and June 30, 2008

Note A- Organization

Rensselaer Polytechnic Institute (Rensselaer) is a nonsectarian, coeducational institution composed of five schools: Architecture, Engineering, Humanities and Social Sciences, Lally School of Management and Technology, and Science. More than 130 programs and 700 courses lead to bachelors', masters', and doctoral degrees in all five schools. Rensselaer Technology Park is a university related park for technology ventures seeking a unique environment focused on the interface between industry and education.

Note B- Summary of Significant Accounting Policies

Basis of Consolidation
The accompanying consolidated financial statements of Rensselaer have been prepared on the accrual basis and include Rensselaer Hartford Graduate Center, Inc. (Center). All significant inter-organizational accounts have been eliminated.

Net Asset Classification
Unrestricted Net Assets include all resources which are not subject to donor-imposed restrictions other than those which only obligate Rensselaer to utilize funds to further its educational mission.

Temporarily Restricted Net Assets carry specific, donor-imposed restrictions on the expenditure or other use of contributed funds. Temporary restrictions may expire either because of the passage of time or because certain actions are taken by Rensselaer which fulfill the restrictions.

Permanently Restricted Net Assets are those that are subject to donor-imposed restrictions which will never lapse, thus requiring that the funds be retained permanently.

Dividends, interest and net gains or losses on investments are reported as follows:

i) as increases in permanently restricted net assets if the terms of the gift require that they be added to the principle of a permanent endowment fund.
ii) as increases in temporarily restricted net assets if the terms of the gift impose restrictions on the current use of the income or net gains.
iii) as increases in unrestricted in all other cases.

Expenses are generally reported as decreases in unrestricted net assets. Expirations of donor-imposed stipulations that simultaneously increase one class of net assets and decrease another are reported as "net assets released from restrictions".

Use of Estimates
The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting period. Actual results could differ from those estimates.

Reclassifications
It is the Institute's policy to reclassify, where appropriate, prior year financial statements to conform to the current year presentation.

Tax Exempt Status
Rensselaer and Rensselaer Hartford Graduate Center, Inc are tax exempt 501(c) (3) Corporations under the Internal Revenue Service Code.

Effective July 1, 2008, Rensselaer adopted the FASB Interpretation No. 48 ("FIN48"), *Accounting for Uncertainty in Income Taxes*-an interpretation of SFAS No. 109, *Accounting for Income Taxes.* The adoption did not have a material effect on the financial statements.

Note B- Summary of Significant Accounting Policies, (continued)

Contributions
Unconditional contributions are recognized as contributions receivable at their estimated net present value when pledged. Temporarily restricted net assets are reclassified to unrestricted net assets when an expense is incurred that satisfies the donor-imposed restriction. Expenses are generally reported as decreases in unrestricted net assets. Contributions of assets other than cash are recorded at their estimated fair value at the date of gift. Conditional promises to give are not recognized until the conditions on which they depend are substantially met.

Recently Issued Accounting Pronouncements
In February 2007, the FASB issued Statement of Financial Accounting Standard No. 159, *The Fair Value Option for Financial Assets and Financial Liabilities* (SFAS 159). The standard permits entities to choose to measure many financial instruments and certain other items at fair value. Rensselaer elected not to adopt the provisions of this statement.

Non-Operating Activities
Rensselaer considers the change in net assets from operating activities on the consolidated statement of activities to be its operating indicator. Non-operating activities include realized and unrealized gains or losses on investments not used to support operations, realized and unrealized gains or losses on interest rate swap agreements, changes in the value of split interest agreements, loss on extinguishment of debt, adjustment for pension and postretirement benefits liability, life income and endowment gifts and loss on disposal of fixed assets.

Cash and Cash Equivalents
Cash and cash equivalents include all highly liquid debt instruments with maturity of three months or less when purchased.

Accounts and Notes Receivable
Accounts and notes receivable arising from tuition fees, Rensselaer Technology Park activity and amounts owed on research contracts are carried net of an allowance for doubtful accounts as follows (in thousands):

	June 30, 2009	June 30, 2008
Student-related receivables	$ 849	$ 765
Loans to students	1,464	1,607
Other	14	14
Rensselaer Technology Park	36	36
Research, training and other agreements	305	212
Total allowances for doubtful accounts	$2,668	$2,634

It is not practicable to determine the fair value of student loan receivables because they are primarily federally sponsored student loans with U.S. government mandated interest rates and repayment terms and subject to significant restrictions as to their transfer or disposition.

Inventories
Inventories consist mainly of bookstore and computer store goods and maintenance supplies and are stated at the lower of cost or current market value, based upon the first-in, first-out method.

Investments
Purchase and sale transactions are recorded on a trade date basis. Realized gains and losses are recognized on an average cost basis when securities are sold.

Net appreciation (depreciation) in the fair value of investments, which consists of the realized gains on losses and the unrealized appreciation or depreciation on those investments, is recognized in the Statement of Activities.

Note B- Summary of Significant Accounting Policies, (continued)

Land, Buildings and Equipment
Land, buildings and equipment are carried at cost or at the fair market value at the date of the gift. Depreciation is computed on a straight-line basis over the estimated useful lives of buildings (50 years) and equipment (3-20 years). All gifts of land, buildings and equipment are recorded as unrestricted operating activity unless explicit donor stipulations specify how the donated assets must be used. Absent explicit donor stipulations about how long those long-lived assets must be maintained, the donor restrictions are reported as being released when the donated or acquired long-lived assets are placed in service. Gifts of land, buildings and equipment with explicit donor stipulations specifying how the assets must be used or how long the assets must be maintained are recorded as temporarily restricted operating activity and reported as being released over the period of time required and be maintained as the assets are used for its specified purpose.

Interest Rate Swap Agreements
Rensselaer has entered into various interest rate swap agreements in order to convert variable rate debt to a fixed rate, thereby economically hedging against changes in the cash flow requirements of Rensselaer's variable rate debt obligations. Rensselaer has also entered into an interest rate swap to convert fixed rate debt to variable rate, thereby economically hedging against changes in the fair value of the debt. Accordingly, the interest rate swap contracts are reflected at fair value in Rensselaer's combined statements of financial position and the related portions of the debt being hedged are reflected at an amount equal to their carrying value.

Net payments or receipts under the swap agreements along with the change in fair value of the swaps are recorded in non-operating activities as realized and unrealized gains or losses on interest rate swap agreements.

Note C- Tuition Revenue

The undergraduate student discount rate was 43.9% and 44.1% for the years ended June 30, 2009 and 2008, respectively.

Student tuition by segment and location is as follows (in thousands):

	2009	2008
Undergraduate tuition:		
Troy Campus	$189,075	$168,617
Less institutional aid	(83,047)	(74,375)
Total undergraduate tuition	$106,028	$ 94,242
Graduate tuition:		
Troy Campus	$ 35,402	$ 31,715
Total graduate tuition	$ 35,402	$ 31,715
Education for working professionals:		
Troy Campus	$ 6,506	$ 6,515
Hartford Campus	13,377	12,107
Total education for working professionals	$ 19,883	$ 18,622

Note D- Contributions Receivable

Contributions receivable are expected to be collected as follows at June 30 (in thousands):

	2009	2008
In one year or less	$ 3,875	$ 1,620
Between one year and three years	18,593	17,014
Greater than three years	22,368	29,358
Less:		
Present value discount (0.56 – 5.14%)	(6,172)	(8,062)
Allowance for uncollectible pledges	(805)	(810)
Total contributions receivable	$37,859	$39,120

Conditional pledges, which are not accrued, approximate $6,986,000 at June 30, 2009, of which $320,000 was unrestricted as to purpose. The remaining conditional pledges are restricted to purpose as follows: $4,840,000 current programs; $1,678,000 endowment; and $148,000 plant. Bequest expectancies totaling $100,280,000 have been excluded from these amounts and are not recorded in the financial statements. In compliance with donor stipulations related to a $360,000,000 transformational gift, income is being recognized as periodic cash payments are received.

Note E- Research Grants and Contracts

Rensselaer has been awarded approximately $76,594,000 and $84,014,000 of grants and contracts which have not been advanced or expended as of June 30, 2009 and 2008, respectively, and accordingly, are not recorded in the financial statements.

Note F- Split Interest Agreements

Split interest gift agreements consist primarily of irrevocable charitable remainder trusts, pooled income funds and charitable gift annuities for which Rensselaer is the remainder beneficiary. Assets held in these trusts are included in investments and recorded at their fair value when received. The value of split interest assets included in the investments at June 30, 2009 and 2008 were $22,837,000 and $29,349,000, respectively. Contribution revenues are recognized at the dates the trusts are established net of the liabilities for the present value of the estimated future payments to be made to the donors and/or other beneficiaries. The liabilities are adjusted during the term of the agreements for changes in the value of the assets, accretion of the discount and other changes in the estimates of future benefits. Discount rates range from 2.8% to 10.6%. The liability for the present value of deferred gifts of $7,599,000 and $10,431,000 at June 30, 2009 and 2008, respectively, is based upon actuarial estimates and assumptions regarding the duration of the agreements and the rates to discount the liability. Circumstances affecting these assumptions can change the estimate of this liability in future periods.

Rensselaer is also beneficiary of certain perpetual trusts held and administered by others. The present values of the estimated future cash receipts from the trusts are recognized as contributions from external trusts and contribution revenue at the date Rensselaer is notified of the establishment of the trust. Distributions from the trusts are recorded as investment income in the period they are received. Changes in fair value of the trusts are recorded as non-operating gains or losses in temporarily or permanently restricted net assets.

Note G- Natural Expense Classification

The following table compares expenses by type for the years ended June 30, 2009 and 2008, respectively (in thousands):

	2009	2008
Salaries and wages	$154,674	$149,589
Employee benefits excluding retirement	29,200	30,431
Retirement plan expense	15,495	17,736
Subtotal employee benefits	44,695	48,167
Total compensation	$199,369	$197,756
Supplies & services	73,284	73,867
Utilities	14,505	14,497
Employee travel	6,830	7,799
Taxes & insurance	8,267	6,522
Telecommunications	288	450
Library materials	2,328	2,194
Interest on debt	18,089	21,004
Depreciation and amortization	34,054	29,015
Student aid and fellowships	42,191	38,523
Operating lease agreements	4,559	3,414
Provision for uncollectible accounts	615	695
Total non salary	204,854	197,980
Total expenses	$404,379	$395,736

Note H- Investments

The carrying value and cost of investments at June 30 is as follows (in thousands):

	2009		2008	
	Carrying Value	Cost	Carrying Value	Cost
Short-term investments	$ 25,833	$ 25,799	$ 15,423	$ 15,419
Bonds and notes	136,369	147,220	129,279	122,532
Domestic equity securities	66,200	84,868	144,968	132,879
Foreign equity securities	59,344	55,167	113,503	82,859
Real estate	110,022	132,447	112,335	101,545
Marketable alternatives	65,781	64,143	149,985	120,374
Private equity partnerships	153,003	185,696	142,372	160,242
Total investments	$616,552	$695,340	$807,865	$735,850

Approximately $59,364,000 of the investment portfolio at June 30, 2009 is invested in international securities that are subject to the additional risk of currency fluctuation.

At June 30, 2009, Rensselaer has committed to investing an additional $242.7 million in various equity and real asset partnerships.

Spending from Endowment Funds
Rensselaer has adopted a "total return" policy for endowment spending. This approach considers current yield (primarily interest and dividends) as well as the net appreciation in the market value of investments when determining a spending amount. Under this policy, the Board of Trustees establishes a spending rate which is then applied to the average market value of investments. Current yield is recorded as revenue and the difference between current yield and the spending rate produces the use of realized gains spent under the total return formula.

Note H- Investments, (continued)

Dividends, Interest and Realized and Unrealized Gains and Losses
Total dividends, interest and realized and unrealized gains (reflected as both operating and non-operating activity) are as follows (in thousands):

	2009	2008
Dividends and interest available for spending	$ 8,206	$ 12,585
Realized gains (loss)	(16,673)	45,817
Unrealized gains (loss)	(151,206)	(59,260)
Net return	(159,673)	(858)

Investment management fees were $1,525,000 and $2,028,000 in 2009 and 2008, respectively, and are netted against realized and unrealized gains.

In May 2000 Rensselaer's Board of Trustees approved the Rensselaer Plan, a strategic roadmap to achieving greater prominence in the 21st century as a top-tier world-class technological research university with global reach and global impact. The Board also committed to endowment withdrawals in excess of Rensselaer's spending formula, as necessary, to fund investment in Plan initiatives. To date, $293.7 million has been spent or committed for such initiatives, exclusive of capital expenditures. In fiscal year 2005, an initial withdrawal from quasi-endowment of $20 million was recognized and displayed in the Statement of Activities as "endowment spending for Rensselaer Plan initiatives." For fiscal years 2006, 2007, 2008 and 2009, the amount reflected as "endowment spending for Rensselaer Plan initiatives" equals $34 million, $35.5 million and $38.3 million and $30.9, respectively. These amounts reflect Board approved commitments against the endowment with the residual being funded from operations.

Derivative Financial Instruments
Investments include derivative financial instruments that have been acquired to reduce overall portfolio risk by hedging exposure to certain assets held in the portfolio. At June 30, 2009, there were approximately $45,000 of open or unsettled forward exchange contracts to sell foreign currency and $45,000 of open or unsettled forward exchange contracts to purchase foreign currency. These contracts are denominated in two North American and European currencies and will settle at various dates through July, 2009. The impact on the combined statement of activities is not significant.

Forward contracts are marked to market monthly. The market and credit risks related to these derivative investments are not materially different from the risks associated with similar underlying assets in the portfolio. These derivative financial instruments are recorded at estimated fair value in investments.

Fair Value Measurement

Effective July 1, 2008, Rensselaer adopted Statement of Financial Accounting Standards No. 157, "Fair Value Measurements" ("SFAS 157"). SFAS 157 defines fair value, establishes a framework for measuring fair value under generally accepted accounting principles and enhances disclosures about fair value measurements. The new standard provides a consistent definition of fair value focusing on an exit price which is the price that would be received to sell an asset in an orderly transaction between market participants at the measurement date.

SFAS 157 establishes a hierarchy of valuation inputs based on the extent to which the inputs are observable in the marketplace. Observable inputs reflect market data obtained from sources independent of the reporting entity and unobservable inputs reflect the entities own assumptions about how market participants would value an asset or liability based on the best information available. Valuation techniques used to measure fair value under SFAS 157 must maximize the use of observable inputs and minimize the use of unobservable inputs. The standard describes a fair value hierarchy based on three levels of inputs, of which the first two are considered observable and the last unobservable, that may be used to measure fair value.

Note H- Investments, (continued)

The following describes the hierarchy of inputs used to measure fair value and the primary valuation methodologies used by Rensselaer for financial instruments measured at fair value on a recurring basis. A financial instrument's categorization within the valuation hierarchy is based upon the lowest level of input that is significant to the fair value measurement. The three levels of inputs are as follows:

- Level 1 - Quoted prices in active markets for identical assets or liabilities. Market price data is generally obtained from exchange or dealer markets.
- Level 2 - inputs other than Level 1 that are observable, either directly or indirectly, such as quoted prices for similar assets or liabilities; quoted prices in markets that are not active; or other inputs that are observable or can be corroborated by observable market data for substantially the same term of the assets or liabilities. Inputs are obtained from various sources including market participants, dealers, and brokers.
- Level 3 - Pricing inputs are unobservable and include situations where there is little, if any, market activity for the investment.

The following table presents the financial instruments carried at fair value as of June 30, 2009, by caption on the consolidated statement of financial position by the SFAS 157 valuation hierarchy defined above (in thousands):

Assets	Quoted Prices in Active Markets Level 1	Significant Other Observable Level 2	Significant Unobservable Level 3	Total Fair Value
Investments:				
Short-term investments	$ 25,026	$ -	$ 807	$ 25,833
Fixed income securities	23,882	-	112,486	136,368
Domestic equity securities	37,301	-	28,898	66,199
Foreign equity securities	14,478	-	44,866	59,344
Real assets	2,308	-	107,715	110,023
Marketable alternatives	-	-	65,782	65,782
Private equity partnerships	-	-	153,003	153,003
Investments	$102,995	$-	$513,557	$616,552
Contributions from external trusts	-	-	7,783	7,783
Total	$102,995	$-	$521,340	$624,335
Liabilities				
Liability on interest rate swap agreements	$ -	$ 50,684	$-	$ 50,684
Total liabilities at fair value	$-	$ 50,684	$-	$ 50,684

Investments included in Level 3 primarily consists of Rensselaer's ownership in alternative investments (principally limited partnership interests in marketable alternatives, private equity, real estate, and other similar funds) The value of certain alternative investments represent the ownership interest in the net asset value (NAV) of the respective partnership; 32.8% of investments held by the partnerships consist of marketable securities and 67.2% are securities that do not have readily determinable fair values. The fair values of the securities held by limited partnerships that do not have readily determinable fair values are determined by the general partner taking into consideration, among other things, the cost of the securities, prices of recent significant placements of securities of the same issuer, and subsequent developments concerning the companies to which the securities relate. Rensselaer regularly reviews and evaluates the values provided by the investment managers and agrees with the valuation methods and assumptions used in determining the fair value of these investments.

Note H- Investments, (continued).

Included in investments at June 30, 2009 and 2008 are investments held by others in the amount of $46,888,000 and $60,179,000, respectively. These investments are classified as Level 3 in the table above.

Interest rate swaps are valued using both observable and unobservable inputs, such as quotations received from the counterparty, dealers or brokers, whenever available and considered reliable. In instances where models are used, the value of the interest rate swap depends upon the contractual terms of, and specific risks inherent in, the instrument as well as the availability and reliability of observable inputs. Such inputs include market prices for reference securities, yield curves, credit curves, measures of volatility, prepayment rates, assumptions for nonperformance risk, and correlations of such inputs. Certain of the interest rate swap arrangements have inputs which can generally be corroborated by market data and are therefore classified within level 2.

The methods described above may produce a fair value calculation that may not be indicative of net realizable value or reflective of future fair values. Furthermore, while Rensselaer believes its valuation methods are appropriate and consistent with other market participants, the use of different methodologies or assumptions to determine the fair value of certain financial instruments could result in a different estimate of fair value at the reporting date.

The following table is a rollforward of the consolidated statement of financial position amounts for financial instruments classified by Rensselaer within Level 3 of the fair value hierarchy defined above (in thousands):

	Significant Unobservable Inputs (Level 3)							
	Short Term Investments	Fixed Income	Domestic Equity	Foreign Equity	Real Assets	Marketable Alternatives	Private Equity Partnerships	Total
Fair value, July 1, 2008	$ 1,039	$ 102,223	$ 39,668	$ 92,629	$ 108,232	$ 142,364	$ 148,455	$ 634,610
Realized gains/(losses)	34	(218)	(554)	(966)	1,406	(4,114)	4,482	70
Unrealized gains/(losses)		(20,825)	(16,029)	(25,667)	(31,401)	(15,658)	(21,885)	(131,465)
Net purchases, sales, settlements	-266	6,823	(5,490)	(20,238)	29,478	(21,024)	24,126	- 13,409
Transfers in/out		24,483	11,303	(892)	-	(35,786)	(2,175)	(3,067)
Fair value, June 30, 2009	$ 807	$ 112,486	$ 28,898	$ 44,866	$ 107,715	$ 65,782	$ 153,003	$ 513,557

	Contributions from External remainder trusts
Fair value, July 1, 2008	$ 9,374
Realized gains/(losses)	-
Unrealized gains/(losses)	(1,200)
Net purchases, sales, settlements	(391)
Fair value, June 30, 2009	$ 7,783

All net realized and unrealized gain/(losses) in the table above are reflected in the accompanying consolidated statement of activities. Net unrealized gains/(losses) relate to those financial instruments held by Rensselaer at June 30, 2009.

Note I- Endowment

Rensselaer's endowment consists of approximately 611 individual donor restricted endowment funds and 168 board-designated endowment funds for a variety of purposes plus the following where the assets have been designated for endowment: pledges receivables, split interest agreements, and other net assets. The endowment includes both donor-restricted endowment funds and funds designated by the Board of Trustees to function as endowments. The net assets associated with endowment funds including funds designated by the Board of Trustees to function as endowments, are classified and reported based on the existence or absence of donor imposed restrictions.

Endowment and similar funds are invested under direction of the Board of Trustees to achieve maximum long-term total return with prudent concern for the preservation of investment capital. All investments of endowment and similar funds are recorded in the statement of financial position as long-term investments, including cash balances held by external investment managers. The fair value of endowment investments (separately invested and pooled) was $589,048 and $766,899 as of June 30, 2009 and June 30, 2008, respectively.

The Board of Trustees of Rensselaer determines the method to be used to appropriate endowment funds for expenditure. Calculations are performed for individual endowment funds at a rate of 5.0 percent of the rolling 16 quarter average market value on a unitized basis one year subsequent to the calculation. The corresponding calculated spending allocations are distributed in equal quarterly installments on the first day of each quarter from the current net total or accumulated net total investment returns for individual endowment funds. In establishing this policy, the Board considered the expected long term rate of return on its endowment.

During fiscal year 2009, Rensselaer adopted FASB Staff Position (FSP) FAS 117-1, "Endowment of Not-for-Profit Organizations: Net Asset Classification of Funds Subject to an Enacted Version of the Uniform Prudent Management of Institutional Funds Act (UPMIFA), and Enhanced Disclosures for All Endowment Funds." The FSP applies to not-for-profit organization with donor-restricted endowment funds and is effective for fiscal years ending after December 15, 2008. The information provided below regarding Rensselaer's interpretation of the relevant law and the composition of the endowment and similar funds has been included to comply with the disclosure requirements of FSP FAS 117-1.

The Board of Trustees of Rensselaer has interpreted New York State's Not-for-Profit Corporate Law as requiring the preservation of the fair value of the original gift as of the gift date of the donor-restricted endowment funds absent explicit donor stipulations to the contrary. As a result of this interpretation, Rensselaer classifies as permanently restricted net assets (a) the original value of gifts donated to the permanent endowment, (b) the original value of subsequent gifts to the permanent endowment, and (c) accumulations to the permanent endowment made in accordance with the direction of the applicable donor gift instrument at the time the accumulation is added to the fund. Unspent appropriations related to the donor restricted endowment fund are classified as temporarily restricted net assets until the amounts are expended by Rensselaer in a manner consistent with the donor's intent. The remaining portion of the donor-restricted endowment fund that is not classified as permanently or temporarily restricted net assets is classified as unrestricted net assets in accordance with New York State law.

Note I- Endowment, (continued)

Rensselaer had the following endowment activities during the year ended June 30, 2009 delineated by net asset class and donor-restricted versus Board-designated funds:

Endowment net asset composition by type of fund as of June 30, 2009 (in thousands):

	Unrestricted	Temporarily Restricted	Permanently Restricted	Total
Endowment net asset composition	$ 238,776	$ 12,499	$ 244,633	$ 495,908
Board-designated endowment funds	171,395	916	-	172,311
Less: Commitments for Rensselaer Plan Initiatives	(138,739)	-	-	(138,739)
Board Designated Endowment Funds at Net	32,656	916	-	33,572
Total endowment funds	$ 271,432	$ 13,415	$ 244,633	$ 529,480

Changes in endowment net assets for the year ended June 30, 2009 (in thousands):

	Unrestricted	Temporarily Restricted	Permanently Restricted	Total
Endowment net assets, beginning of year	$ 485,208	$ 28,839	$ 235,705	$ 749,752
Investment return:				
Investment Income	6,496	-	-	6,496
Net depreciation (realized and unrealized)	(158,100)	(15,433)	(2,526)	(176,059)
Total investment return	(151,604)	(15,433)	(2,526)	(169,563)
Gifts	1,534	-	10,189	11,723
Appropriation of endowment assets for expenditure	(32,826)	-	-	(32,826)
Commitments for Rensselaer Plan Initiatives	(30,900)	-	-	(30,900)
Donor redesignation	20	9	1,265	1,294
Endowment net assets, end of year	$ 271,432	$ 13,415	$ 244,633	$ 529,480

Note I- Endowment, (continued)

Description of Amounts Classified as Permanently Restricted Net Assets and Temporarily Restricted Net Assets (Endowments Only)

Permanently restricted net assets (in thousands):	
The portion of perpetual endowment funds that is required to be retained permanently by explicit donor stipulation:	
Restricted for scholarship support	$ 52,808
Restricted for fellowship support	19,954
Restricted for faculty support	55,474
Restricted for program support	53,475
Restricted for awards and prizes	2,662
Restricted for unrestricted institutional support	60,260
	$ 244,633
The portion of permanent endowment funds subject to a time restriction (in thousands):	
Restricted for scholarship support	$ 6,847
Restricted for fellowship support	611
Restricted for faculty support	(45)
Restricted for program support	4,783
Restricted for awards and prizes	1,219
	$ 13,415

Rensselaer had the following endowment activities during the year ended June 30, 2008 delineated by net asset class and donor-restricted versus Board-designated funds:

Endowment net asset composition by type of fund as of June 30, 2008 (in thousands):

	Unrestricted	Temporarily Restricted	Permanently Restricted	Total
Endowment net asset composition	$ 364,126	$ 27,641	$ 235,705	$ 627,472
Board-designated endowment funds	228,921	1,198	-	230,119
Less: Commitments for Rensselaer Plan Initiatives	(107,839)	-	-	(107,839)
Board Designated Endowment Funds at Net	121,082	1,198	-	122,280
Total endowment funds	$ 485,208	$ 28,839	$ 235,705	$ 749,752

Note I- Endowment, (continued)

Changes in endowment net assets for the year ended June 30, 2008 (in thousands):

	Unrestricted	Temporarily Restricted	Permanently Restricted	Total
Endowment net assets, beginning of year	$ 521,307	$ 31,326	$ 225,509	$ 778,142
Investment return:				
Investment Income	10,203	-	-	10,203
Net depreciation (realized and unrealized)	(16,033)	(2,495)	(1,223)	(19,751)
Total investment return	(5,830)	(2,495)	(1,223)	(9,548)
Gifts	185	-	9,519	9,704
Appropriation of endowment assets for expenditure	(32,149)	-	-	(32,149)
Donor redesignation	1,695	8	1,900	3,603
Endowment net assets, end of year	$ 485,208	$ 28,839	$ 235,705	$ 749,752

Description of Amounts Classified as Permanently Restricted Net Assets and Temporarily Restricted Net Assets (Endowments Only)

Permanently restricted net assets (in thousands):
The portion of perpetual endowment funds that is required to be retained permanently by explicit donor stipulation:

Restricted for scholarship support	$ 60,609
Restricted for fellowship support	11,339
Restricted for faculty support	48,823
Restricted for program support	54,640
Restricted for awards and prizes	2,522
Restricted for unrestricted institutional support	57,772
	$ 235,705

The portion of permanent endowment funds subject to a time restriction (in thousands):

Restricted for scholarship support	$ 11,698
Restricted for fellowship support	1,240
Restricted for faculty support	2,461
Restricted for program support	11,180
Restricted for awards and prizes	2,260
Restricted for unrestricted institutional support	-
	$ 28,839

Note I- Endowment, (continued)

Endowment Funds with Deficits
From time to time, the fair value of assets associated with individual donor-restricted endowment funds may fall below the value of the initial and subsequent donor gift amounts (deficit). When donor endowment deficits exist, they are classified as a reduction of unrestricted net assets. Deficits of this nature reported in unrestricted net assets were $8,393,000 and $170,000 as of June 30, 2009 and 2008, respectively. These deficits resulted from unfavorable market fluctuations that occurred shortly after the investment of newly established endowments, and authorized appropriation that was deemed prudent.

Return Objectives and Risk Parameters
Rensselaer has adopted endowment investment and spending policies that attempt to provide a predictable stream of funding to programs supported by its endowment while seeking to maintain the purchasing power of endowment assets. Under this policy, the return objective for the endowment assets, measured over a full market cycle, shall be to maximize the return against a blended index, based on the endowment's target allocation applied to the appropriate individual benchmarks. Rensselaer expects its endowment funds over time, to provide an average rate of return of approximately 8.0 percent annually. Actual returns in any given year may vary from this amount.

Strategies Employed for Achieving Investment Objectives
To achieve its long-term rate of return objectives, Rensselaer relies on a total return strategy in which investment returns are achieved through both capital appreciation (realized and unrealized gains) and current yield (interest and dividends). Rensselaer targets a diversified asset allocation that places greater emphasis on equity-based investments to achieve its long-term objectives within prudent risk constraints.

Note J- Land, Buildings, and Equipment

Land, buildings, and equipment consist of the following at June 30 (in thousands):

	2009	2008
Land and improvements	$ 27,404	$ 20,946
Buildings	752,888	500,250
Equipment	223,346	212,589
Construction in progress	87,115	237,271
Total land, buildings & equipment	1,090,753	971,056
Less accumulated depreciation	(347,397)	(319,850)
	$ 743,356	$651,206

As of June 30, 2009, Rensselaer had $22,309,656 of open commitments to contractors for construction on work being performed.

Note K- Debt Outstanding

The following table and footnotes illustrate Rensselaer's various debt obligations, all of which are repaid from the general operations of Rensselaer and the Center, as appropriate.

Outstanding bonds and notes payable of Rensselaer are comprised of the following (in thousands):

Debt:	Year of Final Maturity	Weighted Average Annual Interest Rate	June 30, 2009	June 30, 2008
U.S. Department of Education Dormitory Bonds and 1988 Mortgage Loan	2018	3.0%	$ 1,525	$ 1,662
Rensselaer County IDA – Industrial Development Facility Issue:				
Series 1997A (1)	2022	Variable	8,625	8,987
Series 1999A and B (2)	2030	5.14%	29,104	33,512
Series 2006 (8)	2036	4.84%	63,384	63,420
Troy Industrial Development Authority Civic Facility Issue:				
Series 2002A (3)	2015	5.43%	16,225	16,320
Series 2002B-E (3)	2042	Variable	202,975	202,975
Series 2007 (10)	2037	5.00%	51,708	51,766
Series 2008 A and B (11)	2037	Variable	90,000	90,000
2004 Bank of America Term Loan (4)	2019	4.57%	24,325	26,183
2006 Bank of America Revolving Loan (6)	2011	Variable	35,000	35,000
2006 Bank of America Revolving Loan (7)	2011	Variable	13,000	13,000
2007 Bank of America Revolving Loan (9)	2012	Variable	41,400	41,400
2008 Bank of America Revolving Loan (12)	2013	Variable	9,956	10,000
2008 Bank of America Revolving Loan (13)	2013	Variable	38,300	17,400
Student Loan Program Debt				
DASNY 1992 CUEL	2009	6.80%	642	983
Rensselaer Technology Park Debt:				
2005 Bank of America Term Loan (5)	2013	Variable	6,190	7,333
2009 M & T Bank Loan(14)	2015	5.0%	20,000	0
2009 Whiting Turner Agreement(15)	2015	Variable	1,598	
			$653,957	$619,941

Note K- Debt Outstanding, (continued)

Debt principal outstanding is reflected net of bond discount/premium where applicable in the amount of $2,461,774 and $2,595,000 at June 30, 2009 and 2008, respectively. Such costs are being amortized on the straight-line method over the term of the related indebtedness.

Long-term debt and notes payable are collateralized by certain physical properties with a carrying value of $19,323,000 and $17,564,000 at June 30, 2009 and 2008 respectively and by pledges of specified portions of tuition, fees and revenues from various facilities. At June 30, 2009 and 2008, Rensselaer had $2,138,000 and $77,106,000, respectively of assets held by trustees for construction, debt service and other project-related expenses. Certain of the long term debt and notes payable contain restrictive covenants including the maintenance of specified deposits with trustees.

Notes to Debt Outstanding

1. On March 12, 1997, Rensselaer entered into an agreement with the Rensselaer County Industrial Development Agency, providing for the issuance of $13,240,000 in variable rate demand revenue bonds for the purpose of financing the renovation of three of Rensselaer's buildings and the acquisition of a new student record system. The bonds are subject to a remarketing agreement and bear a variable interest rate that resets weekly, but in no event may exceed 12% per annum. In the event that Rensselaer receives notice of any option tender on its variable-rate-bonds, or if the bonds become subject to mandatory tender, the purchase price of the bonds will be paid from the remarketing of such bonds. However, if the remarketing proceeds are insufficient, Rensselaer will have a general obligation to purchase the bonds tendered pending reissuance under its multimodal provisions.

2. On June 30, 1999, Rensselaer entered into an agreement with the Rensselaer County Industrial Development Agency, which provided for the issuance of $41,110,000 in revenue bonds. Proceeds from the issue in the amount of $24,196,000 were used for the construction and/or renovation of three buildings, issuance costs, and to legally defease Dormitory Authority Series 1991 Bonds. Interest rates on the bonds range from 4.125% to 5.00%.

3. On May 1, 2002, Rensselaer entered into an agreement with the Troy Industrial Development Authority, which provided for the issuance of $218,875,000 in Series 2002 A-E revenue bonds, including $202,975,000 in variable rate mode. The transaction also generated a $1,125,000 premium on the Series 2002A bonds. Proceeds from the issue in the amount of $203,150,771 were utilized for the construction costs of two buildings, related campus-wide infrastructure improvements, issuance costs and to legally defease Dormitory Authority Series 1993 Bonds. On May 11, 2006 the Series 2002E bonds in the amount of $25,000,000 were remarketed and converted from variable to a 5-year put option, with interest during the period ending September 1, 2011 set at 4.05% On May 2, 2008 Rensselaer changed the interest rate mode on Series 2002 B, C & D bonds from auction rate securities to variable rate demand bonds backed by three bank letters of credit, these letters of credit have expiration dates of May 2011. In the event that Rensselaer receives notice of any optional tender on its Series B,C or D variable-rate bonds, or if these bonds become subject to mandatory tender, the purchase price of the bonds will be paid from the remarketing of such bonds. However, if the remarketing proceeds are insufficient, Rensselaer will be obligated to purchase the bonds tendered and has secured a standby letters-of-credit for an amount up to an aggregate of $178 million. These letters of credit expire on May, 2011 and if drawn, must be repaid upon expiration. As a result of extinguishment of debt a $4,800,000 loss was recognized during fiscal year 2008.In fiscal year 2002, Rensselaer entered into an interest rate swap agreement, with a term of 35 years, on $150,000,000 (notional) of the Series 2002 B-D bonds issued, in order to convert variable rate borrowings to a fixed rate liability. This swap effectively locks in a fixed rate liability of 5.0325%. In February 2006, Rensselaer entered into an amendment with the counterparty which, in effect, altered the fixed rate liability to 4.30% until June 2011, at which point it converts to 4.593%. The impact on the consolidated Statement of Activities in 2009 as it relates to the fair market value of the interest rate swap was $10,286,000.

4. On March 4, 2004, Rensselaer entered into an agreement with Bank of America for a $30,000,000 15-year unsecured term loan for the purpose of financing a portion of its pension obligations and to fund the costs of certain capital improvements. The note bears an interest rate of 4.57% for eight years, at which point it will convert to a floating rate based on the one month LIBOR plus 40 basis points. The loan agreement requires compliance with certain financial ratio covenants.

Note K- Debt Outstanding, (continued)

5. On December 31, 2005, Rensselaer entered into an agreement with Bank of America for a $9,834,734 unsecured term loan for purposes of refinancing of Rensselaer Technology Park 1995 and 1998 term loans with Bank of America, as successor to Fleet Bank. The fully amortizing loan matures on December 31, 2013. The note bears interest at LIBOR plus one quarter of one percent. The loan agreement requires compliance with certain financial ratio covenants. In conjunction with this refinancing, on July 19, 2005 Rensselaer entered into a forward starting interest rate swap of $9,835,000 (notional) with Bank of America beginning January 1, 2006, effectively paying a fixed rate of 5.82% for term of the swap, which is contiguous with the loan's term. The impact on the consolidated Statement of Activities in 2009 as it relates to the fair market value of the interest rate swap was $172,295.

6. On April 14, 2006, Rensselaer entered into an agreement with Bank of America for a $35,000,000 unsecured revolving debt facility, which matures on July 1, 2011. Rensselaer has the right to convert to a term loan with a maturity of 2021. The note bears interest at LIBOR plus .48 of one percent. The loan agreement requires compliance with certain financial loan covenants. In conjunction with this transaction, on March 20, 2006, Rensselaer entered into a forward starting interest rate swap of $35,000,000 (notional) with Bank of America beginning January 1, 2007, effectively paying a fixed rate of 5.57% on the term loan. The maturity date of the swap is June 1, 2021. The impact on the consolidated Statement of Activities in 2009 as it relates to the fair market value of the interest rate swap was $2,522,000.

7. On May 15, 2006, Rensselaer entered into an agreement with Bank of America for a $10,000,000 unsecured revolving debt facility, which matures on July 1, 2011. Rensselaer has the right to convert to a term loan with a maturity of 2021. The loan has a revolving feature which permits additional draws up to a total of $13,000,000 if completed prior to July 1, 2010. The note bears interest at LIBOR plus .48 of one percent. On June 15, 2006, Rensselaer completed a $10,000,000 advance on this revolving loan. On April 13, 2007 Rensselaer advanced the remaining $3,000,000 under this agreement bringing the total principal amount outstanding to $13,000,000. The loan agreement requires compliance with certain financial loan covenants. In conjunction with this transaction, on March 20, 2006 Rensselaer entered into a forward starting interest rate swap of $10,000,000 (notional) with Bank of America beginning January 1, 2007, effectively paying a fixed rate of 5.57% on the term loan. The maturity date of the swap is June 1, 2021. The impact on the consolidated Statement of Activities in 2009 as it relates to the fair market value of the interest rate swap was $719,605.

8. On June 15, 2006, Rensselaer entered into an agreement with the Rensselaer County Industrial Development Agency, which provided for the issuance of $62,380,000 in Series 2006 fixed rate revenue bonds. The transaction generated a $1,616,000 premium. Proceeds from the issue in the amount of $63,996,000 was utilized for the construction costs of one building, related campus-wide infrastructure improvements, and issuance costs. On June 7, 2007 Rensselaer entered into a swap transaction with Morgan Stanley, with a notional of $62,380,000 and a maturity of March 1, 2036, effectively agreeing to pay SIFMA and receive 66.68% of 10 year LIBOR. This agreement was amended on January 11, 2008 to change the terms for the period of January 1, 2008 to March 1, 2011 so that Rensselaer received 68% of one Month LIBOR plus 90.25 bps and pays SIFMA. The impact on the consolidated Statement of Activities in 2009 as it relates to the fair market value of the interest rate swap was $1,408,000.

9. On May 23, 2007, Rensselaer entered into an agreement with Bank of America for a $41,400,000 unsecured revolving debt facility, which matures on May 22, 2012. Rensselaer has the right to convert to a term loan with a maturity of 2022. The note bears interest at LIBOR plus .43 of one percent. The loan agreement requires compliance with certain financial loan covenants. In conjunction with this transaction, on April 24, 2007, Rensselaer entered into a forward starting interest rate swap of $41,400,000 (notional) with the Bank of America beginning April 1, 2008, effectively paying a fixed rate of 5.55% on the term loan. The maturity date of the swap is June 1, 2022. The impact on the consolidated Statement of Activities in 2009 as it relates to the fair market value of the interest rate swap was $3,163,000.

10. On December 12, 2007, Rensselaer entered into an agreement with the City of Troy Industrial Development Agency, which provided for the issuance of $50,000,000 in Series 2007 three year fixed rate put bonds. The transaction documents are multi modal and allow for a final bond maturity of 2037. The transaction generated a $1,795,000 premium. Proceeds from the issue in the amount of $51,795,000 were utilized for the construction costs of several buildings, related campus-wide infrastructure improvements and issuance costs.

Note K- Debt Outstanding, (continued)

11. On January 24, 2008, Rensselaer entered into an agreement with the City of Troy Industrial Development Agency, which provided for the issuance of $90,000,000 in Series 2008 A & B variable rate demand bonds. These bonds are credit enhanced with a bank letter of credit having a maturity of January 2011. In the event that Rensselaer receives notice of any optional tender on its Series A&B variable-rate bonds, or if these bonds become subject to mandatory tender, the purchase price of the bonds will be paid from the remarketing of such bonds. However, if the remarketing proceeds are insufficient, Rensselaer will be obligated to purchase the bonds tendered and has secured a standby letters-of-credit for an amount up to an aggregate of $90 million. The letters of credit expire in January, 2011 and if drawn, must be repaid upon expiration. Proceeds from the issue in the amount of $90,000,000 were utilized for the construction costs of several buildings, related campus-wide infrastructure improvements and issuance costs.

12. On May 9, 2008, Rensselaer entered into an agreement with Bank of America for a $10,000,000 unsecured revolving debt facility, which matures on May 8, 2013. Rensselaer has the right to convert to a term loan with a maturity of 2028. The note bears interest at LIBOR plus .65 of one percent or Prime Rate less 1.75 of one percent. The loan agreement requires compliance with certain financial loan covenants.

13. On June 20, 2008, Rensselaer entered into an agreement with Bank of America for a $38,300,000 unsecured revolving debt facility, which matures on June 19, 2013. Rensselaer has the right to convert to a term loan with a maturity of 2028. The note bears interest at LIBOR plus .65 of one percent or Prime Rate less 1.75 of one percent. The loan agreement requires compliance with certain financial loan covenants.

14. On April 20, 2009 Rensselaer entered into an agreement with M&T Bank for a $20,000,000 unsecured term loan facility, amortization of which commences April 1, 2010 with a final maturity of April 1, 2015. The note bears interest at a fixed rate of 5.00%. The loan agreement requires compliance with certain financial loan covenants.

15. On April 24, 2009 Rensselaer entered into an agreement with The Whiting-Turner Contracting Company for a loan not to exceed $15,000,000, amortization of which commences January 1, 2011 with a final maturity of December 31, 2015. The note bears interest at Prime plus 2.00% adjusted monthly until January 1, 2011, after which the interest rate will become fixed at the then current Prime plus 2.00% rate until the note matures.

As of June 30, 2009, Rensselaer had a standby letter of credit with Bank of America totaling $1,509,000 for workers compensation insurance security purposes. In addition, Rensselaer had standby letters of credit with Bank of America totaling $1,440,000 and $250,000 for general liability insurance and professional liability insurance security purposes, respectively, related to current construction projects on the Troy, New York campus. There were no draws against these letters of credit during the fiscal year. Rensselaer also has a mortgage loan guarantee in place for one loan made by HSBC Bank USA in 1996 to finance construction and renovation costs for an on-campus fraternity residential facility. The balance of the mortgage loan, which totaled $600,000 at inception, was $290,000 on June 30, 2009.

The Institute has an unsecured line of credit with Bank of America valued at $30,000,000, with interest calculated on the outstanding balance at a daily rate of term LIBOR plus .30%. There was an outstanding balance of $6,010,000 on the line of credit at June 30, 2009. The Institute has an unsecured line of credit with TD Bank valued at $20,000,000, with interest calculated on the outstanding balance at a daily rate of term LIBOR plus 1.50%. There was an outstanding balance of $10,000,000 on the line of credit at June 30, 2009. Both of these lines of credit are subject to an annual renewal at November 30th.

Principal payments due on all long-term debt as of June 30, 2009 for each of the next five fiscal years are (in thousands):

Year	Amount
2010	$ 10,131
2011	16,273
2012	19,205
2013	22,026
2014	21,512
Thereafter	564,810

Note K- Debt Outstanding, (continued)

Rensselaer has letter of credit agreements with various financial institutions to purchase certain of the Institute's variable rate demand bonds in the event they cannot be remarketed. In the event that the bonds covered by these agreements were not remarketed and the agreements were not otherwise renewed, the principal amounts due in the principal debt service payments table (including variable rate demand bonds not subject to a liquidity facility) would be $18,756, $284,068, $19,205, $22,026, $21,512 and $288,390.

The fair value of Rensselaer's long-term debt is estimated based upon the amount of future cash flows, discounted using Rensselaer's current borrowing rates for similar debt instruments of comparable maturities. The fair value of long-term debt was approximately $577,135,000 and $544,117,000 at June 30, 2009 and 2008, respectively.

Rensselaer was in violation of a certain financial covenant as of December 31, 2008, related to certain of its debt arrangements, for which it obtained waivers and amended the covenant.

Interest capitalized at June 30, 2009 and 2008 was $497,000 and $403,000, respectively.

Note L- Retirement Plans

Defined Benefit Plans
The following table sets forth Rensselaer's defined benefit and postretirement plans' change in projected benefit obligation, change in plan assets, funded status (the postretirement plans are unfunded) and amounts recognized in Rensselaer's balance sheet at June 30, 2009 and 2008. The defined benefit plan calculations were based upon data as of or projected to June 30, 2009 and 2008. Postretirement benefit plan calculations were based upon data as of July 1, 2008 and 2007. Rensselaer's funding policy is based upon and is in compliance with ERISA requirements.

	Defined Benefit		Postretirement	
Change in benefit obligation (in thousands):	2009	2008	2009	2008
Benefit obligation at beginning of year	$(263,025)	$(265,896)	$(12,446)	$(13,690)
Service cost	(3,669)	(4,494)	(588)	(645)
Interest cost	(17,765)	(16,099)	(852)	(767)
Plan participants' contributions	(232)	(243)	(610)	(817)
Amendments/Curtailments/Special Termination	0	0	0	500
Settlement of Dental & Life Insurance Plans	0	0	82	0
Actuarial (gain)/loss	(265)	7,239	(499)	1,609
Benefits paid	15,157	15,910	1,358	1,364
Administrative expenses paid	789	558	0	0
Benefit obligation at end of year	$(269,010)	$(263,025)	$(13,555)	$(12,446)

The accumulated benefit obligation for the defined benefit pension plan was $264,003,000 and $258,855,000 as of June 30, 2009 and 2008, respectively.

	Defined Benefit		Postretirement	
Change in plan assets (in thousands):	2009	2008	2009	2008
Fair value of plan assets at beginning of year	$219,555	$220,798	$ 0	$ 0
Actual return on plan assets	(37,215)	(5,818)	0	0
Employer contribution	13,315	20,800	748	547
Plan participants' contribution	232	243	610	817
Benefits paid	(15,157)	(15,910)	(1,358)	(1,364)
Administrative expenses paid	(789)	(558)	0	0
Fair value of plan assets at end of year	$179,941	$219,555	$ 0	$ (0)

Note L- Retirement Plans, (continued)

Funded Status and amount recognized in the Statement of financial position (in thousands):	Defined Benefit 2009	Defined Benefit 2008	Postretirement 2009	Postretirement 2008
Liability	$(89,069)	$(43,470)	$(13,555)	$(12,446)

Amounts recognized in unrestricted net Assets (in thousands):	Defined Benefit 2009	Defined Benefit 2008	Postretirement 2009	Postretirement 2008
Net prior service cost/(credit)	$ 225	$ 285	$ 1,550	$ 1,692
Net actuarial (gain)/loss	133,834	81,199	456	984
Unrestricted net assets	$(134,059)	$(81,484)	$ 2,006	$ 2,676

Other changes in plan assets and benefit obligations recognized in unrestricted net assets (in thousands):	Defined Benefit 2009	Defined Benefit 2008	Postretirement 2009	Postretirement 2008
New prior service cost/(credit)	$ -	$ -	$ -	$ (500)
New net actuarial loss/(gain)	55,889	15,119	499	(1,609)
Settlement of Dental & Life Insurance Plans	-	-	(82)	-
Amortization of:				
Prior service cost/(credit)	(60)	(73)	142	126
Actuarial loss/(gain)	(5,390)	(7,180)	9	5
Settlement Charge	-	-	102	-
Total recognized in non operating (income)/expense	$50,439	$ 7,866	$ 670	$(1,978)

Net periodic benefit cost is included in the Following components (in thousands):	Defined Benefit 2009	Defined Benefit 2008	Postretirement 2009	Postretirement 2008
Service cost	$ 3,669	$ 4,494	$ 588	$ 645
Interest cost	17,765	16,099	852	767
Expected return on plan assets	(18,410)	(16,540)	0	0
Amortization of:				
Prior service cost/(credit)	60	73	(142)	(126)
Actuarial loss/(gain)	5,390	7,180	(9)	(5)
Net periodic benefit cost/(income)	8,474	11,306	1,289	1,281
Settlement Charge	0	0	(102)	0
Net periodic benefit cost/(income)	$ 8,474	$ 11,306	$ 1,187	$ 1,281

In the aggregate, Rensselaer's Defined Benefit Plan will be invested to ensure solvency of the plan over its remaining life and to meet pension obligations as required. A secondary goal is to earn the highest net rate of return within prudent risk limits to ensure the achievement of the primary goal and adherence to the following Rensselaer guiding investment principles:

> Capital preservation is a fundamental goal of the Institute's funds, therefore strategies and approaches emphasizing absolute positive returns are favored.

Risk is defined as loss of capital, not deviation from a benchmark, and a Sharpe ratio measurement is preferred to an Information ratio measurement.

The Plan's expected rate of return is the result of periodic asset allocation studies reviewed and approved by the Investment Committee.

Note L- Retirement Plans, (continued)

Weighted average asset allocation at June 30, 2009 and 2008, by asset category are as follows:

	Defined Benefit	
Asset Category	2009	2008
Domestic Equity	10.8%	17.7%
International Equity	10.8%	12.5%
Private Equity	5.9%	3.0%
Marketable Alternatives	18.9%	24.7%
Real Assets	16.2%	11.5%
Fixed income	26.7%	18.1%
Cash	10.7%	12.5%
	100.0%	100.0%

The Plan contains features that allow participants to have a percentage of their benefits fluctuate based on the return of a S&P 500 index account. Rensselaer maintains assets in that index fund to hedge those liabilities that are not part of the above asset allocation.

Rensselaer's expected contributions for fiscal year ending June 30, 2010 are $18,600,000 and $794,000 for the defined pension plan and postretirement plan, respectively.

The amounts in unrestricted net assets expected to be recognized as components of the net periodic benefit cost in fiscal year ending June 30, 2010 are $6,342,000 and ($147,000) for the defined pension plan and postretirement plan, respectively.

The following are the expected future benefit payments (in thousands):

Fiscal Year Ending in:	Defined Benefit	Postretirement
2010	$18,356	$ 794
2011	18,744	880
2012	19,430	911
2013	20,050	970
2014	20,584	1,041
2015-2019	111,374	5,984

The weighted average rates forming the basis of net periodic benefit cost and amounts recognized in Rensselaer's statement of financial position at June 30 were:

	Defined Benefit		Postretirement	
Benefit obligations	2009	2008	2009	2008
Discount rate	6.75%	7.00%	7.00%	7.00%
Expected return on plan assets	8.25%	8.25%	-	-
Rate of compensation increase	4.00%	4.00%	-	-
Net periodic benefit cost				
Discount rate	7.00%	6.25%	6.25%	6.25%
Expected return on plan assets	8.25%	8.25%	-	-
Rate of compensation increase	4.00%	4.00%	-	-

Note L- Retirement Plans, (continued)

For measurement purposes, a 8.0 percent, 7.5 percent and 11.0 percent annual rate of increase in the per capita cost of covered pre-65 medical, post-65 medical benefits and prescription drug benefits, respectively, was assumed for fiscal year 2010. These rates were assumed to decrease gradually to 5 percent for fiscal year 2016 and remain at that level thereafter. A plan amendment established a maximum of $85 per month for retired employees who retire after normal retirement age. Once Rensselaer's share of medical premiums for Medicare eligible retirees reaches the $85 per month maximum, the health care cost trend rate will no longer have any effect except for grandfathered participants not subject to the cap and pre-65 coverage.

Assumed health care cost trend rates have a significant effect on the amounts reported for the postretirement benefit. A one-percentage point change in the health care cost trend rates would have the following effects (in thousands):

	1-Percentage Point Increase	1-Percentage Point Decrease
Effect on total of service and interest cost components	$ 89	($ 76)
Effect on postretirement benefit obligation	$627	($548)

Based upon service at retirement date, Rensselaer pays for a portion of health care benefits for retired employees. In addition, Rensselaer Hartford Graduate Center, Inc. pays for dental and life insurance benefits for employees who had retired prior to July 1, 1997.

Defined Contribution Plan
Rensselaer and the Center also have non-contributory Defined Contribution Plans open to full-time employees who have met minimum service requirements. Contributions to these plans (8% of employee salary) were $7,020,000 and $6,515,000 in fiscal 2009 and 2008, respectively.

In addition, the Center has its own pension plan in association with Teachers Insurance and Annuity Association and College Retirement Equities Fund (TIAA-CREF). The TIAA-CREF is a money purchase plan so there is no past service cost. The Center's contributions to this plan (8% of employee salary) were $383,000 and $327,000 in fiscal 2009 and 2008, respectively.

Note M- Commitments and Contingences

In the normal course of business, Rensselaer has been named a defendant in various claims. Although there can be no assurance as to the eventual outcome of litigation in which Rensselaer has been named, in the opinion of management such litigation will not, in the aggregate, have a material adverse effect on Rensselaer's financial position.

Leases
At June 30, 2009, minimum annual commitments under operating leases for real property and equipment are as follows (in thousands) :

	Operating Leases	Capital Leases
2010	$ 1,332	$ 1,366
2011	1,376	1,368
2012	1,410	1,359
2013	1,057	1,368
2014	990	1,383
Thereafter	19,547	36,054
Total	$25,712	42,898
Less: amount representing interest		(22,952)
Present value of minimum lease payments		$19,946

Rensselaer Polytechnic Institute
Notes to the Consolidated Financial Statements
For the Years Ended June 30, 2009 and June 30, 2008

Note N- Asset Retirement Obligations

In March 2005, the FASB issued FASB Interpretation No. 47, *Accounting for Conditional Asset Retirement Obligations* (FIN 47), which was issued to provide clarity surrounding the recognition of conditional asset retirement obligations, as referred to in FASB Statement No. 143, *Accounting for Asset Retirement Obligations*. FIN 47 defines a conditional asset retirement obligation as a legal obligation to perform an asset retirement activity in which the timing and (or) method of settlement are conditional on a future event that may or may not be within the control of the entity. Based on the guidance in FIN 47, management of Rensselaer determined that sufficient information was available to reasonably estimate the fair value of known retirement obligations.

FIN 47 requires the initial application of the interpretation to be recognized as a cumulative effect of a change in an accounting principle. Specifically, FIN 47 requires the recognition, a cumulative effect, the cumulative accretion and accumulated depreciation for the period from the date the liability was incurred to the date of adoption of this interpretation. The liability incurred date is presumed to be the date upon which the legal requirement to perform the asset retirement activity was enacted.

Upon adoption of FIN 47 on June 30, 2006, Rensselaer recognized asset retirement obligations in the amount of $6,935,000 related to asbestos contamination in buildings, decommissioning expenses and tank disposals, included in other liabilities.

The following is a summary of the asset retirement obligation:

Change in Asset Retirement Obligation (in thousands):	2009	2008
Asset retirement obligation at beginning of year	$7,650	$7,314
Accretion expense	379	336
Less: disposals	(8)	-
Asset retirement obligation at end of year	$8,021	$7,650

Note O-Subsequent Events

Rensselaer has performed an evaluation of subsequent events through September 23, 2009, the date on which the consolidated financial statements were issued.