IDAHO STATE UNIVERSITY

Office of Research
921 South 8th Avenue,
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Physical Address:
1010 South 5th St.
Bldg 11, Room 205

Public Version

October 6, 2009

U.S. NRC Public Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Attention: Mary Adams,
Senior Program Manager

Subject: **Response to the RAI for SNM 1373 License Application Renewal, and the Second in Response to the RAI pertaining to the Physical Security Plan Related to the SNM 1373 License**

Dear Ms. Adams:

Attached are our responses to the Request for Additional Information (RAI) that you sent to us, dated August 4, 2009.

The response is in two parts, the first addressing the license application (Enclosure 1) and the second addressing the Physical Security Plan (Enclosure 2). The latter is withheld from public disclosure. In subsequent discussions between you and our NRC Reactor License Project Manager, for License R-110, the need for a revision in the Physical Security Plan (PSP), which addresses the entire nuclear laboratory complex at Idaho State University, was discussed. It is our plan to submit this revised PSP by December 1, 2009.

Should you have any questions, please refer them to the Reactor Administrator, Dr. Jay Kunze, at 208-282-4147.

Sincerely,

Pamela L Crowell

Pamela L. Crowell, Ph.D.
Vice President of Research

Affirmation:
I certify that the foregoing is true and correct:

CONNIE M. TILLOTSON NOTARY PUBLIC STATE OF IDAHO

Executed on: October, 06, 2009. Signature Connie M. Tillotson expires 4-13-2011 Bannock County

c: Ms. Mary Adams, Senior Project Manager, Fuel Manufacturing Branch, US NRC, w/both attachments, Mail Stop O-12-D 03

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Summary of Responses to the Questions in the RAI of August 4, 2009
October 5, 2009 Revision to the SNM #1373 License Renewal Application Revision

RP-1: Section 10(b) references the Emergency Plan.

RP-2: Release of radioactive material (fission products) has been added to Section 8(b)

RP-3: 8(a) was revised and is covered by ISU Radiation Safety Manual (RSM) section 3.1 and 3.2.3

RP-4: 7(a) has been revised reflecting handling and exposure monitoring practices. The history of personnel exposures over the last 15 years shows all were well below ALARA notification levels for ISU.

RP-5: 8(a) has been revised to reference the practice covered in RSM 10.4

RP-6: 8(a) has been revised and is covered in RSM 11.3

RP-7: 8(d) has been revised and covered in RSM 11.1

RP-8: 7(d) has been revised to address gaseous and liquid effluents. (None, except argon activation in air, which is well below detectable minimums.

RP-9: 8(a) has been revised accordingly pertaining to reporting of incidents

RP-10: 8(a) has been revised and instrument calibration addressed in 7(c)

RP-11: The Radiation Protection Program is addressed in section 6, 9(b), and in the RSM 4

RP-12: RSM 4.6, 5, 6, and 8(a) covers training of radiation users

RP-13: 7(d) has been revised to discuss rad waste minimization

RP-14: 8(a) has been revised to comply with 10 CFR 20.1101(c)

RP-15: To clarify, the physical science building is not the same as the Idaho Accelerator Center. The only remaining reference to the Idaho Accelerator Center is in the cancellation of use of SNM at the IAC

CS-1: Addressed in revisions to sections 7(c), 8, and 10. The supplemental information sheets also show that the fission product inventory of these plates is essentially insignificant, and would give a personnel dose that is negligible even if all were concentrated at one location.

CS-2: Addressed in revisions to sections 7, 8, and 10, even though criticality is not possible with the facility and number of fuel plates allowed by this license.

CS-3: The CAAS is further addressed the revisions to section 10

FS-1: Covered in the revisions to Section 8 (b)

FS-2: Covered in the revisions to Section 10 (a)

IDAHO STATE UNIVERSITY

College of Engineering
921 South 8th Avenue,
Stop 8060
Pocatello, Idaho
83209-8060

October 10, 2009

TO: Mary Adams, Senior Program Manager
Fuel Manufacturing Branch
U.S. Nuclear Regulatory Commission

FROM: Jay F. Kunze, Reactor Administrator Jay F. Kunze

SUBJECT: **Submission of the Response to the RAI of August 4, 2009**

The enclosed material is the response to the RAI, including the Safeguards Information in a separate labeled package.

This is being submitted to the Public Document Control Desk, except for the Safeguards Information and the supplemental information giving detail of the calculations pertaining to temperatures attainable in a fire and the amount of fission product inventory in the plates.

I apologize for this transmittal being a week later than originally committed. As you are aware, Mr. Duane Hardesty, the program manager for our R-110 Reactor License, made an unofficial visit to our facility last week and was of considerable help in discussing with us how some of the questions in the RAI should be answered, since ours is merely a training facility and not related to the more significant issues concerning fuel manufacturing and handling facilities. Among these decisions was the conclusion, which Mr. Hardesty discussed with you, that our Physical Security Plan, which covers both the SNM and the Reactor licenses, needs to be revised and re-submitted to the NRC. We are committed to make these revisions by December 1, 2009.

Please advise if this submission is inconsistent with what you intended or expected.

Phone: (208) 282-2902
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email: engineering@isu.edu

SNM License #1373 - Supplemental Information to the License Renewal Application of February 26, 2009, revised October 5, 2009

SUBJECT: **Evaluations involving release of radioactive material in the event of fire.**

Note, the fission density that has occurred in the plates is negligible, and hence internal pressure from gaseous fission products is negligible. The only way that fission products would be released is for the aluminum cladding on the plates to melt.

Permanent Storage Location
The 150 fuel plates have a permanent storage location (when not in use for experiments) in a steel box, approximately 3 ft high by 3.5 ft wide by 3 ft deep, a total of 31 cubic feet.

The box is closed, and air exchange with the outside is quite restricted.

The plates are stacked on wooden trays, to protect the plates from being scratched. The total mass of the wooden trays is estimated to be less than 10 kg, (22 pounds)

Total mass of the aluminum plates is 41.5 kg (91 pounds) of aluminum, and [redacted]kg of uranium dioxide.

The energy needed to bring the plates to the melting temperature of aluminum (1220 F) is

0.23 (Btu/lb F) x 91 pounds x 1150 F = 24,000 Btu = 25 MJ

A) **Wood in the Storage Box as the Source of Combustion**

The amount of wood that in burning would release this quantity of energy is approximately

5 pounds (at nominally 5000 Btu per pound), about 1/4 of the amount of wood in the box.

This energy release would not occur adiabatically within the box, for the shell of the steel box would readily conduct heat to the room.

Furthermore, combustion of less than 0.2 pounds of wood would completely exhaust the oxygen in the air within the box.

Thus, it is essentially impossible for the wood in the box to bring the aluminum plates to melting temperature

B) Combustibles in the Room as Source of Heat

The graphite in the "thermal column" of the subcritical device will combust very slowly. The main source of combustibles will be the wooden furniture and the platform on which the subcritical tank rests. The total amount of wood-based combustibles in the room should never exceed 400 kg (880 pounds). Combustion of this amount of wood would release ~ 4.4 million Btu (.~ 4600 MJ)

This amount of wood (400 kg), if combusted adiabatically in the room and deposited all of its heat in the room, would raise the temperature of the equipment and materials, including the storage box for the plates, to more than the melting temperature of aluminum. However, there are three conditions that will significantly limit the combustion of the wood (without any active interference by fire fighters), as follows:

1. The air in the room (0.065 pounds per cubic foot at 4700 ft elevation above sea level = ~210 pounds of air, ~44 pounds of oxygen) will not support combustion of even 16 pounds of wood.

2. The combustion would not be adiabatic - much heat would escape, just in heating up the concrete walls. Estimated maximum temperature that the room could reach is 1000 F under very conservative conditions of minimal heat transfer. (Based on ~22,000 pounds of metal, conrete, and other materials.)

3. Activation of the fire alarm would shut of the building ventilation system, which would significantly restrict the flow rate of make up air into the room to replace the oxygen used in combustion.

Hence, even without active intervention of fire fighters, the room would never reach a temperature of 1220 F, sufficient to melt the aluminum plates.

As stated in the revised license application, combustibles in the room will be limited to less than 12 cubic feet in-situ and 6 cubic feet of transient materials (a total of 18 cubic feet, ~ 800 pounds of wood-based combustibles).

C) When plates are in the subcritical assembly.

A similar analysis applies when the plates are in the subcritical assembly. The only difference is that no credit can be taken for exhaustion of the oxygen in the subcritical assembly (reference section (A) above) for the tank is essentially open to air exchange, even with the locked cover on the top.

D) Fission Products in the Subcritical Plates

The 150 plates have only seen exposure to a neutron source, with a maximum multiplication factor of 0.87. For a source strength of 10^6 per second, this leads to an estimated 1 milliwatt of power for the full assembly.

The maximum exposure that these plates received was several years ago when the subcritical assembly was set up at the Idaho Accelerator Center, and exposed to an accelerator source. A liberal (high) estimate of the exposure time is 24 hours. Such operation, producing 1 milliwatt of fission power, at a time of two years from present, will result in a maximum estimated fission product inventory of both gamma and beta equal to 0.1 microCuries (2/3 of this beta, 1/3 is gamma). **All of these** fission products, if all were to be placed as a point source at a distance of one foot, would give a dose rate of 0.4 microRad per hour, or 3.5 mR per year if exposed for the entire 8760 hours in a year. This result, under these rather improbable assumptions, is an insignificant dose. Even if all of the plates were to be melted, release and concentration of all of the fission products at one spot would never occur.

Subsequent use of the subcritical plates will only be with a standard Ra-Be or Pu-Be source, not with an accelerator produced neutron source. Thus, the above estimate is an upper bound of any fission product inventory that might be expected in the future.

Summary: Fire in the subcritical assembly room cannot conceivably be intense enough to bring the aluminum plates to their melting point. But even if such temperatures (1220 F) were possible, the total fissioni product inventory is trivial (~0.1 microCuries), and the maximum dose rate that all of these fission products would give at a distance of one foot is trivial (3.5 mR for a full year).

APPLICATION FOR LICENSE RENEWAL
MATERIALS LICENSE No. SNM-1373
February 26, 2009, Revised October 5, 2009

License Re-Application - Idaho State University, Pocatello ID 83209

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Attachment (III) contains sensitive, unclassified information. When separated from Attachment (III), this document is decontrolled.

APPLICATION FOR LICENSE RENEWAL
MATERIALS LICENSE No. SNM-1373
February 26, 2009, Revised October 5, 2009

1. Information about the Applicant, Plans and Qualification [ref. 10 CFR 70.22(a) (1)]

Name:	Idaho State University
Address:	Pocatello, ID 83209
Description of Business or Occupation:	Institution of Higher Learning

The Idaho State University (ISU) is operated by the State of Idaho with its principal office at Pocatello, Idaho. The Idaho State Board of Education provides oversight and direction of the higher education institutions in Idaho and is located in Boise, Idaho, (P.O. Box 83720-0037).

University officers are currently:

President of the University
Administration Building
Idaho State University

Vice President for Research
Administration Building
Idaho State University

Vice President for Finance and Administration
Administration Building
Idaho State University

Dean of the College of Engineering
Lillibridge Engineering Laboratory Building
Idaho State University

Radiation Safety Officer
Technical Safety Office
Idaho State University

The current President of the University has designated the Vice President for Research as the university official who has overall responsibility for this license. A roster of current university officials with complete contact information is provided in Attachment (I). The information given in this attachment may be subject to change due to personnel reassignments. Such changes will require that only the information in Attachment (I) be updated as necessary by notification of

NRC. There is no control or ownership exercised over the applicant by any alien, foreign corporation, or foreign government.

2. Activity for Which the Material Will Be Used [ref. 10 CFR 70.22(a) (2)]

The Special Nuclear Material (SNM) in this license is used for education, research, and training programs. This license re-application specifies the same total mass of [redacted] gm of U-235 as was specified in the previous license: [redacted] gm of U-235 are contained in 150 uranium-aluminum fuel plates and the remaining U-235, rounded up to 1 gm, is contained in one fission counter and 74 uranium-aluminum foils.

2.1 Principal Location of Use

The fuel plates will primarily be used in the Lillibridge Engineering Laboratory (LEL) building where they will be loaded in various lattice arrangements in a water-filled tank to produce a subcritical assembly (SCA). Attachment II is a more detailed description of the SCA. The fuel plates may be used singly for a quasi-homogeneous assembly or in groups of two or more to produce a more heterogeneous configuration. The uranium-aluminum foils will be used as neutron monitors in some experiments performed with the subcritical assembly or at the nearby (50 ft distance) AGN-201 nuclear reactor, in Room 20 of the Nuclear Engineering Laboratory complex.

The materials are used primarily for instructional purposes in senior and graduate-level laboratory courses. In addition, research programs utilizing the materials in the subcritical assembly will also be encouraged. No experiments or activity involving the use of the SNM will be performed without the prior approval of the Reactor Administrator or Reactor Supervisor.

Some of the experiments to be carried out with the subcritical assembly are:

(1) Approach to critical.
(2) Flux distribution measurements.
(3) Exponential pile measurements.
(4) Fermi age determination.
(5) Determination of optimal cell dimensions in a heterogeneous subcritical assembly.
(6) Effect of fuel-plate thickness on multiplication factor.

The SNM may be used as sources of fissile material for research into improved nondestructive interrogation techniques for detecting fissile materials or transuranic waste in various simulated sealed shipping containers.

APPLICATION FOR LICENSE RENEWAL
MATERIALS LICENSE No. SNM-1373
February 26, 2009, Revised October 5, 2009

2.2 Alternate Locations of Use

Small amounts of the SNM, consisting of some of the U-Al foils and/or up to ten (10) of the fuel plates may be transported to adjacent nuclear facilities for temporary one-day use. These alternate locations are:

1) The AGN-201 nuclear reactor Room [redacted] (Figure 2)
2) The Particle Beam Laboratory in the adjacent Physical Science Building (See Figure 4)

During such one-day use, the material will continuously be in the custody of one of the Nuclear Engineering Department personnel cleared for safeguard information access and control. (These include the Reactor Administrator, Reactor Supervisor, Nuclear Engineering Department Chair, or a cleared reactor operator.)

Up to 10 fuel plates and/or up to 25 uranium-aluminum foils may be used occasionally at Particle Beam Laboratory in the Physical Science Building or at the AGN-201 Nuclear Reactor in Room [redacted] of the LEL building . In this capacity, the fuel plates and/or foils may be used as sources of fissile material for research and development of advanced methods for the nondestructive assay and evaluation (NDA/NDE) of fissile material content in various configurations. The U-Al foils would be used to monitor flux levels, and the fuel plates would be used to represent fissile material in various shipping arrangements in test to investigate effectiveness of NDA/NDE interrogation techniques.

When small amount of the licensed material is used at these two alternate locations, the material will be in the custody of an authorized custodian. The material will not be stored overnight at either of these alternate locations, but will be returned at the end of each day to the CAA, Room [redacted], for overnight storage.

Transport of the small amounts of material between the LEL building and the Particle Beam Lab in the Physical Science Building will require the approval of the Technical Safety Office, which administers the transportation of all radioactive materials in or out of ISU.

All materials will be surveyed for radiation emission and surface contamination prior to transport and transfer of the materials back to the Nuclear Facility. Records of material transfer and use at the Particle Beam Laboratory will be maintained in the activity log in Room [redacted], and shall include the date and time of transfer, material inventory information, responsible user, and pertinent radiological survey information.

APPLICATION FOR LICENSE RENEWAL
MATERIALS LICENSE No. SNM-1373
February 26, 2009, Revised October 5, 2009

3. The Place and Plan for Carrying Out the Activity [ref. 10 CFR 70.22(a) (2)]

The SNM will be used primarily in Room [redacted] in the basement of the LEL building. The material will be stored in a locked storage container in Room [redacted]. A map of the ISU campus showing the location of the LEL Building is shown in Figure 1, as Building #7. The LEL basement floor plan is shown in Figure 2. Room [redacted] is 20-feet by 20-feet square with a 12-foot ceiling. The floor is a 4-inch-thick reinforced concrete slab. The floor will safely accommodate the weight of the entire SCA. Room [redacted] is a controlled access area (CAA). Only safeguards-approved ISU personnel in the College of Engineering have authorized access to CAAs in the Nuclear Engineering Complex.

4. Period of Time for License [ref. 10 CFR 70.22(a) (3)]

This license is requested for a period of 10 years, from the starting date of October 2008. . It is expected that a request for renewal will be submitted at the end of that period.

5. Specification of the Special Nuclear Material [ref. 10 CFR 70.22(a) (4)]

(a) Uranium-aluminum fuel plates.

The fuel plates were fabricated in 1960 by M & C Nuclear, Inc., for Rutgers University, New Brunswick, New Jersey. The manufacturer's specifications for the plates are as follows:

Total number of plates	150
Total mass of uranium	[redacted] gm
Enrichment of U-235 isotope	[redacted]%
Total U-235 content	[redacted] gm
U-235 loading per plate	[redacted] gm
Overall dimensions of plate	(26±0.015 in) x (3.0±0.015 in) x (0.080±0.006 in)
Dimensions of uranium bearing portion of the plate	(24 in x 2.75 in x 0.04 in)
Cladding thickness	0.020 in

(b) Fission counter and uranium-aluminum foils.

(i) Fission counter.

Total uranium mass	0.002 gm
U-235 enrichment	93%
Total uranium mass	0.002 gm

(ii) Uranium-aluminum foils.

Total number of foils	74
Total uranium mass	0.3 gm (0.004 grams of U-235 per foil)
U-235 enrichment	93%
Total uranium mass	0.3 gm

(iii) Neutron Source (either Pu-Be or Cf-252, authorized under the ISU Broad Scope NRC License #11-27380.

Specifications for the above items were taken from the U.S. Atomic Energy Commission's Nuclear Material Transfer Report.

6. Technical Qualifications of the Applicant and Staff [ref. 10 CFR 70.22(a) (6)].

Responsibility for the supervision and operation of licensed activities will reside with the Reactor Administrator, the Reactor Supervisor, and the ISU Radiation Safety Officer.

Biographical data listing qualifications for those members of the ISU faculty who have responsibility for the supervision and operation of the SNM are included in Attachment (I).

7. Equipment and Facilities to Protect Health and Minimize Danger to Life and Property [ref. 10 CFR 70.22(a) (7)]

Attachment II is a description of the Sub-Critical Assembly, including figures.

(a) Handling procedures.

(i) Fuel plates.

Disposable plastic gloves or other hand coverings will be used by personnel while handling the fuel plates.

(ii) Uranium-aluminum foils.

Tongs, disposable plastic gloves, or other hand coverings will be used by personnel while handling the foils.

(iii) General Rules

ISU ALARA policies will be followed at all times.
No food or drink are permitted in the working area.
Personal dosimetry is required when in the working area.

Note: Personal dosimetry records are available via the ISU Technical Safety Office.

(b) Working area.

See Section 3 above: "The Place and Plan for Carrying Out the Activity."

(c) Measuring and monitoring instruments.

Beta, gamma, and neutron dosimeters provided by an NVLAP (National Voluntary Laboratory Accreditation Program) certified vendor are issued to all students and staff working with the special nuclear material.

Electronic equipment for measuring and detecting radiation with the following generic characteristics will be available for use during SCA operations:

Hand-held survey instruments:
- Ludlum Model 14A Geiger Counter with beta/gamma probe (or equivalent).
- Ludlum Model 2A Geiger Counter with thin-window pancake probe (or equivalent).
- Thermoelectron ASP2e Geiger Counter with beta/gamma probe (or equivalent).
- Ludlum Model 3 Survey Meter with ZnS alpha probe (or equivalent).

In addition, all available portable radiation monitoring equipment described in the renewal application for the Broad Scope By-products Materials License 11-27380-01 may be used by College of Engineering personnel.

All radiation detection instruments used in connection with this license shall be calibrated annually by the ISU Technical Safety Office at intervals not to exceed 15 months.

Beta/gamma and neutron portable survey instruments will be available to personnel to determine radiation fields during and following experimental operations. The types of instruments available to personnel are equivalent to the instruments described above. Surveys will be performed upon entry to the experimental chamber and shall include beta/gamma will be performed upon entry to the experimental chamber and shall include beta/gamma surveys. Survey data will be recorded in the log book for the SCA in Room 23.

Water samples will be analyzed for gross activity following each experimental series to detect possible damage to or defects in the fuel plates. Water samples will be analyzed by the Technical Safety Office using a liquid scintillation counter.

An energy compensated criticality detector, Eberline DA1-6C, or equivalent, connected to a RMS-II area radiation monitor system, shall be mounted near to (within 6 feet) the SCA tank with readout at the control console. The control console is adjacent to the SCA tank. This RMS-II system will provide direct radiation readings during experiments and subsequent post-irradiation decay of short-lived fission products and induced activity.

(d) Waste disposal.

There will be very little waste contaminated by radioactive materials resulting from the handling, storage, and use of materials under this license. No gaseous or liquid effluents have been used or produced with the exception of Argon activation in air, which is below detectable limits. Radiation and radioactive material users are instructed in minimizing radioactive waste and contamination, primarily plastic gloves. Any contaminated material will be controlled and disposed of by ISU Technical Safety Office personnel in accordance with 10 CFR 20 Subpart K.

(e) Storage facilities and security measures.

(This information is provided in Attachment (III).)

(f) Water handling system.

Deionized water will be used as the moderating medium in the SCA. The deionized water will be stored in three 53-gallon polyethylene drums. The drums will be connected to each other by a ½ inch pipe in such a manner that water can flow freely between the tanks.

At the beginning of each experiment deionized water will be pumped from the storage tanks to fill the assembly tank. At the end of each experiment the water will be drained out of the assembly tank and into the storage tanks through a 3/4-inch drain line near the bottom of the tank. An alternative experimental approach would be to pump the water into the tank after the SNM material is loaded with the desired SCA lattice. As the water level increases, the neutron multiplication (k_{eff}) can be measured as a function of moderator height.

A schematic diagram of the water handling system is provided in Figure II-4 of Attachment II. The drain pipe will be opened and closed by a "normally opened" solenoid valve. In the event of a power failure, the pump will shut off and the drain valve will open so that any water in the tank will necessarily drain out of the assembly tank. Without water acting as moderator the neutron multiplication factor of the assembly will be extremely small. Power feeding the solenoid drain valve and the pump will first go through a double-pole normally-open solenoid switch. This switch will be held open if a signal is generated by the criticality alarm. In the event of an inadvertent criticality (an extremely improbable event), or a high radiation alarm (≥12 mrem/hr), power will be automatically cut off to the pump and the solenoid drain valve, causing water to drain out of the assembly tank. Further, the solenoid switch will be wired in such a manner that any attempt to disconnect the solenoid switch from the criticality alarm will result in loss of power to both the pump and the solenoid drain valve. The wiring diagram for this installation is shown in Figure II-5 in Attachment (II).

8. Proposed Procedure to Protect Health and Minimize Danger to Life and Property [ref. 10 CFR 70.22(a) (8)]

(a) Radiation hazard.

Radiation hazard from subcritical assembly during operation with the Pu-Be source and all 150 plates in the assembly. Calculations and measurements taken with a Bonners Sphere neutron detector gave the following:

	Direct Calculations	Bonner Sphere Data
Fast neutrons	0.16 mrem/hr	<4.6 mrem/hr
Thermal neutrons	---	0.21 mrem/hr
Gamma photons	5.0 mrem/hr	2.6 mrem/hr

These dose equivalent rates are not expected to constitute a hazard to personnel for the following reasons:

(1) The dose equivalent rates listed above are given at the surface of the assembly tank. Personnel are rarely that close to the assembly for any extended period.

(2) Personnel will only spend a few hours a week in the vicinity of the SCA while it is operating.

(3) Personnel are required to actively pursue the ISU ALARA policy.

(4) Personnel dosimeters are surveyed every quarter for adults likely to receive 10% of the annual allowable limits.

Operation of the SCA to date has not revealed any radiation hazard to personnel. However, a criticality alarm is installed in Room 23, as required by 10 CFR 70.24. Furthermore, all personnel involved in the operation of the SCA shall wear ISU-issued personal dosimetry capable of measuring beta, gamma, and neutron dose equivalents. Internal intake of license material is prevented by plate leak checks, water sample analysis, safe handling procedures, and minimum personal requirements. Visitors will be issued self-reading pocket dosimeters while in Room 23. In the event that the number of visitors exceeds the number of available self-reading pocket dosimeters, a minimum of 1 dosimeter will be issued for every 4 visitors, so that at least one-quarter of the visitors to the facility are monitored for exposure to ionizing radiation. In addition to the fixed criticality alarm, an independent portable gamma detector will be in operation at all times that personnel are in Room 23 while fuel is located in the SCA tank.

Operation of the SCA to date at the LEL has not revealed any residual radiation levels above background after the fuel is put into the storage container. Any new operational procedure or experiment dealing with SNM that will likely increase radiation exposure must have prior approval of the ISU Radiation Safety Officer. All user of radiation or radioactive material are trained annually must adhere to the ISU Radiation Safety Manual (RSM) and ISU ALARA goals. The RSM is reviewed and updated by the ISU Radiation Safety Committee and is available online at http://www.physics.isu.edu/health-physics/tso/rad.html.

Should a radiological incident occur it will be reported in accordance with 10 CFR 70.74 and 10 CFR 20 Subpart M. Records of activities will be kept in accordance with 10 CFR 20 Subpart L.

(b) Fire hazard.

No materials or chemicals will be stored in Room 23 which could present a significant fire hazard. Plywood and particle board will be used in Room 23 as boxes, structural walkway around SCA, and for work surfaces. Small amounts of paper for documentation and printer paper will also be used in Room 23. Low risk in-situ combustibles within Room 23 will be limited to quantities less than 12 cubic feet. Low risk combustibles being materials such as paper, plywood, and particle board. Transient combustibles shall be limited to 6 cubic feet within Room 23. No liquid combustibles are allowed withing the room. Normal fire rules will be observed. There are three 10 lb dry-chemical, "ABC"-class fire extinguisher located in the reactor laboratory area, see Figure 2. Some reactor personnel have been trained on use of fire extinguishers but it is not required training. Fire extinguishers are monitored and maintained by ISU Facilities and Maintenance. A simplified fire safety evaluation found a fuel cladding failure to be unlikely for typical combustibles in the room. Furthermore, the fission product inventory in these subcritical plates is in the sub microCurie range, and would result in negligible doses to personnel if if all were released to the environment of the of the laboratory.

A heat-rise sensor is located in the ceiling in Room 23 above the assembly tank. Activation of the sensor by a fire will sound the building fire alarm and energize an indicator light on a fire location annunciator panel, which is located at the east main entrance to the Lillibridge Engineering Laboratory Building. The heat rise is checked and maintained by ISU Facilities and Maintenance. Room 23 has two and a half floor to ceiling concrete walls, solid concrete floor, and an one hour fire door, the remaining room barriers do not have a fire rating. There is no automatic fire suppression system in the building. In the event of a fire which may cause damage to the fuel plates or foils, a subsequent leak test (swipes) will be performed on all fuel plates and foils. All electronics which may have been damaged by a fire will be tested before returning to use, namely the SCA criticality alarm and SCRAM system.

In the most recent non-fire related emergency drill, August 24, 2009, the fire department were contacted through ISU Public Safety per the emergency calling tree. The fire department was contacted by dispatch 4.5 minutes after the initial distress call. Fire department personal arrived at the building 10 minutes after being contacted by dispatch, and arrived in the reactor laboratory 1 minute 10 seconds later.

(c) Inadvertent criticality.

The SCA has been designed to be subcritical by at least 13% (k-effective < 0.87) under all conditions using ordinary water as the moderator and as the radial and top reflector. Operational measurements have verified the design calculations. Criticality, however, might be possible by the deliberate and unauthorized use of superior moderator or reflector materials with the licensed material arranged in an optimal geometric configuration. Prevention of inadvertent criticality is accomplished by prohibiting the use of superior moderator or reflector materials in the SCA room. Specifically, beryllium, beryllium oxide, and heavy water are not permitted in the SCA room. The use or storage of graphite in the SCA room is restricted. Approximately 4,500 lb of graphite blocks make up the thermal column beneath the SCA tank. This graphite is stacked in layers within a metal framework and will not be disassembled or otherwise disturbed during operation of the SCA except as to allow for the insertion of suitable neutron sources required for the operation of the SCA or fission foils for flux mapping or neutron diffusion experiments. Additional graphite will not be allowed within 4 feet of the SCA or the thermal column, without prior approval of of the Reactor Administrator and an analysis of the intended use and its potential effect on the reactivity of the most reactive system. The Reactor Safety Committee must approve the results of the analysis.

In addition to the restrictions placed on the use of the superior moderating and reflecting materials to guard against inadvertent criticality, restrictions shall be in place for the use of other fissile materials in conjunction with the operation of the SCA. Small quantities (not to exceed 3 gm total, but not including the Pu-Be neutron sources) of fissile nuclides (i.e., U-235 and/or Pu-239) may be used as approved by the Reactor Administrator as neutron monitors for flux mapping experiments. The only special nuclear materials that may be used or stored in Room 23 are the fuel plates, the U-Al foils, and fission counters, the latter representing small quantities (not to exceed 3 gm) of fissile materials.

Accordingly, the following administrative control notice will be posted at the entrance to the SCA room:

> "NOTICE The following materials are <u>not</u> to be taken into or stored within the subcritical assembly room, #[redacted]: beryllium, beryllium oxide, heavy water, or fissile nuclides (i.e., ^{235}U and/or ^{239}Pu) exceeding 3 gm of any one isotope or combination of isotopes except for the Pu-Be sources necessary for facility operation. Graphite may be taken into the subcritical assembly room only with the approval of the Reactor Administrator."

A fixed criticality alarm system is installed in Room [redacted], as described below in Section 10 (a).

(d) Leakage testing and surveys.

Ten percent of the fuel plates will be leak tested using standard swipes for alpha contamination following each experiment and at normal inventory periods. Ten percent of the uranium-aluminum foils will be leak tested in conjunction with the fuel plates following use or when performing the inventory. For the purposes satisfying the requirements of this section, a leak test will be assumed to have been performed satisfactorily if the test was performed within a week following the completion of the experiments.

A general area and contamination survey will be performed in conjunction with the leakage testing. In addition, a bi-annual general contamination survey and radiation survey will be performed in Room [redacted], under direction of the Technical Safety Office (TSO). The action levels for these surveys will follow the guidelines of the ISU Radiation Safety Manual. After each use of the plates in the subcritical tank with water, a water sample will be analyzed by TSO, using liquid scintillation counters. The results are reported to the Reactor Supervisor. There has been no detectable water contamination to date

(e) Fuel integrity.

The fuel plates have been used for laboratory experiments at the SCA in Room [redacted] for two decades, with approximately two sets of experiments per year. The careful handling of the plates during this period has resulted in no detectable leakage of fission products, based on swipes following the experiments, and analysis of the tank water.

(f) Transportation.

Transport of the small amount of material permitted to be used in the Physical Science Building Particle Beam Laboratory will be done by personnel using containers approved by the TSO. The TSO will be informed when such transport is to occur.

9. Material Control and Accountability [ref. 10 CFR 70.22(b)]

(a) Inventory procedures.

Inventory of the material will be performed at least twice each year. It is anticipated that all fuel plates will be used in most experiments conducted in Room [redacted], and conclusion of such a total plate-use experiment may serve as an inventory check. This fact, along with assembly procedures, will reveal any missing material. An approved emergency plan establishes procedures to be followed in the event of loss or theft of special nuclear material.

(b) Administrative controls.

The Reactor Administrator is responsible for the safe storage and use of the special nuclear material. The Reactor Safety Committee (RSC) has reviewed and approved all plans and procedures for the usage of the materials in the SCA. The Reactor Safety Committee shall review and approve all new experimental plans and procedures for the use of the licensed material prior to implementation. The Reactor Safety Committee shall review and approve all changes to existing experimental plans and procedures that may affect safety. The RSC was formed at the request of the NRC in 1968 to review and approve experimental procedures performed with the ISU AGN-201 reactor (License R-110, Docket No. 50-284). The Radiation Safety Officer shall review radiation dose data annually to ensure that doses are maintained ALARA and shall report the findings of the assessment to the Radiation Safety Committee.

There must be a minimum of two persons in Room [redacted] whenever operations involving special nuclear material in the assembly are in progress. One of these individuals must have been cleared for access to Safeguards Information. Access to Room [redacted] and the fuel storage containers will be controlled by the restricted distribution of keys. This distribution will be as follows:

> The Reactor Administrator, the Reactor Supervisor, and the Chair of Nuclear Engineering Department each hold the key to Room [redacted] (the subcritical facility room). Other personnel, authorized by the Reactor Administrator and who have undergone a background check, may have access to a key to Room [redacted] as needed. The Reactor Supervisor and Reactor Administrator will control keys to the locks securing the fuel storage container and the assembly access cover.

Prior to working or handling licensed nuclear material, all personnel shall have received training or shall be under the supervision of persons who have received training in radiation protection from the ISU Technical Safety Office.

Statements of qualification for personnel responsible for the use of the special nuclear materials under this license are in Attachment (I).

10. Additional requirements

(a) Criticality alarm.

The criticality alarm in Room [redacted] is a Ludlum Model 300 remote area monitor, or equivalent system. It is currently installed on the wall less than six feet away from the assembly tank and is clearly audible within Room [redacted]. The criticality alarm system meets the radiation level criteria stated in 10 CFR 70.24(a)(2).

In the event of loss of power or damage to the criticality system the water will be automatically drained from the SCA tank, assuring subcriticality. Should the criticality accident alarm system be out of service no experimental use of fuel plates within the SCA tank will be permitted.

(b) Emergency evacuation procedure.

The procedures given below will be carried out under the direction of the person responsible for the assembly at the time the emergency occurs. Detailed emergency procedures are provided in the approved facility Emergency Plan.

All power to the pump and solenoid drain valve will be shut off by placing the drain valve and pump power switch in the OFF position.

The portable gamma survey meter will be taken from Room [redacted] by the evacuating personnel.

Once all personnel are out of Room [redacted], the door will be closed and a radiation survey will be performed in all areas adjacent to Room [redacted]. If radiation levels exceed 10 mrem/hr outside of Room [redacted], the building fire alarm will be activated to evacuate the entire building. Pull stations for activating the fire alarm are located in the main corridors near the stairs as shown in the basement building floor plan in Figure 2. Exits and access routes to and from the basement are shown on the building basement floor plan and in the first floor plan (Figure 3).

Building ventilation will be secured by pushing the "Penthouse Power Emergency Trip" switch located on the wall facing Room 15 about 6 feet inside the door entrance #14 to the Nuclear Engineering Laboratory complex.

The Reactor Administrator, the Nuclear Engineering Department Chairperson, the Radiation Safety Officer, and the Reactor Supervisor or their designated alternates are all on an emergency call list and will be notified of the emergency. Building reentry will be directed by the Reactor Administrator and/or the Reactor Supervisor in consultation with the Radiation Safety Officer (or their alternates).

Emergency equipment and communication and alarm systems will be tested annually. Emergency procedures will be reviewed with permanent staff and personnel who work with the SNM. Periodic review of these procedures will be accomplished by annual instruction and drills.

NOTE: Cancellation of Plans to Use SNM Materials at the Idaho Accelerator Center (IAC)

A previous license amendment included authorization for the SNM to be used at the Idaho Accelerator Center, which is located 1.2 miles from the LEL Building, yet on the ISU campus. This amendment was approved on September 22, 2005 by the NRC as a result of response to the Request for Additional Information (TAC No. L31845, dated January 11, 2005), which was submitted to NRC with a letter dated February 18, 2005.

However, use of the SNM at the Idaho Accelerator is not requested as part of this license renewal. The facility "White Room" at the Idaho Accelerator Center which was used for experiments involving the prior SNM license amendment is no longer alarmed or monitored, and there are no plans to use the SNM at the IAC within the foreseeable future.

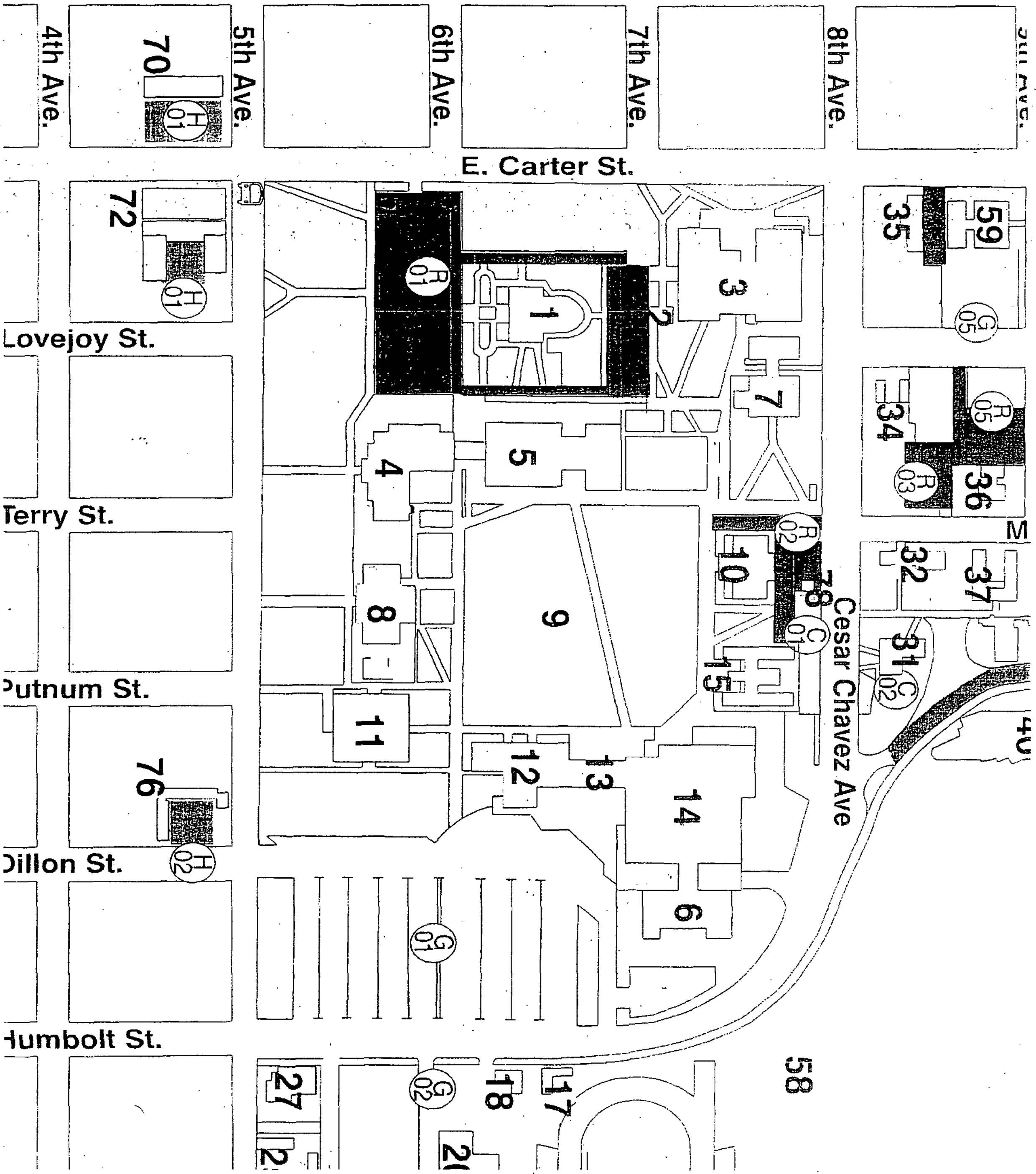

Figure 1 - Campus Map - LEL building is #7, Physical Science Building is #3, and #27 is Campus Security

APPLICATION FOR LICENSE RENEWAL
MATERIALS LICENSE No. SNM-1373
February 26, 2009

BASEMENT FLOOR - BLDG. 07 - ENGINEERING
SCALE: NO SCALE

Figure 2 - Basement of Lillibridge Engineering Building

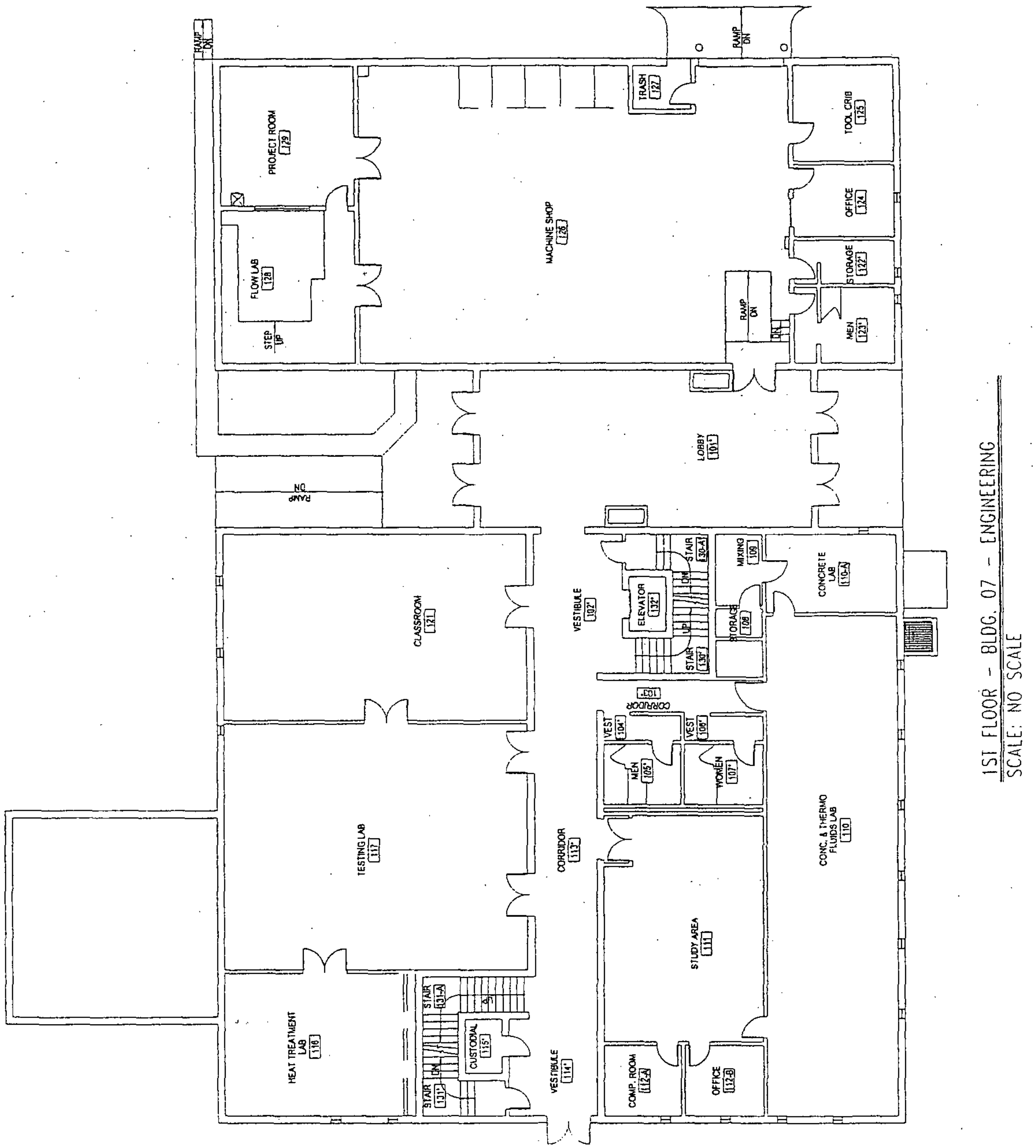

Figure 3 - First Floor of Lillibridge Engineering Building

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February 26, 2009

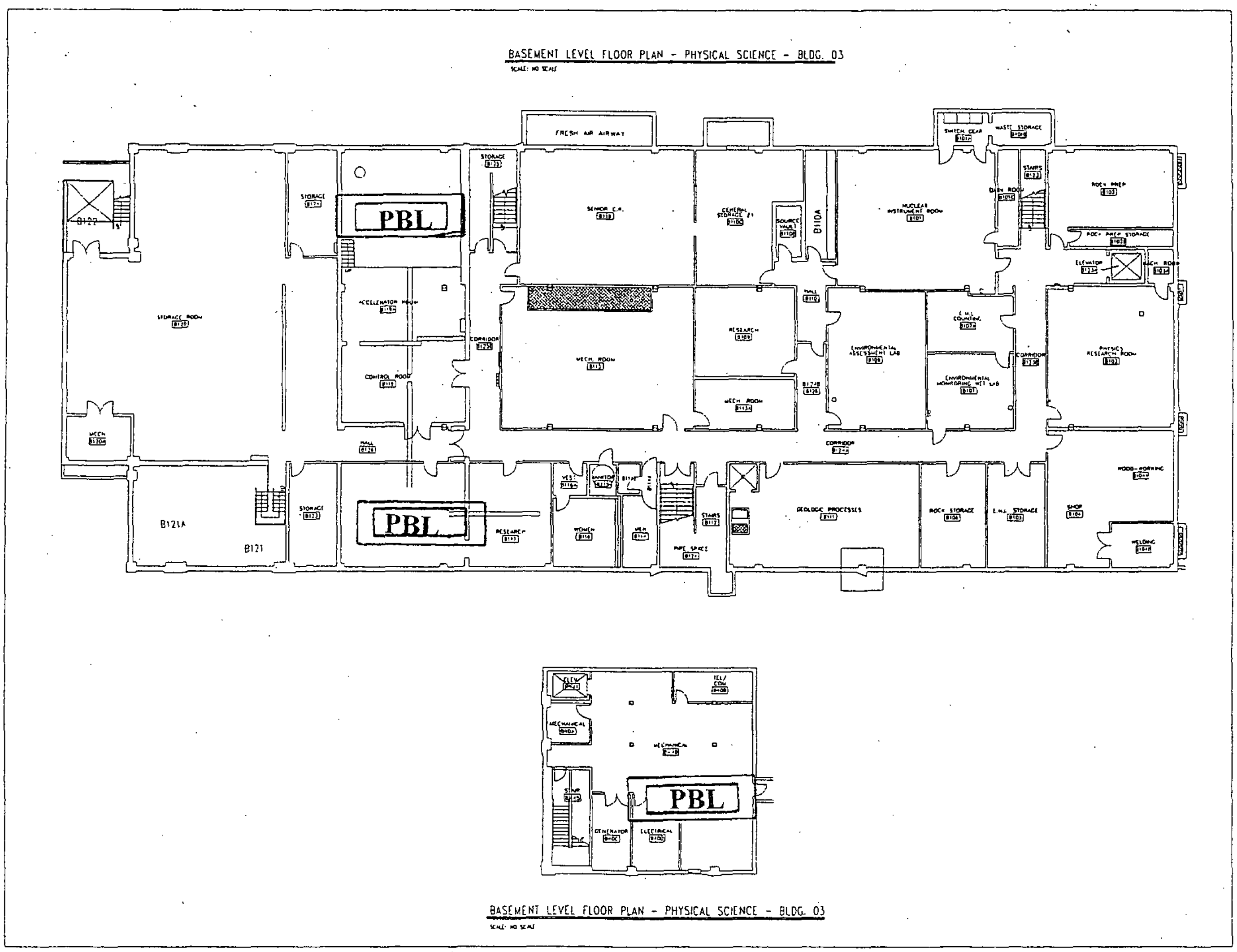

Figure 4 - Basement of Physical Science Building - showing Particle Beam, Laboratory (PBL)