C. C. 106

City of Cambridge

MASSACHUSETTS

In City Council Nov 5, 2001

MAS Exec Session 6:22

YEA	NAY	ABSENT	PRESENT	
✓				Ms. Kathleen L. Born
✓				Mr. James Braude
✓				Ms. Henrietta Davis
✓				Ms. Marjorie C. Decker
✓				Vice Mayor David P. Maher
✓				Mr. Kenneth E. Reeves
✓				Mr. Michael A. Sullivan
✓				Mr. Timothy J. Toomey, Jr.
✓				Mayor Anthony D. Galluccio

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The MIT Research Reactor Laboratory

Only facility in US doing advanced radiation treatment for difficult-to-treat brain cancers

October 31, 2001

The MIT Research Reactor Laboratory is a small non-power nuclear reactor. It is owned and operated by MIT to support medical, environmental, geologic, physics and materials research done by MIT and many other institutions, ranging from Children's Hospital to Caltech and the state universities of Massachusetts, Alabama, and Utah. It is also a teaching laboratory for MIT's nuclear engineering department, which has consistently been ranked #1 in the nation by US News and World Report.

The reactor does not generate electricity. It is one of 26 such small research reactors operated by universities in the United States.

It is the only facility in the United States doing advanced radiation treatment for brain cancers such as melanoma that has metastasized to the brain and glioblastoma multiforme, a highly malignant form of brain cancer. Advances in technology installed last year made the facility on the Cambridge, Mass. campus the standard of the world for radiation treatment of these otherwise untreatable brain cancers. Clinical trials have been conducted by Beth Israel Deaconess Hospital at the MIT Research Reactor. (See http://web.mit.edu/newsoffice/tt/2000/dec06/cancer.html)

Description
The inherent safety of the MIT Research Reactor is based on its minimal use of heat, pressure and fuel. It operates at low atmospheric pressure (14.7 pounds per square inch) and at the low temperature of dishwasher water (122° F) with a small amount of aluminum-uranium fuel. It does very precise work in medical treatments and technical assessment of materials and their properties. MIT has operated the Research Reactor since 1958 without incident.

MIT operates the facility on a "not for profit" basis, and makes it available to Boston area hospitals and colleges in conjunction with their research and educational objectives. The facility has been used extensively by Boston-area high schools for the purpose of providing tours of a research reactor to students.

1/600th the size of a modern power reactor
In contrast to the MIT reactor , which operates at 5 megawatts of thermal power, a modern nuclear power reactor that generates electricity operates at a thermal power level that is 600 times greater and with 600 times the quantity of fuel. A typical modern nuclear power reactor produces 3,000 megawatts of thermal power (3000 MWt) to generate approximately 1,050 megawatts of electric power (1050 MWe). The pressure in a power reactor, about 2000 pounds per square inch, is about 136 times greater than the natural atmospheric pressure (14.7 psi) used at MIT.

Research
The important research activities at the building include:

- Nuclear medicine—A $3 million state-of-the-art intermediate energy neutron beam was built in 2000 at the research reactor for the treatment of brain cancer and metastasized melanoma in the brain. This project has been funded by the National Institutes of Health for patient trials conducted by Beth Israel Deaconess Hospital

- Design and construction of superior neutron beams for the enhancement of medical therapies in the treatment of cancer.

- Treatment of rheumatoid arthritis through the use of beta-emitting radioisotopes such as dysprosium-165. The isotope emits a beta particle (an electron). The treatment is achieved by injecting the radioisotope into the affected joint and then allowing the emitted radiation to destroy the damaged tissue. This relieves the pain in the joint and avoids the need for surgery. The efficacy of this approach was proven during patient trials that were conducted at local area hospitals using dysprosium-165 that was produced at the MIT Research Reactor. See http://web.mit.edu/newsoffice/tt/2000/jan26/arthritis.html

- Air pollution studies through the use of neutron activation analyses. This involves collection of air particulates on filters, the activation of these filters by neutron beams, and then the determination of the metals or other trace elements of the filters by observing the X-rays emitted from the activated materials.

- Testing of materials proposed for advanced nuclear power reactors.

- Geologic studies on the origin of meteorites and volcanic lavas through the use of neutron activation analysis.

Safety and security features of the MIT Research Reactor

- An impact of any type **cannot** cause a nuclear explosion.

- The 15-inch core of the MIT Research Reactor is located inside a shield of reinforced concrete that is five feet thick. It blocks nearly all the radiation, thereby allowing people to work safely in the building. The work area in turn is enclosed by the containment building, which has outer walls of concrete two feet thick covered with heavy steel.

- Due to its low operating temperature and pressure and the quality of its design and construction, the research reactor's steel and concrete containment structures are designed to prevent the release of radioactivity in all accident scenarios foreseen by its designers--including such extremes as a truck bomb.

- The Research Reactor automatically turns off upon loss of electric power. Any disruption of the core would cause the research reactor to cease operation. Six control blades (any one of which will shut the reactor down) will drop by gravity upon loss of power or activation of any of 22 safety monitors.

- It also is designed to prevent a power surge and release of radioactive fission products from the fuel.

- The water is not pressurized, and thus is not a major source of stored energy, as in a power plant. During full power operation, the water that circulates through the reactor is heated about 8 degrees C (about 15 degrees F), to a maximum of 50 C (122 F).

- It has natural convection cooling to cool the reactor in the event of loss of cooling pumps.

- Monitors keep track of the radiation levels both inside and outside the reactor building. Some of these monitors will act automatically to seal the containment building before any radiation is released.

- Since the tragic events of September 11, 2001, security has been heightened in accordance with changes in Nuclear Regulatory Commission (NRC) guidelines. An armed guard is posted around the clock. The research reactor has detailed emergency and security plans.

- The operation of the MIT research reactor is regulated closely and inspected by the NRC. The research reactor staff have a close working relationship with the City of Cambridge. MIT communicates regularly with government agencies on security matters. There have been no credible threats made against the MIT Research Reactor.

Training--MIT has an excellent training record. The operating staff is licensed by the NRC, and is required to undergo a very rigorous training program and pass two-day exams administered by the NRC. All users of the reactor are checked for security access. It takes four to six months to obtain the lowest license. Nearly the entire staff holds a higher level of license that requires additional training and an additional NRC exam.

What would happen if a large plane attempted to hit the research reactor?

The MIT facility was built to a very high standard of safety, although it was not built with such an attack in mind. Following the September 11 airliner attacks on the World Trade Center and the Pentagon, a preliminary engineering assessment of such an attack was made. The MIT Research reactor is a small building nestled among neighboring buildings. It is close to the ground and exceedingly difficult to hit with a large jetliner. In contrast, the Pentagon stands by itself, and the World Trade Center's twin towers stood alone at an altitude of more than 1,360 feet.

MIT experts in construction and engineering conciude that, in the improbable event that a pilot could hit the target, it is very unlikely that any plane part would strike the radioactive core. It is believed that one or possibly two engines might penetrate the outer two feet of concrete and steel, but not the biological shield's five feet of concrete or the floor's three feet of concrete. The plane's wings (which contain the fuel tanks) would likely break off on impact with the outside of the building. The jet fuel would spill and by itself cause an intense fire, as it would wherever it happened. The conclusions of the MIT experts are consistent with preliminary assessments on other research reactors.

Other Questions: ==========

CLOSING–Has MIT considered closing the reactor? MIT is continuously evaluating its laboratory facilities as part of its commitment to quality education. The reactor was reviewed in that spirit several years ago and it was decided to continue operation.

FUTURE–What are its future plans? We have recently received funding from the National Institutes of Health to have Beth Israel Deaconess Hospital conduct trials of our novel method for the treatment of brain cancer and metastasized melanoma cancer. We will be using the new state-of-the-art neutron beam that was recently built at the reactor at a cost of $3M. It is the best beam in the world and the only one in the U.S. for this type of research.

CAPACITY–What is its capacity? The reactor is rated at 5 megawatts thermal, about 1/600th the thermal capacity of a modern nuclear reactor that produces electricity. It is capable of operating at higher powers but is not licensed to do so. The safety margins are very large.

SECURITY–Are there new security precautions since 9/11? Yes. The reactor is regulated by the U.S. Nuclear Regulatory Commission. We comply with all of their rules. They have recommended upgrades and we are in compliance. There is an armed guard on duty around-the-clock.

SECURITY--Who is in charge of security there? MIT is responsible for security in its capacity as the reactor owner and operator. On 11 Sept, MIT increased security on its own. The NRC later that day (almost immediately) issued a set of recommendations in accordance with its existing contingency plans. MIT was already doing what was being recommended. About a month later, the NRC issued a set of required security upgrades. MIT was already doing those things as well. MIT is not allowed by federal law to say what the heightened measures are. However, you can assume that the" number of security personnel or details" have been increased. We continue to review security for the reactor as we do for all activities on the MIT Campus.

GUARDS--Does MIT use its own campus police for the job, or do they contract out for security? MIT uses its own police who are specifically trained every year on the reactor's security needs. We also maintain regular contact with the Department of Emergency Preparedness for the City of Cambridge.

NRC–How does the NRC monitor security? NRC has several types of inspections. Types include: operations, radiation safety, security, safeguards, and training. For each type the NRC has a specific protocol of the things that are to be checked and the procedure to be used to check them. They also have people who are specifically trained in each area. They try to hire people with experience and make every effort to do more than merely check paper trails. The inspectors try to observe activities rather than merely review documentation of an activity. This makes for a

much more productive inspection. We can't give you details on their security inspections. We can say that the NRC does have quality people.

SAFETY-How does the Nuclear Regulatory Commission make sure it is safe and secure? The NRC conducts regular security inspections. The method used to conduct these inspections are not public. There have been no deficiencies. NRC has several types of inspections. Types include: operations, radiation safety, security, safeguards, and training. For each type the NRC has a specific protocol of the things that are to be checked and the procedure to be used to check them. They also have people who are specifically trained in each area. They try to hire people with experience and make every effort to do more than merely check paper trails. The inspectors try to observe activities rather than merely review documentation of an activity. This makes for a much more productive inspection. We can't give you details on their security inspections. You should ask them directly. We can say that the NRC does have quality people.

TOURS–Is the reactor still open for tours? The reactor is still open for tours because that is one of its important educational functions. However, there are some stiff restrictions. We are taking high school groups from schools where we already know the teachers from previous years. We are not taking anyone whose identity can not be confirmed in advance.

WEB PAGE--Is the layout of the reactor still available on the web? Doesn't this give someone from the outside enough information to access the facility if they want to sabotage it? The MIT reactor web site was off-line and being reviewed for content, after the NRC closed its web site. The MIT site will be back up by Nov. 1.

FUEL--What is the fuel? People are concerned about theft of Russian nuclear fuel to make nuclear bombs; should we be similarly concerned about MIT's fuel? No, we don't need to be concerned. Research reactor fuel is not attractive as a weapons source because such fuel is alloyed with aluminum or other materials. It requires sophisticated equipment, technical expertise, and time to separate the fuel from the alloys. The federal government limits the amount of fresh fuel in circulation at any one time to a quantity that is well below what is needed for a weapon. The spent fuel is too radioactive and contains too many isotopes to have any practical value as a weapons source.

SPENT FUEL POOL--Is there a spent fuel pool on site? What happens to the nuclear waste? The MIT Research Reactor does have a spent fuel pool. It is below grade and very protected as a result of that. Research reactor fuel is owned by the U.S. Department of Energy and hence it is returned to DOE when spent. This is in contrast to power reactor fuel which, as of yet, has no repository. As a result, the MIT spent fuel pool is always well below capacity and sometimes close to empty. Another important difference is that our spent fuel has a relatively low power history. This means that it is radioactive enough to ensure that anyone trying to steal it would receive a lethal dose of radiation. (Note: For most of our spent fuel this dose would also

be disabling so someone who was willing to die in the process wouldn't be physically able to achieve their goal.)BUT, the low power history also means that the residual energy (called decay heat) is low. So the pool poses no threat if a September 11 type event occurred. It just isn't a hazard from that perspective. =

THREATS-- Prior to our licensing, we went through an extensive analysis of the consequences of various types of accidents and incidents that were considered credible (unfortunately the deliberate crash of a fully fueled airliner wasn't considered credible until 9/11). In all of these cases, the design of the reactor safety features either prevent the release of radiation completely, or limit any release to well below the level the Nuclear Regulatory Commission considers to be a safe limit. U.S. Nuclear Regulatory Commission.

DRILLS We regularly conduct training drills in emergency response.

John Bernard, Director
MIT Research Reactor Laboratory
617 253-4202

CITY OF CAMBRIDGE

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EMERGENCY MANAGEMENT
DEPARTMENT
David B. O'Connor
Director

October 11, 2001

Robert W. Healy, City Manager
Cambridge City Hall
Cambridge, MA

Re: Council Order O-7 of October 1, 2001

Dear Mr. Healy:

I am writing with an preliminary response to your request for information relative to Council Order O-7.

First of all, there are no nuclear reactors in Cambridge other than the reactor currently in operation at MIT. Harvard has never had a nuclear reactor. There are no other reactors in Cambridge presently. Many years ago MIT had two very small (sub critical) graphite piles that were used at one time for research. The fell into disuse and were decommissioned and removed in the early 1990's. The only other research reactors in Massachusetts are in Lowell, at U-Mass Lowell and in Worcester at Worcester Polytechnic. At one time there was a nuclear reactor in Watertown at the Watertown Arsenal but it was decommissioned a number of years ago.

The MIT reactor was first placed into commission in July of 1958 and was used until 1974. The reactor was rebuilt from 1974 until 1976 and was placed back in use during 1976. The reactor was shut down for a period of reconstruction during 1999 and was back in full use in June of 2000.

As part of the NRC licensing procedure the reactor's license is reviewed triennially. Part of the NRC procedure requires that the reactor be visited by the Fire Chief, Police Commissioner and Emergency Management Director and that these officers review the reactor emergency plan. The visit for this triennium is scheduled for the afternoon of November 8th at 1:00PM. At this meeting we will be discussing a number of issues relating to the reactor security plan and the reactor emergency plan.

I should note that all aspects of the security plan and all security procedures are classified as "Safeguards" information and cannot be disclosed or made part of the public record. I can say that the security at the reactor has always seemed very thorough. At a meeting

with the MIT reactor staff on October 1, 2001 we discussed two ways to enhance the security. The MIT staff were quite receptive to my suggestions and I received a telephone call today from Dr. Bernard, the director of the lab, to tell me that the suggestions had been approved by the NRC. I cannot describe the suggestions in this letter as they constitute Safeguard information.

I have some real concern about the language "fully visible" security system in the council order. Having security personnel or systems "fully visible" could well be counter productive and might violate some of the NRC regulations relative to reactor security and might not comply with certain aspects of the security plan.

One thing of note was that on September 11th I called the reactor less than ten minutes after the second World Trade Center crash to ask them to shut down. At the time I called that had already shut down and sealed off the reactor and had fully implemented the aspects of the security plan dealing with external threat situations. Although I cannot detail the procedures they followed in this letter, the excellent implementation of these procedures was very encouraging.

I will provide you with a follow up on this letter after the November 8th meeting at MIT. If you feel you need additional information prior to that date please let me know.

Respectfully,

David B. O'Connor

CITY OF CAMBRIDGE

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EMERGENCY MANAGEMENT
DEPARTMENT
David B. O'Connor
Director

October 29, 2001

Robert W. Healy' City Manager
Cambridge City Hall
Cambridge, MA

Re: Security at MIT Reactor

Dear Mr. Healy:

I am writing in response to your inquiry relative to parking near the MIT Reactor Lab. I understand that there are some security concerns from someone in the community relative to parking on the street in the area of MIT building NW-12.

Since I spoke with you I have reviewed my notes and the MIT Reactor Lab Security Plan. The security plan was approved by the Nuclear Regulatory Commission (NRC) after review of the plan and an examination of the site, taking into consideration a wide range of risks that I cannot detail in this letter. I also looked at the notes that were made at the time of the extensive review of the reactor conducted by the Police and Fire Chiefs, the Health Commissioner and myself several years ago.

There is absolutely no requirement by the NRC plan that there be restrictions on vehicles parked in the street adjacent to the lab complex. It was determined quite some time ago that no credible vehicular bomb located beyond the MIT property line could cause sufficient damage to damage the reactor to result in the release of any radiation.

The electronic, physical and armed human security in place are actually more that is required by the security plan approved by the NRC. I cannot enumerate all of the security that is in place as the exact security precautions are classified as "Safeguards" information. I should note however that I was extremely pleased to learn that an observer was not able to see the armed personnel. This is a very strong indication that the plan is being fully implemented.

If you have any additional questions please let me know and I will either answer them or get you the information needed.

Respectfully,

D. B. O'Connor

CITY OF CAMBRIDGE • EXECUTIVE DEPARTMENT

Robert W. Healy, City Manager *Richard C. Rossi, Deputy City Manager*

November 5, 2001

To The Honorable, The City Council:

Please find attached a response to Council Order No. 7, dated 10/1/01, regarding the MIT Nuclear Reactor, which was distributed at the Council Meeting of October 29, 2001.

Dr. John Bernard, Director of the MIT Facility will be present for the Executive Session. Due to a scheduling conflict, I respectfully request that the Council move to Executive Session by 6:45 p.m. Enclosed is additional information provided to me by Dr. Bernard.

I am recommending that these communications be referred to Executive Session scheduled for the discussion of this matter.

Very truly yours,

Robert W. Healy
City Manager

RWH/mec
Attachment

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Consent Agenda #1

Information referred to
Executive Session.

In City Council November 5, 2001

Moved to
Executive Session
9-0-0