ATTACHMENT A

Massachusetts Institute of Technology

/uclear Reactor Laboratory
/mber 13, 2011

The MIT Nuclear Reactor Laboratory (NRL) has served the Institute and the national scientific community for 53 years as an interdepartmental center operating a high performance research reactor in support of MIT's mission of education and research. The NRL's mission is to provide faculty and students from MIT, as well as the national scientific and engineering community, with both a state-of-the-art reactor facility and the infrastructure to enable and support its use for research and other societal objectives.

Highest priority is placed on operating the research reactor in a highly professional manner that is safe to MIT and NRL staff, researchers, the public, and the environment. The NRL is also committed to educating the general public by promoting education and training in nuclear sciences and technologies.

What Goes on at MIT's Reactor?

The NRL provides faculty and students with a high-quality neutron source complemented with an extensive infrastructure to facilitate its use. The Laboratory's primary objective is to support research and educational training in the areas of:

- nuclear fission engineering
- radiation effects in biology and medicine
- advanced material studies
- advanced fuels studies
- neutron physics
- geochemistry
- environmental studies

Through the years, MIT undergraduate and graduate students have benefited tremendously from the hands-on experience they have gained at the NRL. More than two hundred BS, MS, and PhD theses have been completed, and more than 300 students have participated in the NRL's Reactor Operator Training Program. Faculty and scientists from MIT, as well as other institutions, perform cutting edge research at the Laboratory. A current example of research going on at the Laboratory, especially relevant given the recent situation in Japan, is the testing of improved fuel cladding materials that will lead to enhanced reliability, performance, and safety at commercial nuclear power plants, as well as national and university research reactors.

The national importance of the MIT's reactor has been recognized by its partnership with the Idaho National Laboratory's Advanced Test Reactor. Together, these facilities form a National Scientific User Facility (NSUF), which is charged with providing the national community with a robust capability to perform in-core experiments on advanced fuel and materials. The NSUF test space in both reactors is made available at no cost to external users whose projects are selected via a peer review process.

Finally, the NRL implements MIT's educational mission by providing public lectures and tours, hosting research students, offering lab courses for professionals, undergraduates, and advanced secondary students, and establishing an outreach program to encourage understanding of nuclear energy and its applications. Approximately 1,500 people visit the reactor annually, of which 2/3 are school children.

What are the Safety Systems at MIT's Reactor?

MIT's NRL is fully regulated by the Nuclear Regulatory Commission and is currently licensed to operate at 6 MW. Its power level is 500 times smaller than that of a typical commercial power plant that produces electricity. The reactor has a correspondingly lower amount of nuclear fuel in its core compared to a power plant. New fuel is not stored on-site, and waste fuel is regularly shipped off-site. The reactor has never had any nuclear accident or radioactive release above the minimal authorized levels in its lifetime. Physical and procedural access to the reactor is carefully controlled.

MIT's reactor is equipped with both engineered and passive safety features that ensure its safe shutdown under abnormal conditions. For example, since the reactor operation requires electricity, any loss of electricity results in a shutdown. Thus, if there were an external event such as a hurricane that disrupts the electricity supply, the reactor shuts down safely. The heat released from the core after such a shutdown is absorbed by the cooling water without the need for pumps, and this heat is not sufficient to cause the cooling water to boil, let alone the fuel to melt. In addition to this passive safety feature, there are back-up diesel generators and battery systems that are tested regularly. Trained NRL staff carry out ongoing monitoring of all operational and safety systems.

The reactor core is located inside a containment building (two feet of reinforced concrete within a steel shell) that serves to isolate the reactor from the environment. The building is entirely contained and sealed through a variety of redundant systems. Studies show this structure could prevent a large truck bomb from causing significant radioactive release.

Based on the history of earthquake activity in the Boston area, structures in this area are generally designed to withstand a force of 0.225 g, with the expectation that such an event could occur once every 10,000 years based on the existing history. The NRL's core vessel is designed to withstand much higher forces. In addition, the reactor is protected against the consequences of potential seismic activity by seismic detection systems, which trigger automatic shutdown, and by the containment building. The recent east coast earthquake would have caused no structural damage even if it were centered in the Boston area.

MIT benefits from very close cooperation with the Cambridge Fire, Emergency Management, and Police Departments. The reactor's emergency response systems and procedures are regularly reviewed and approved by City officials. In addition, MIT and the City participate in joint emergency preparedness training exercises on a regular basis.

http://web.mit.edu/nrl/www/

ATTACHMENT B

CITY OF CAMBRIDGE • EXECUTIVE DEPARTMENT

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

795 Massachusetts Avenue, Cambridge, Massachusetts 02139
Voice: 617.349.4300 Fax: 617.349.4307 TTY: 617.349.4242 Web: www.cambridgema.gov

May 23, 2011

To the Honorable, the City Council:

In response to Awaiting Report Item Number 11-40, regarding a report on the safety of nuclear reactors in Cambridge, Fire Chief Gerald A. Reardon reports the following:

There is only one actual nuclear reactor within the City of Cambridge. It is a research reactor on the campus of MIT. By comparison the MIT Research Reactor operates at about 1/500th of the power of the typical commercial power plant that generates electricity.

For several years members of the Cambridge Fire Department has availed themselves of training and familiarization opportunities with the MIT Reactor staff.

The reactor is inspected regularly by state, and federal inspectors as well as providing training and certification of all operators.

The most recent inspection was this past February; we are updated of all inspections and work with the MIT staff on a regular basis.

The construction of the facility along with the safety and engineering protocols in place leave the fire department feeling quite comfortable about the safety of this facility.

Very truly yours,

Robert W. Healy
City Manager

RWH/mec

City of Cambridge

O-10
IN CITY COUNCIL
April 4, 2011

COUNCILLOR SEIDEL
VICE MAYOR DAVIS
COUNCILLOR DECKER
COUNCILLOR KELLEY
MAYOR MAHER
COUNCILLOR REEVES
COUNCILLOR SIMMONS
COUNCILLOR TOOMEY

WHEREAS: Given the recent earthquake in northeastern Japan and resulting tsunami which caused damage to the Fukushima Daiichi and Daini nuclear plants; now therefore be it

ORDERED: That the City Manager be and hereby is requested to confer with relevant City department heads and members of area university communities regarding the safety of nuclear reactors in Cambridge; and be it further

ORDERED: That the City Manager be and hereby is requested to report back to the City Council on this matter.

In City Council April 4, 2011
Adopted by the affirmative vote of eight members.
Attest:- D. Margaret Drury, City Clerk

A true copy;

ATTEST:-
D. Margaret Drury, City Clerk

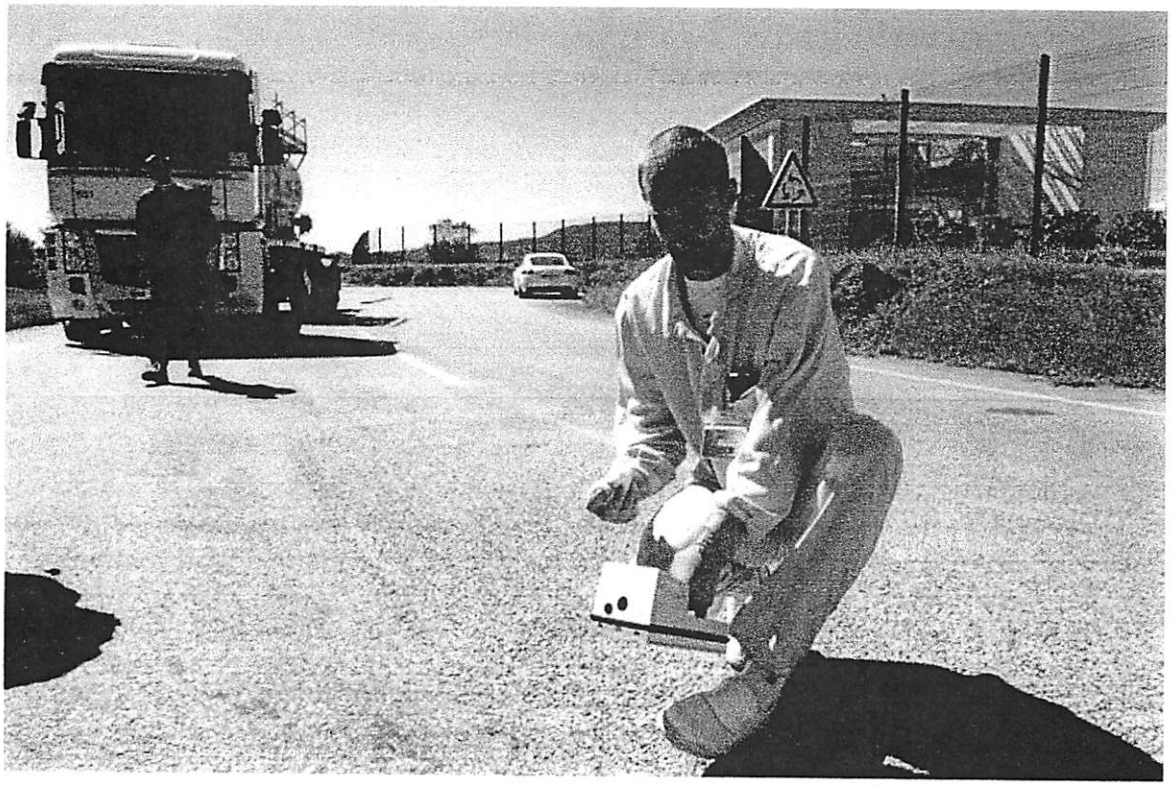
ATTACHMENT C

The New York Times

Explosion at French Nuclear Site Leaves One Person Dead

By STEVEN ERLANGER and NICOLA CLARK
September 12, 2011

PARIS — One person was killed and four were injured Monday afternoon in an explosion at a nuclear waste treatment site in southern France, according to the French Nuclear Safety Authority.

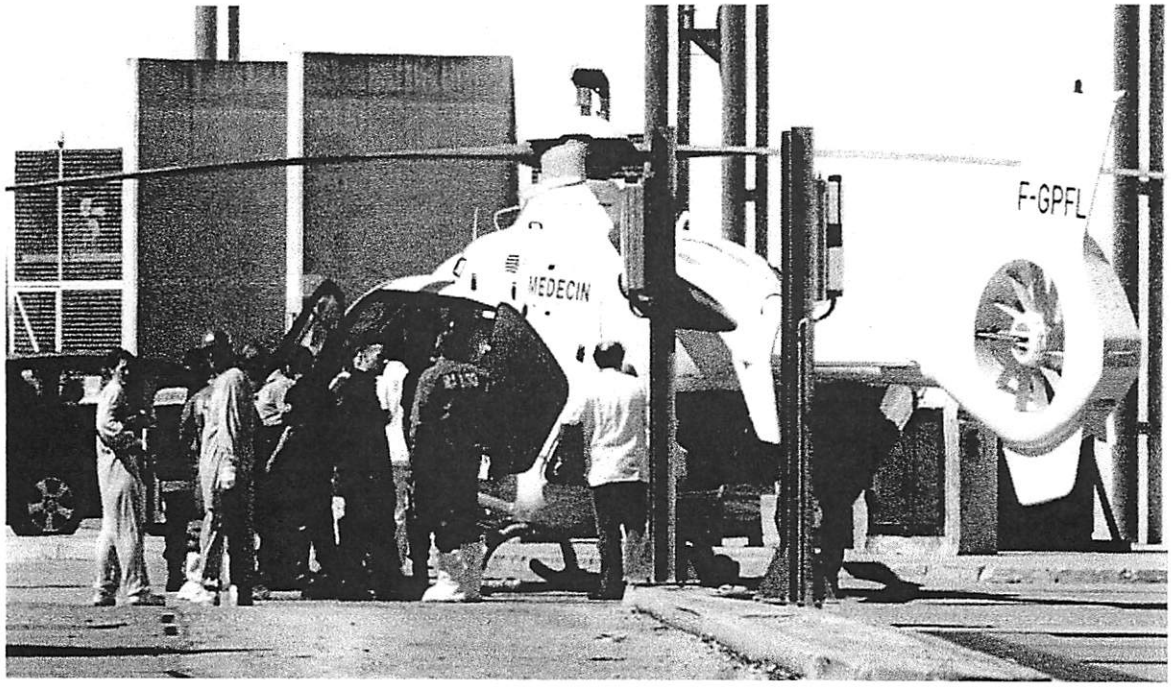


Jerome Rey/European Pressphoto Agency

A member of a specialized team checked for radiation outside the Centraco nuclear waste treatment center on Monday.

The authority and local police officials said there had been no radiation leak. About five hours after the explosion, the authority announced that the episode was over. The site, about 20 miles from Avignon, has no nuclear reactors, the authority said. A spokesman for the French power utility Électricité de France,

which owns the site, said, "It is an industrial accident, not a nuclear one."



Reuters

Rescue workers evacuated a person who was injured after an explosion at the French nuclear waste treatment site.

Olivier Isnard, an emergency manager at France's Institute for Radioprotection and Nuclear Safety, said the explosion took place in the foundry of the waste processing plant, which was melting about four tons of used, mildly radioactive metal objects. The cause of the explosion was not yet known, he said, but he emphasized that the level of radiation — about 67,000 becquerels — contained in the molten metal was minor.

"This is very, very low — nothing close to the radioactivity you would find inside a nuclear power plant," he said.

Even so, firefighters set up a security perimeter around the installation.

The spokesman for the utility said the foundry oven was used to destroy two types of low-level waste — "metallic waste, like tools and pumps," and "burnable

waste, like gloves or technicians' overalls."

He said the fire caused by the explosion had been controlled.

The French Interior Ministry said the workers were not contaminated. The Nuclear Safety Authority said one injured person was in serious condition.

The facility where the explosion took place is known as Centraco and is owned by Socodei, a subsidiary of EDF.

Mr. Isnard said that initial tests at the site showed no change to environmental radiation levels, and that the foundry building's conditioning and ventilation systems continued to function normally. A crisis team and a group of specialized firefighters were dispatched to take air and soil samples, he said.

Nathalie Kosciusko-Morizet, a government minister responsible for energy and environmental issues, visited the site.

She characterized the event Monday as an "industrial accident at a nuclear site" which she conceded had "aroused emotion and vigilance."

Cécile Duflot, a leader of the French Green Party, asked the government "for the greatest transparency, in real time, about the situation and the environmental and health consequences."

France in recent months has reaffirmed its commitment to nuclear power — which provides 77 percent of the country's energy needs — even as neighboring countries, including Germany and Switzerland, have shrunk from nuclear in the wake of the Fukushima accident in Japan in March.

J. David Goodman contributed reporting from New York.

ATTACHMENT 1

Re: MIT Nuclear Reactor Laboratory

Safety & Security Questions

1. How does MIT's 6 kW reactor compare in size to other research reactors in the US?
2. How many research reactors the size of MIT's are located in an urban area in the US?
3. Are there any other nuclear facilities in the US located within 50' of both an active railroad line and a public street?
4. How many safety violations have occurred at the MIT NRL since it began operation, and what has been their severity?
5. What changes were made following the discovery of an operator asleep and unreachable while on duty at the MIT NRP on June 30, 2003?
6. What changes were made following the exposure of a worker to excessive levels of radiation in 2007, when the NRC cited MIT for Severity Level IV safety violations?
7. Does the MIT reactor meet all current provisions of the Massachusetts Building Code, particularly regarding seismic design?
8. Has a comprehensive seismic analysis and risk assessment been performed by a qualified engineering firm with no affiliation to MIT or the NRC, and if so, by whom and how recently?
9. Has this analysis included seismic and blast damage evaluation of all equipment, both internal and external, including backup power, water, communication and other systems?
10. If so, has the blast analysis included the risk posed by explosive contents of freight railroad cars passing within 50' of the facility?
11. Has a risk assessment evaluated the potential for negligent or malicious acts by operators, including both students and employees, i.e., Fort Hood, etc.?
12. Are there fail-safe mechanisms in place to assure that operators follow established procedures and to limit damage if they do not?
13. What is the age of the oldest components of the cooling system, including piping, valves, and the heat exchangers which transfer heat from the reactor to the external cooling tower?

[illegible] Reactor Laboratory

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10. If so, has the blast analysis included the risk posed by explosive contents of freight railroad cars passing within 30' of the facility?

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13. What is the age of the oldest components of the cooling system, including piping, valves, and the heat exchangers which transfer heat from the reactor to the external cooling tower?

14. How often is this piping inspected by X-ray or other means?

15. Is the NRL connected to the public water supply and sewage systems?

16. How is ventilation air provided to plant operators, and how long can the facility function without a connection to the outdoor atmosphere?

17. Is the NRL located in a federally designated Flood Plain?

18. How long is the facility capable of operating safely with the access door below water level?

19. How often is the reactor containment inspected for corrosion or other deterioration between the concrete and steel jacket?

20. What radiation exposure would be created if Highly Enriched Uranium or spent fuel were vaporized outside the reactor core during delivery or removal?

22. How long would the radiation persist, and how long would it take and cost to clean up?

23. What is the likely evacuation radius and duration following a worst-case radiation event?

24. Is the MIT NRL participating in the latest NRC-mandated seismic upgrades which were implemented following the 2011 Virginia earthquake?

25. How much Highly Enriched Uranium is present at the MIT NRL, and how does this amount compare to the minimum amount needed to construct a functioning nuclear weapon?

26. What is the status of MIT NRL's plans to convert to less enriched Uranium 235 (originally to have been completed by 2014)?

27. Is adequate (military level) security provided during delivery and removal of bomb-grade materials?

28. Is the MIT NRL participating in the latest Homeland Security upgrades to secure weapons grade or "dirty bomb" materials?

29. What is the maximum amount of spent fuel that is permitted to be stored at the MIT NRL, and what is the maximum amount that has actually been stored?

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Economic Risk Questions

30. Has there been any comprehensive, independent analysis of the economic impact which would result from a radiation leak at the MIT facility?

31. Is the facility subject to the liability caps imposed by the Price-Andersen Act, and if so, what is that amount of the cap?

32. What is the current amount of liability insurance carried by MIT for the NRL?

33. What is the current Assessed Value of property in the City of Cambridge, including both taxable and non-taxable properties?

34. What is the current value of the MIT Endowment, and is the University prepared to indemnify neighbors for all direct and indirect losses they might incur as the result of a leak?

35. What is the potential value and alternative uses of the property currently occupied by the MIT NRL and its buffer zones?

36. What is the cost to the of the public safety coordination that the City provides to the MIT NRL, and how does this compare to that provided for other research groups and property owners?

37. What costs and benefits would result if the MIT NRL were located elsewhere (for example, at another existing nuclear facility, such as Pilgrim Station, Plymouth MA (40 miles from Boston) or Seabrook Station, Seabrook NH (45 miles from Boston)?

38. Has MIT formally investigated alternative locations for the MIT NRL (at either the Departmental or University level), and if so, how recently?

39. What is the remaining "Useful Life" of the MIT NRL?

40. What is the plan for decommissioning the facility, and when is this likely to occur?

Economic Risk Questions

29. Has there been any comprehensive, independent analysis of the economic impact which would result from a radiation leak at the MIT facility?

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ARTICLE 1

nuclear.com
NRC event notification report

MIT - OPERATOR ASLEEP AT REACTOR CONTROLS

MASSACHUSETTS INSTITUTE OF TECHNOLOGY - NOTIFICATION DATE: 06/30/2003

OPERATOR ASLEEP AT REACTOR CONTROLS

The following was emailed from the licensee to the NRC Project Manager:

"The licensee Facility Director called the NRC project manager to report that on 6/29/03 between 0605 EDT and 0645, the operator at the control console fell asleep for approximately 25 minutes. The operator had logged console operations at 0605 and 0645. Other licensee personnel had tried to contact the console operator during this time period without success. The licensee is investigating the event and will review this situation with all reactor operators."

This is in violation of 10 CFR 50.54 (k).

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+------------------------------------------------------------------------+
|Research Reactor                          |Event Number:  39969         |
+------------------------------------------------------------------------+
+------------------------------------------------------------------------+
| FACILITY: MASSACHUSETTS INSTITUTE OF TECH     |NOTIFICATION DATE: 06/30/2003|
|   RXTYPE: 5000 KW TANK RESEARCH HW            |NOTIFICATION TIME: 17:44[EDT]|
| COMMENTS:                                     |EVENT DATE:       06/30/2003|
|                                               |EVENT TIME:       06:45[EDT]|
|                                               |LAST UPDATE DATE: 06/30/2003|
|    CITY: CAMBRIDGE                 REGION: 1  +----------------------------+
|  COUNTY: MIDDLESEX                   STATE: MA |PERSON          ORGANIZATION |
|LICENSE#: R-37                     AGREEMENT: N  |RICHARD BARKLEY      R1      |
|  DOCKET: 05000020                             |ALEXANDER ADAMS      NRR     |
+-----------------------------------------------+                            |
| NRC NOTIFIED BY:  JOHN BERNARD                |                            |
|  HQ OPS OFFICER:  BILL GOTT                   |                            |
+-----------------------------------------------+                            |
|EMERGENCY CLASS:          NON EMERGENCY        |                            |
|10 CFR SECTION:                                |                            |
|NINF                  INFORMATION ONLY         |                            |
|                                               |                            |
+------------------------------------------------------------------------+
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Source: The above is excerpted from NRC Operations Center, Event Notification Report for July 1, 2003

next -- Click here to go to next info-nugget

previous -- Click here to go to previous info-nugget

nuclear.com home -- Click here to go back to main page

Questions or comments? Email steve.schulin@nuclear.com

ARTICLE 2

Public Citizen 30 YEARS
Protecting Health, Safety & Democracy

Updated September 2004

Contact: Michele Boyd (202) 454-5134

Price-Anderson Act: The Billion Dollar Bailout for Nuclear Power Mishaps

The Price-Anderson Act bestows a twofold subsidy on the nuclear industry. First, the Act artificially limits the amount of primary insurance that nuclear operators must carry – an uncalculated indirect subsidy in terms of insurance premiums that they don't have to pay. This distorts electricity markets by masking nuclear power's unique safety and security risks, granting nuclear power an unfair and undesirable competitive advantage over safer energy alternatives. Second, Price-Anderson caps the liability of nuclear operators in the event of a serious accident or attack, leaving taxpayers on the hook for most of the damages. This makes capital investment in the nuclear industry more attractive to investors because their risk is minimized and fixed.

Consequently, the Act is a dual-edge sword for the public that it purportedly protects. The legislation was intended first of all to bolster investor confidence, whereas victim compensation is secondary. Price-Anderson establishes only phantom insurance for the public, then provides a real bailout mechanism for the nuclear energy industry by reducing its need to pay for insurance, subsidizing the industry at the taxpayers' expense.

If proposed new reactors are as safe and economical as the nuclear industry claims, the industry should be able to privately insure these ventures without an extension of the Price-Anderson crutch. When Congress first enacted Price-Anderson in 1957, it was designed to be a temporary measure to prop up an infant industry. After nearly five decades and billions in hand-outs, it is impossible to justify extending subsidies like the Price-Anderson Act.

Price-Anderson expired for new reactors in December 2003, but was reauthorized for another 20 years in the energy bill that was signed into law on August 2005.

Understanding how the Price-Anderson Act provides a crutch for nuclear energy is important for all citizens concerned about the United States' continued reliance on nuclear power and the vulnerability of nuclear plants to terrorist threats.

What is the Price-Anderson Act?

The Price-Anderson Act became law in 1957 as part of amendments to the Atomic Energy Act of 1954. The Act sets a limit on the monetary liability of companies for a nuclear accident, and defines the procedural mechanisms for the industry's insurance coverage.

Under the Nuclear Regulatory Commission's (NRC's) corresponding regulations, nuclear reactor owners must obtain $300 million in insurance liability coverage from a private insurer, referred to as *primary financial protection.* One company – Connecticut-based American Nuclear Insurers – provides 100 percent of this primary financial protection. In the event of an accident that exceeds $300 million in damages, the operators of the 103 operating nuclear reactors covered under the Act must pay up to $95.8 million[1] per reactor to cover costs in retrospective annual premiums capped at $10 million per year. This means that the potential total insurance pool financed by private interests is about $10.2 billion ($300 million primary financial protection + $95.8 million from each of the 103 reactors).

What are the Problems with Price-Anderson?

• Nuclear operators are not liable for the entire costs of their own nuclear accidents, and the financial burden for this risk is inappropriately transferred to taxpayers. Since corporations under Price-Anderson are only responsible for around two percent of the estimated cost of a serious accident, nuclear power corporations can largely ignore (from a financial perspective) the dangers that reactors impose on American communities.

In the wake of the 1979 Three Mile Island accident, the federally-funded Sandia National Laboratory prepared a report on behalf of the NRC known as "CRAC-2." This 1982 study estimated that damages from a severe nuclear accident could run as high as $314 billion – or more than $560 billion in 2000 dollars. Since that study, the NRC has developed "more realistic" modeling improvements to the agency's *probabilistic risk assessment.* A review of their 1982 study "found that property damages would be twice as much as those calculated in 1982, solely on the basis of the modeling improvements made."[2] In addition, the Chernobyl catastrophe has cost the nations of Russia, Ukraine and Belarus $358 billion.[3] This Chernobyl total, however, is vastly understated, since it does not attempt to estimate the costs to other nations, which also experienced health costs from the far-reaching nuclear fallout.

The $10.5 billion provided by private insurance and nuclear reactor operators represents less than two percent of the $560 billion in potential costs of a major nuclear accident. Since nuclear reactor operators have their liability capped through Price-Anderson, that means taxpayers could be responsible and/or the public inadequately compensated for hundreds of billions of dollars in costs from an operator foul-up or a terrorist attack.

• A second major problem is that Price-Anderson is blind to comparative differences in and arbitrarily treats the whole industry uniformly. Higher-risk reactors - including older, relicensed reactors with aging parts - are not required to carry correspondingly higher levels of insurance coverage. Moreover, the Price-Anderson Act does not stipulate security requirements to protect against terrorism at insured reactors. In light of the tragic events of September 11, there should be a thorough and independent

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[1] The NRC revised its Price-Anderson regulations on August 4, 2003, slightly increasing the industry's liability.

[2] Keith O. Fultz, "A Perspective on Liability Protection for a Nuclear Plant Accident," Government Accounting Office, GAO/RCED87-124, June 1987, page 40.

[3] Mark Zepezauer and Arthur Naiman, "Take the Rich Off Welfare," (Tucson, AZ: Odonian Press, 1996), p. 86.

assessment of the security needs at U.S. nuclear power facilities before reauthorization of Price-Anderson is even considered.

• A third major problem with Price-Anderson is that it distorts the economic viability of the nuclear power industry since taxpayers cover the industry's insurance costs. Not surprisingly, the nuclear industry has fought hard to keep the Price-Anderson liability limit. In sworn testimony before Congress in May 2001, John L. Quattrocchi, senior vice-president of the company that provides most of the private insurance for the nuclear industry (American Nuclear Insurers) stated, "[k]nowing the extent of one's liability provides economic stability and incentives that would not exist without a limit." Translation: taxpayers, not the nuclear industry, should bear the brunt of the potential risks of a severe nuclear accident, in order to make their company a stable investment for shareholders.

• A fourth problem is that Price-Anderson was originally intended by Congress to be a temporary solution to what they thought was a temporary problem – the refusal of private insurers to underwrite the risks of nuclear power. In a 1957 report, the U.S. Senate wrote that Price-Anderson would only be needed for ten years because "...the problem of reactor safety will be to a great extent solved and the insurance people will have had an experience on which to base a sound program of their own." But the historical record debunks this initial optimism. Nuclear reactors continue to experience significant safety problems. These safety concerns have increased substantially in the wake of the September 11 terrorist attacks. The mature nuclear industry has failed to prove its safety record – which should be reason enough for skepticism about the proposed new reactors that backers of Price-Anderson reauthorization seek to promote.

• Fifth, while $10.5 billion is not enough, there is scant assurance that even those funds would be available if required. The bulk of that amount would be paid in so-called "retrospective" premiums, wherein reactor operators don't have to pay the premiums until after the accident, with very little in the way of up-front guarantees. With electricity deregulation, many nuclear power plants have been purchased by or transferred to unregulated merchant operators that do not have a guaranteed rate base. Their Price-Anderson obligations - and public's financial protection in the case of a nuclear mishap - is backed by nothing more than the continued stability of energy conglomerates. And from Pacific Gas & Electric's bankruptcy to the shattered retirement savings of Enron employees, energy conglomerates have shown themselves to be anything but stable. The Price-Anderson Act is vague on what the government's financial obligations are in the event funds are unavailable from the nuclear industry, but this scenario would likely increase the burden on taxpayers.

• The total effect of Price-Anderson is large opportunity to evade responsibility if there is an accident and victims require payment of damages. Thus, the Act has *no fault liability* for reactor operators, and injured victims are precluded from directly suing vendors or manufacturers responsible for the accident.

The execution of the law after a major accident poses legal hurdles to a victim seeking compensation. The Act states that jurisdiction over an accident falls to the federal district court. Thus, the Act restricts plaintiffs' ability to utilize any state laws which go above and beyond federal protections. Furthermore, no fault liability limits reactor operator accountability even if they are reckless or criminally negligent. Moreover, Price-Anderson protects nuclear operators from punitive damages that are not covered under their private insurance coverage.

• Similarly, Price-Anderson Act indemnifies Department of Energy nuclear contractors even in cases of gross negligence and willful misconduct, which seems to discourage contractor accountability and a safety culture. No other government agency provides this level of taxpayer indemnification to non-government personnel.

Why the Act is important now?

The President and leaders in Congress, touting the viability of nuclear power to meet America's energy needs, are calling for the construction of a new generation of nuclear reactors. Since the nuclear industry has admitted that they would be unable to compete with alternative energy sources without this billion-dollar subsidy, Congress is now debating Price-Anderson renewal. If the nuclear power industry is willing to propose building new reactors in America's communities, the least they could do is stand behind their own technology and accept 100 percent liability for any nuclear accident that occurs. Safety might become a serious concern for the industry if they knew that they actually would have to pay for anything that goes wrong. In light of the September 11 attacks, security limitations at nuclear power plants are all the more serious. Continuing to hide behind Price-Anderson's taxpayer bailout is dangerous for America's communities and pocketbook.

ARTICLE 3

MIT's Oldest and Largest Newspaper

The Tech

Established 1881

The Weather
Today: Rainy, 60°F (16°C)
Tonight: Rainy, 55°F (13°C)
Tomorrow: Showers, 65°F (18°C)
Details, Page 2

Volume 125, Number 46 | Cambridge, Massachusetts 02139 | Friday, October 14, 2005

RIAA Sues Six More MITnet Users

By Kelley Rivoire
EDITOR IN CHIEF

Six MIT students are among the 757 individuals the record industry sued for copyright infringement two weeks ago. The record companies allege that the students shared songs over the Internet without authorized permission.

The students are identified only by the IP addresses used at the time the songs were shared. The record industry has requested court permission to issue subpoenas that would require MIT to provide the names corresponding to the IP addresses. The Record Industry Association of America, which files the lawsuits on behalf of the record companies, notifies university administrators prior to filing the suits, RIAA spokesperson Amanda Hunter said in an e-mail.

Including the new round of lawsuits, the record industry has sued 29

RIAA, Page 16

ABC Says MIT's Nuclear Reactor Unsafe

By Beckett W. Sterner
NEWS EDITOR

How vulnerable are nuclear research reactors to terrorist attacks? An ABC News investigative report that aired last night claimed that many university reactors, including MIT's, need to take stronger security measures to protect their uranium stocks.

ABC's report, which wades into the highly technical and classified topic of nuclear reactor security, has encountered controversy over some of its claims. The report often elides important differences between the reactors that would influence the risk levels of certain attacks.

There are three major ways in which the uranium used by a reactor could play a role in a terrorist attack: theft for use in a weapon, a bomb detonated outside the reactor, and a bomb exploded near the reactor core.

In ABC's investigation they were able to park a large truck about 30 feet from MIT's reactor. However, that distance is not significantly less than the distance to Albany Street, and is still larger than the reactor's security perimeter, said Nuclear Reactor Laboratory Director David E. Moncton PhD '75.

Considering the broader context of terrorist attacks, MIT's reactor poses relatively little threat, said Police Chief John DiFava.

For example, he said, there is a 800–900 foot long liquid natural gas tanker that docks in Boston Harbor regularly."I don't think anybody really knows what would happen if that hull would breach," he said, noting divergent studies that suggest the fuel may just burn or could result in a 3-mile radius explosion.

Regarding MIT's reactor, he said, "is it a real risk — is it a perception issue, or is it just people who are hostile to nuclear power?"

The MIT reactor is used for med-

Reactor, Page 15

RICKY RAMIREZ—THE TECH

A student operator, whose name MIT refused to release citing security reasons, sits at the control board for MIT's nuclear reactor.

Initiative To Assist FSILG Retention

By Marie Y. Thibault
ASSOCIATE NEWS EDITOR

A new spending initiative from MIT will commit $250,000 to building community in fraternities, sororities, and independent living groups — an effort with unclear benefits, said Interfraternity Council President Christopher P. Child '06.

The new plan, called the Recruitment and Retention Initiative, is intended to help FSILG members become more financially self-sufficient. It will allocate money for workshops and retreats designed to educate FSILG members, develop chapters, and strengthen alumni and community relations.

Stephen D. Immerman, senior associate dean for student life, said he did not know exactly how the $250,000 RRI figure was determined, but that most likely it was calculated by taking the fixed cost per person, $5,000, and multiplying it by the number of beds open, then subtracting savings from the FSILG cooperative and various grants.

"We want to focus on how we can enhance a chapter's ability to be competitive instead of just pay for empty beds," said Stephen D. Immerman, senior associate dean of student life, this summer.

Unlike its predecessor, the Financial Transition Plan, RRI funds will not be distributed directly to houses. Instead, chapters can apply for hardship grants funded within the RRI allotment if they have made efforts to improve their financial situation but continue to struggle, said David N. Rogers, director of FSILGs.

RRI, Page 17

Average City Property Tax Rates to Remain Constant

By Rosa Cao
STAFF REPORTER

Cambridge residential property tax rates, originally projected to rise by 2.5 percent, will instead remain constant this fiscal year. This year, an election year for Cambridge city councillors, marks the first time in 10 years that taxes have not risen.

Contentious tax increases last fiscal year resulted in some homeowners' taxes jumping by 11 percent or more because of updated appraisals of their properties.

This year, 46 percent of homeowners will see their tax payments decrease, while about 50 percent will experience an increase of under $250, according to information provided by the City of Cambridge. The average payment is quoted at $7.38 per $1,000 of property value, the lowest in Mas-

Taxes, Page 19

Mathematics Alumnus Aumann Wins Nobel Prize in Economics

By Diana Jue

When Robert Aumann PhD '55 was told that he was one of the winners of the 2005 Nobel Prize in Economic Sciences, he was also told to suppress his most basic urge — and keep the secret for 15 minutes. When it finally became public knowledge, "there were many hugs and kisses," he said.

Aumann, 75, who received his doctoral degree in mathematics from MIT, will share the $1.3 million prize with University of Maryland Professor Thomas C. Schelling for "enhanced our understanding of conflict and cooperation through game-theory analysis," according to the Nobel Foundation.

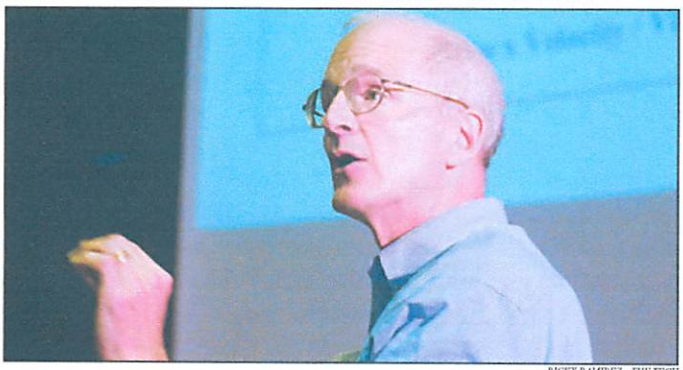
Game theory is a branch of mathematics that analyzes "interaction between entities," including "organizations, companies, and even species," he said. Each party is out to maximize its own well-being. "It's an underlying theory, rather than a specific application," and can be applied not only to parlor games, but also to economics, elections, war, and international relations, he said.

Aumann's contributions to game theory primarily involve the use of mathematical analysis to develop concepts and hypotheses. In his work on the theory of repeated games, Aumann showed that in the long-term, peaceful cooperation is sustained between parties, even when they have drastically differing interests.

John F. Nash, a former C.L.E. Moore instructor and winner of the 1994 Nobel Prize in Economics, introduced him to game theory while he was a graduate student at MIT, Aumann said.

Bengt Holmstrom, head of the Economics Department, said that Aumann "has been the main force behind the game theory revolution that has so profoundly changed academic research in economics."

Aumann, Page 21



RICKY RAMIREZ—THE TECH

Edward Cussler, winner of the 2005 Ig Nobel Prize in Chemistry, talks about how he and his lab partner, Brian Gettelfinger, answered the question: "Can people swim faster in syrup or water?" The Ig Nobel Prize lectures were given last Saturday in 10-250. Information, including videos, can be found at *http://www.improbable.com*.

MIT Refutes ABC Reactor Safety Claims

Reactor, from Page 1

ical and nuclear power research, said Vice President for Research Alice P. Gast. Nuclear power is likely to play an increasingly important role in America's energy supply as gas reserves decline and fuel prices rise, as stated by a report on nuclear power released by MIT in 2003.

Down and dirty with uranium

MIT's reactor runs on highly enriched uranium (HEU), a possible ingredient for nuclear weapons. The fuel can also be used in "dirty bombs" that disseminate vaporized harmful radioactive material over a large area.

Most research reactors have converted to low enriched uranium (LEU) in a slow process funded by the Department of Energy, and MIT will follow suit when the DOE provides funding, Gast said. LEU fuel must undergo a complex reaction to be turned into weapons-grade material, but can still be used in dirty bombs.

Attacking a nuclear reactor is not as simple as blowing it up or walking in with guns blazing, however. MIT's reactor is shielded by many layers of metal and concrete, making it difficult for an external explosion to vaporize the radioactive material inside. ABC's report raises questions over what security measures are needed to deter attacks and also over what scenarios pose a significant danger.

The Nuclear Regulatory Commission, which oversees security requirements at research reactors, is examining evidence provided by ABC to see whether further action needs to be taken at any facility, said Elliot Brenner, director of the NRC Office of Public Affairs.

"Nothing about the access or tour has been criticized by ABC," Moncton said, referring to the undercover tour taken by two ABC journalist interns. MIT has more security measures in place than many reactors, and ABC found that MIT's reactor was one of only two with armed guards.

ABC Media Relations spokesperson Adam Pockriss did not respond to questions submitted on the story yesterday.

ABC reports weak security

After a four-month investigation during which journalism interns traveled to the 25 reactors on college campuses across the country, ABC reported finding "unmanned guard booths, a guard who appeared to be asleep, unlocked building doors and, in a number of cases, guided tours that provided easy access to control rooms and reactor pools that hold radioactive fuel."

The story also highlighted the issue that "many of the schools permit vehicles in close proximity to the reactor buildings without inspection for explosives."

Whether or not an external explosion could release radioactive material into the atmosphere depends on the design of the reactor.

"A pretty big plane could fly into it and not damage it," Moncton said, referring to MIT's reactor core.

In the "worst case scenario, that building is going to implode, not explode," DiFava said.

On the other hand, the televised investigation reported that the interns were able to walk up to another college's open water reactor with large tote bags that were not searched by staff.

The two major concerns raised by the investigation regarding MIT's reactor in particular did not involve direct access to the reactor, but rather access to online information and the ability to drive a truck to within 30 feet of the reactor building.

> *In the "worst case scenario, that building is going to implode, not explode."*
> *–John DiFava, referring to MIT's nuclear reactor building*

Given that the reactor is about 50 feet from Albany Street and about 300 from Massachusetts Avenue, regular traffic passes nearly as close as the ABC truck had reached. A large bomb would have to be closer to significantly damage the building, Moncton said.

He said a study on the effect of an explosion on the reactor was conducted by Lincoln Laboratory scientists with consultation of MIT faculty shortly after 9/11. The report showed that the reactor would not be significantly damaged by a large truck bomb at the distance of the security perimeter.

DiFava said that explosions from large bombs carry most of their force upwards, rather than outwards, lessening the impact on the reactor building.

"There wouldn't be any dispersal of material," Moncton said, and that to be a dirty bomb, the explosion must vaporize the uranium instead of just blowing apart chunks of it.

Another problem ABC investigators reported was that they were able to find floor plans for the reactor using computers in Barker Library.

Moncton said that these plans are out of date and do not list the location of guards or security cameras.

Director of Reactor Operations John A. Bernard Jr. said that many nuclear engineering dissertations have the same diagrams as those available at Barker. The floor plans had been publicly available before Sept. 11, 2001, but were taken offline afterwards by MIT.

The final criticism leveled at MIT by ABC was that the schedule for the reactor was available online.

Moncton said that the availability of the schedule had been under discussion with the NRC for several months before ABC's investigation began. The schedule is used by off-campus researchers who use the reactor, he said.

Bernard said that about one month ago, after ABC's visit, MIT decided to stop publicly listing times when the reactor was inactive for fuel delivery, thus making it impossible to tell when fuel deliveries were being received based on the activity of the reactor.

Some confusion seemed to prevail on NRC's awareness of the schedule being online. "That's something I'd want us to pursue, and we will," said Roy Zimmerman, director of the Office of Nuclear Security and Incident Response for the NRC, after learning about the online schedule from ABC lead investigator Brian Ross.

Debate over fuel safety heats up

Perhaps the best recognized security threat posed by research reactors is the possibility that a terrorist could steal highly enriched uranium for use in a nuclear weapon.

Once HEU is placed in a reactor, however, it acquires a lethal level of radioactivity that would incapacitate a person in a few minutes. Accordingly, someone trying to steal active fuel would need extremely strong protective shielding.

Before being placed in the reactor, HEU is both safe enough to hold in your hands and immediately usable for a nuclear weapon. MIT's reactor has at most two kilograms of fresh HEU on site at any time, Moncton said, a small fraction of what is needed for a bomb. He said the fuel is delivered on a just-in-time basis, so that the reactor does not need to stockpile fuel.

Transporting spent fuel is dependent on a political balancing act between the danger of storing fuel at the reactor and the danger of transporting it long-distance to another site.

"Being able to ship is a complicated alignment of a number of stars," Moncton said. The MIT reactor has sometimes been unable to send away its fuel for multiple years at a time, he said, although the current amount being stored is at a historical low.

"We could probably smooth out the bureaucratic process," Gast said. "I think nationally we need to deal with spent fuel as a national priority."

The difficulty of a terrorist transporting spent fuel is under debate. Moncton said that spent fuel can still incapacitate someone trying to carry it without shielding.

The international definition for what level of radioactivity is incapacitating is too low for a suicidal terrorist, though, said Matthew G. Bunn G, a senior research associate at Harvard who studies nuclear nonproliferation measures. "One person can pick it up and carry it away," Bunn said, referring to spent fuel from a reactor like MIT's. Bunn is also finishing his thesis in the Engineering Systems Division at MIT.

The effort needed to turn spent fuel into weapons material is not nearly as significant as that to produce enriched uranium from scratch, Bunn said.

The difficulty in shipping away spent fuel has been a problem for MIT in the past. Moncton said that reactor staff were unable to ship away fuel for long enough that last year they slightly exceeded the limit imposed by the NRC on how much total uranium could be stored on site, requiring MIT to notify the NRC of a regulations infraction.

One of the most significant security issues facing reactors, then, requires the coordination of state and federal regulators, as well as the vigilance of reactor staff.

Next House Hosts Benefit Dinner

Next House held a service dinner last Oct. 10 in Next House dining. Proceeds from the event, $413, were donated to the Boston Food Bank.

Ray C. Lee '09 fills a plate with chili made by Next House residents.

Jessica K. Lee '08 prepares to serve a chocolate cake made by Housemaster Liba Mikic, one of several homemade dishes made by Next House residents.

Photography by Christina Kang

ARTICLE 4

MIT research reactor incident exposes worker, NRC says

BOSTON - The Massachusetts Institute of Technology (MIT) was cited for two violations at its nuclear research reactor after a worker was exposed to a startlingly high dose of radiation in October, federal inspectors with the US Nuclear Regulatory Commission said in interviews Friday.

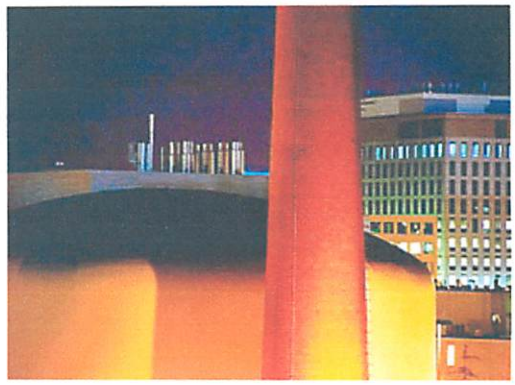
Charles Digges, 21/12-2007

Thought the incident was rated as "not serious" by regulators, it points to the leitmotif of dangers associated with research reactors and the relative independence from strict safety guidelines that their commercial counterparts are forced to adhere to.

One of the most prestigious technological universities in the world, MIT's campus is located on the banks of the Charles River in Cambridge, Massachusetts and surrounded by an urban population of more than 2 million in the Boston area. The MIT reactor is the second largest research reactor ion the United States, second only to the research reactor at the University of Missouri, Columbia.

A special NRC inspection triggered by the irradiation of the worker found the MIT had fallen short in making reasonable checks to assess the scale and extend of radiation levels present in work areas surrounding the 49 year old research reactor as required by NRC regulations, said agency spokesman Neil Sheehan.

MIT also failed to provide the injured worker adequate safety training as required for all employees who are likely to receive a dose of more than 100 millirems of radiation exposure in a year, Sheehan said.



MIT's research reactor.
web.mit.edu

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Norwegian radiation authorities issue lightning fast permit for reactivation of a leaking reactor
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Norway imports Russian uranium
(13/05-2002)

Worker in good condition, but information sparse

The university would not immediately release the name or position of the exposed worker, but a spokeswoman for the press office said the worker had recovered from the incident.

MIT's Nuclear Reactor Laboratory Director David Moncton, who is authorised to comment further on the incident, had not returned Bellona Web phone messages by this printing. An update will be issued if Moncton can be reached.

The failings leading to the radiation exposure incident are listed in the NRC report as Severity Level IV violations, said Sheehan, which is a category reserved for incidents of very low safety significance.

History of the incident
On October 17th, MIT reported that one of the reactor's operators had a radiation measurement of more than four rems for the period between July 1st and September 30th.

That accounts for more than 80 percent of the total radiation that a worker can be safely exposed to during an entire year, said Sheehan. All other employees' radiation exposure measurements for the same time period were normal, he said.

"The NRC inspection team noted various weaknesses" in MIT's program to monitor radiation levels, according to the NRC report released Thursday, which also described the school reaction to the high radiation exposure as "prompt, comprehensive, and technically sophisticated."

The school notified its own safety officials and the federal commission.

"The university will have to respond to the violations" within 30 days, Sheehan said. "We will use that information to determine whether further enforcement action is necessary to ensure compliance with agency requirements."

Dangers of research reactors
Research reactors, including the one at MIT are much smaller in size than their commercial counterparts that are used for energy production. But they deal with atypical fuels and many produce highly enriched uranium and plutonium – which depending on institutional security can pose high safety and proliferation risks.

Sheehan identified MIT's reactor as an HWR reflective type reactor. This, said NIls Bøhmer, Bellona's nuclear physicist, means it is a heavy water reactor running on uranium and capable of producing both weapons grade uranium and plutonium.

MIT's five-megawatt reactor, which went online in 1958, uses weapons grade, highly enriched uranium as fuel, according to the University's newspaper, The Tech

Poor training at research reactors, Bøhmer is a problem of international scale, as are general safety problems for workers.

"The management of these reactors tends to be ad-hoc and they are typically old and lack more modern safety features of commercial power plants," said Bøhmer.

"When viewing incidents at research reactors at an international level, what happened at MIT – as constituted by an IAEA report on research reactors – is a typical incident."

Bøhmer noted that the report on research reactors worldwide by the IAEA cited fire safety violations and high vulnerability of workers to irradiation as their chief dangers, given that each research reactor is tended to by individual institutions that often do not have or observe codified national nuclear safety codes.

"And such safety codes are hard to nail down by the very nature of the reactors Is for

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"And such safety codes are hard to nail down by the very nature of the reactors is for

experimental purposes," said Bøhmer. "They deal with new combinations of fuel – not always safe."

In the United States, said Sheehan, all research reactors fall under the purview of the NRC, and said he was "sure there had been other incidents" at the MIT reactor, given it's age.

Nuclear proliferation

Nuclear proliferation is also another danger of research reactors, and have been identified by the IAEA and Bellona. Primary among these dangers is the fact that HEU is stored in universities and research institutes as opposed to fortified military compounds, making the fuel far more vulnerable to terrorist seizure.

Nuclear Reactor Laboratory Director David Moncton told The Tech in a 2005 interview that the MIT reactor has at most two kilograms of fresh HEU on site at any time - a small fraction of what is needed for a bomb. He said the fuel is delivered on a just-in-time basis, so that the reactor does not need to stockpile fuel, the newspaper reported.

To mitigate the dangers of at least Russian origin HEU at research reactors throughout the world, the United States, Russia and the IAEA signed off on the Global Threat Reduction Initiative to repatriate Russian origin HEU from 20 reactors in 17 countries.

The programme is moving successfully, and last week, the Czech Republic sent some 80 kilograms of HEU back to Russia for storage and eventual reprocessing.

As the agency responsible for overseeing safety at research reactors in the United States, the NRC's Sheehan said that the post 9/11 world had seen serious upgrades to security at US research reactors. He said this included 24-hour surveillance patrols, NRC safeguards and strict access restrictions, but refused to disclose further details about security at the MIT reactor.

Recent incidents at MIT's reactor

The last recorded incident of a notice of violation sent to MIT regarding the use of its experimental reactor by the NRC was dated October 2003 of a July 2003 incident during which a reactor operator was found asleep at the controls.

MIT was assessed a $5,500 fine for the incident, and it was assigned a Severity Level III violation by the NRC.

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ARTICLE 5

The Boston Globe

Potent fuel at MIT reactor makes for uneasy politics

by Brian Bender, Boston Globe
29 Dec 2009

WASHINGTON - MIT's 50-year-old nuclear reactor, one of only three US research facilities not run by the Department of Energy that still use material that could also be used to make atomic bombs, will probably not be converted to use a safer fuel for at least another five years because of technical obstacles, according to a recent government report obtained by the Globe.

That means the reactor on the university's Cambridge campus, originally slated for fuel conversion by 2014, will continue to present a political liability for US officials, who are strongly urging other countries around the world - most notably Iran - to forgo the civilian use of highly enriched uranium to prevent the spread of nuclear weapons.

MIT's 50-year-old nuclear reactor was originally slated for fuel conversion by 2014. Dominic Chavez/Globe Staff/File 2008; "We would like to get this particular monkey off our back," said David Moncton, the nuclear reactor laboratory's director. Dominic Chavez/Globe Staff/File 2008

MIT views the delays, out lined in a November report by the Nuclear Regulatory Commission, as unfortunate, if unavoidable.

"We would like to get this particular monkey off our back because it is not helpful for public relations," said David Moncton, the nuclear reactor laboratory's director.

The US government has spent millions of dollars in recent years helping other nations convert their civilian reactors from using highly enriched uranium to low enriched uranium, a suitable alternative for generating nuclear power that cannot be used to make an atomic bomb. And President Obama is expected to seek further commitments next year from foreign nations to phase out highly enriched uranium from civilian reactors.
But while the Department of Energy set a goal of 2014 to switch the MIT reactor to the lower-grade fuel, that commitment is not likely to be met, according to the Nuclear Regulatory Commission, largely because the MIT facility needs a special kind of new fuel to maintain its uniquely high density core - fuel that will take years to develop and certify before it can be manufactured in sufficient quantities.

"To meet this goal will require significant effort," according to the internal report. It said that the Department of Energy, which is overseeing the development of the new fuel, is "working towards establishing commercial capability, but it will not be ready by the 2014 conversion deadline."
A Department of Energy spokesman expressed hope that the conversion can be completed sooner, but acknowledged there is a lot of work still ahead. "The fuel must be designed and extensively tested, new fuel fabrication processes must be developed, and multiple analyses and reviews must be performed to verify the fuel and hence the reactors' safety," he said.

Yet some former government officials also partially blame MIT for the delay, citing its insistence that the new fuel must provide the same performance as the current fuel - even though other forms of low enriched uranium fuel have long been available.

"There has been a tremendous amount of foot dragging, particularly on the part of the universities," said Victor Gilinsky, a former NRC commissioner who is now an energy consultant in California.

He noted that the MIT reactor could be converted quickly if it were willing to give up some performance.

"We could be a lot further if there was more focus on the fuel development end by the government, but also willingness to make compromises at the user end," he said. "Maybe you don't need the same performance."
Moncton, who took over as director in 2004, maintains that MIT is doing everything it can to convert the reactor as quickly as possible, to demonstrate to other countries that have similar facilities that the new fuel will be able to preserve their operations as well.

Most specialists agree that the facility - along with another at the University of

MIT warns the delays, outlined in a November report by the Nuclear Regulatory Commission, are still "minor," if unavoidable.

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"You'd get a big radiation dose, but it wouldn't stop you from carrying it off," said Matthew Bunn, a professor at Harvard's Kennedy School of Government and author of "Securing the Bomb," noting that government regulations do not require MIT to meet the same security guidelines as the plant that provides new fuel rods to the reactor several times a year.
Still, the thorniest issue is the double standard the MIT reactor presents to other countries, according to multiple specialists and government officials.
A congressional commission recently cited the conversion of such domestic reactors as a critical step to prevent the spread of nuclear weapons material worldwide, noting that other countries may refuse to convert their reactors if the US continues to use highly enriched uranium.
Arms control groups have urged the Nuclear Regulatory Commission to revoke the licenses of the US facilities if they don't meet the 2014 deadline.
The concerns come at a time when the United States and its allies are trying to persuade Iran to give up its uranium enrichment program, contending that if it only seeks civilian nuclear energy - and not weapons - as the country maintains, it should purchase low enriched uranium fuel from other countries.

The International Atomic Energy Agency has accused Iran of using a civilian nuclear effort to shield a secret bomb-making program. Ironically, a number of Iran's nuclear scientists were trained in the 1970s on the MIT reactor before the two nations cut off diplomatic ties.

The MIT reactor, which was built in 1958 when the university began its nuclear engineering department, is now used for a variety of academic research and also brings in about $1.5 million a year from commercial work, which covers about 60 percent of the annual operating costs, said Moncton, the director. He stressed MIT does not make a profit.

In addition to training nuclear engineers, one of its primary uses is medical research, including cancer therapies and studies of cell biology and blood chemistry. It is also a money-making enterprise, by radiating seeds used in prostate cancer treatments and by turning silicon into high-performance semiconductors for the hybrid car market.

But several officials with knowledge of the situation said that only recently have MIT officials been fully cooperative on the conversion plan - and only because they have been assured by the Department of Energy that they will not lose any capacity by using the new fuel.

Bunn said that when he previously served on a government panel reviewing nuclear security risks MIT "was absolutely against" converting the reactor. "If you told them to convert to the fuels available today," he added, they would flatly refuse.

Alan J. Kuperman, director of the nonproliferation program at the University of

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In addition to training nuclear engineers, one of its primary uses is medical research, including cancer therapies and studies of cell biology and blood chemistry. It is also a money-making enterprise, by radiating seeds used in prostate cancer treatments and by turning silicon into high-performance semiconductors for the hybrid car market.

But several officials with knowledge of the situation said that only recently have MIT officials been fully cooperative on the conversion plan - and only because they have been assured by the Department of Energy that they will not lose any capacity by using the new fuel.

Bunn said that when he previously served on a government panel reviewing nuclear security risks MIT "was absolutely against" converting the reactor. "If you told them to convert to the fuels available today," he added, they would flatly refuse.

Alan J. Kuperman, director of the nonproliferation program at the University of

Texas at Austin, said a major scientific argument against conversion had been that the reactor's "peak neutron flux" would be diminished by 10 percent with the new fuel.

Moncton, however, said that is no longer a concern and he believes the Department of Energy, which will pay for the conversion and additional costs, is working on a new fuel that will allow the reactor to maintain its capacity.

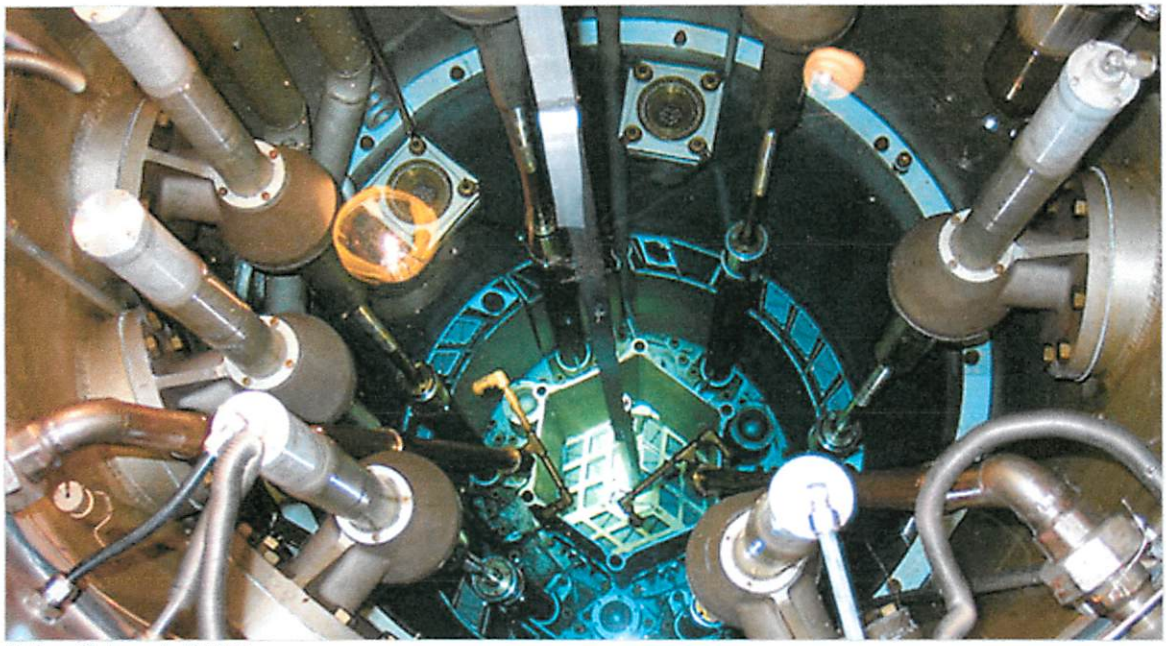
"We will maintain our performance with this new fuel," he said. "We can get basically equivalent performance. That is why we are interested in doing this."

Bryan Bender can be reached at bender@globe.com.
Credit: Bryan Bender, Globe Staff

ARTICLE 6

The New York Times

Research Reactors a Safety Challenge



Yakov Ostrovsky/M.I.T.

ACCESS The core tank of the nuclear reactor at M.I.T. President Obama sees such research reactors as vulnerable.

By WILLIAM J. BROAD
April 12, 2010

In Cambridge, Mass., at the Massachusetts Institute of Technology, a nuclear reactor emits an eerie blue glow 24 hours a day, 7 days a week. **Its fuel is 93 percent uranium 235 — the high-purity uranium it takes to energize an atom bomb and exactly what the West fears that Tehran wants to produce.**

The facility at M.I.T. is just one of some 130 civilian research reactors around the globe that use highly enriched uranium. Nuclear experts say that **running them takes tons of bomb-grade fuel, enough to build many hundreds of nuclear warheads. And most are lightly guarded.**

That is only one of the challenges that President Obama and dozens of world leaders have been struggling with during a nuclear security summit meeting held in Washington on Monday and Tuesday. The agenda aims at bolstering safeguards on the world's nuclear arms, as well as a range of sensitive materials and sites, like the M.I.T. reactor.

"We must ensure that terrorists never acquire a nuclear weapon," Mr. Obama told cheering crowds in Prague a year ago. "So today I am announcing a new international effort to secure all vulnerable nuclear material around the world within four years. We will set new standards, expand our cooperation with Russia, pursue new partnerships to lock down these sensitive materials."

The research reactors are seen by Mr. Obama and his aides as particularly vulnerable to terrorist attack, and therefore particularly difficult to secure in four years.

Typically, the civilian sites employ few of the standard military protections, like barbed wire, checkpoints, camouflage, heavily armed guards and antiaircraft guns. Instead, they tend to encourage easy use by university, industry and other researchers. The M.I.T. Nuclear Reactor Laboratory, for instance, welcomes college and high school students and gives public tours. It is currently working with General Electric and Hitachi to see if the small reactor can produce medical isotopes for Boston-area hospitals.

"We're quite optimistic we can supply a niche market," David Moncton, director of the M.I.T. reactor, said in an interview. Research reactors that run on highly enriched uranium are in part a legacy of the cold-war ambitions of Washington and Moscow to promote atoms for peace. They were offered by the two superpowers as prizes to woo client states. Today, nations are trying to control and diminish the threat of terrorist theft by enhancing site security, shutting down obsolete reactors and replacing the bomb-grade fuel with low-enriched varieties.

Earlier this year, for example, experts from the National Nuclear Security Administration in Washington conducted a sensitive operation in Chile to remove highly enriched fuel from two research reactors. But an 8.8 magnitude earthquake struck amid the delicate endeavor, throwing Chile into chaos and forcing the nuclear teams to improvise on how to remove the crated fuel.

The summit meeting intends to accelerate such efforts by creating a surge of financial and technical support that will push Mr. Obama's four-year plan over the finish line.

But nuclear specialists warn that the president's goal is not only daunting (some call it "mission impossible") but has now achieved such a high profile that world leaders might end up simply throwing money at the problems instead of pursuing long-range solutions like ending civil commerce in highly enriched uranium. At worst, they say, the meeting could reinforce the dangerous status quo.

"I'm concerned that the summit might be moving in the wrong direction," said Alexander Glaser, a nuclear specialist at the Woodrow Wilson School of Public and International Affairs at Princeton. "If you have events and deadlines, it's easier to spend millions on a security system rather than qualifying a new reactor fuel."

Relatively easy security enhancements at reactor sites include adding fuel vaults, motion detectors, security cameras, steel doors, magnetic locks and central alarms. The process of switching to a reactor fuel that has little or no bomb use is difficult, costly and time consuming. But in the end it offers a more fundamental fix, virtually eliminating the risk of diverting reactor fuel to make bombs.

The M.I.T. reactor illustrates the potential difficulty of switching to a new reactor fuel. For decades, federal officials have talked about replacing its bomb-grade fuel with a safer variety. But, until recently, the costly process never got much attention or financing.

Dr. Moncton of M.I.T. said the planned switch to low-enriched fuel had recently slipped to 2015 from 2014. But that was no real danger, he added, because the terrorist risk was essentially zero.

"They couldn't make a bomb" from the reactor's limited fuel supply, he said in the interview. "But we believe in the global issue and want to do our part to get it out of the civilian sector."

A common rationale for low security at research reactors is that the amount of fuel is often too small to make a bomb. However, nuclear experts worry that two or three thefts would yield enough and that some sites have more than enough material to make a weapon.

As a class, research reactors serve mainly as factories for the production of the subatomic particles known as neutrons, which are used for scientific experiments and various types of nuclear production. By contrast, power reactors tend to be much larger and their high heats are typically used to spin turbines and make electricity.

The cores of research reactors emit an eerie blue glow known as Cherenkov radiation, after the Russian scientist who first explained its origins. It occurs when charged particles zip through cooling water, emitting bursts of harmless light.

Matthew Bunn, a nuclear expert at the Belfer Center for Science and International Affairs at Harvard, said in the most recent edition of his annual report, "Securing the Bomb," published Monday, that **security arrangements for research reactors tend to be "remarkably modest." Among the typical problems: no armed guards, no background checks, no security requirements and no fences with intrusion alarms.**

Last year, Congressional investigators reported another problem: foreign resistance to security upgrades. One unnamed country, they noted, has refused multiple federal offers for nine years.

Some nuclear specialists have accused the federal government of dragging its feet on fuel conversions at domestic reactors. In early 2008, the Natural Resources Defense Council, an environmental group that tracks nuclear issues, petitioned the Nuclear Regulatory Commission to set a date by which it would no longer license the civilian use of highly enriched uranium. "The high national security risks," the group argued, "clearly outweigh the benefits."

Among other things, the group argued that such a move would set a good example for other countries. Early this year, the commission denied the petition.

"We urge President Obama to seek a global ban on the commercial use of highly enriched uranium," said Thomas B. Cochran, a nuclear expert at the council. "Until then, securing and reducing the global stocks of this material should be a top priority for world leaders — and for this summit."

Most of the world's research reactors that are fueled with bomb-grade uranium are located in Russia and, according to nuclear experts, Moscow has resisted pressure from Washington to convert them to low-enriched fuel.

Indeed, outside St. Petersburg, a new research reactor is being built that is meant to run on highly enriched uranium, to the dismay of American officials.

"Nobody ever talks about it," said Dr. Glaser of Princeton. "It's quite a significant reactor, a lot of uranium." He called it "a significant blow to the conversion efforts."

Dr. Glaser added that whether Mr. Obama and his aides can persuade Russia to change its position on the use of highly enriched uranium is "probably one of the key questions for the summit."

A version of this article appeared in print on April 13, 2010, on page D3 of the New York edition.

ARTICLE 7

THE WALL STREET JOURNAL. | BUSINESS

SEPTEMBER 2, 2011

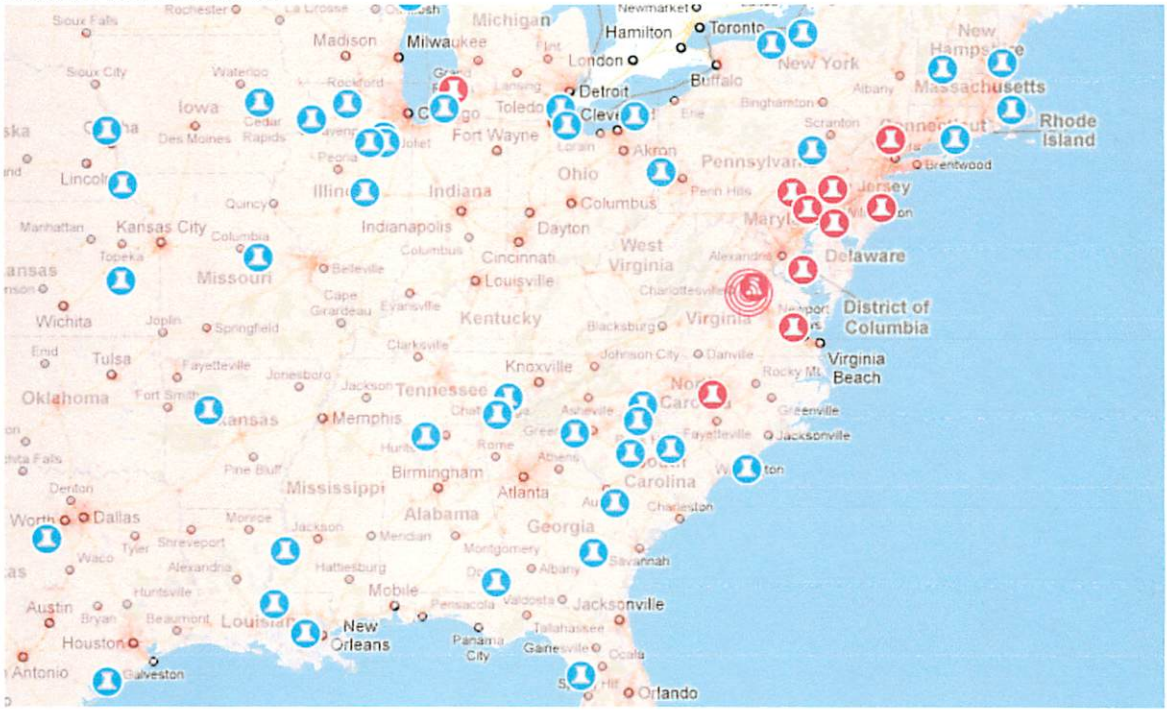
Nuclear Operators Told to Reassess Quake Risk

By REBECCA SMITH

Nuclear regulators said Thursday they want the operators of all 104 U.S. commercial reactors to conduct new assessments of their facilities' vulnerability to earthquake damage.

The decision was motivated by the increased awareness that seismic risks may have been underestimated by nuclear-power industry and regulators in the past, especially for the central and eastern U.S.

Nuclear Plants Rattled



A draft requirement for the new assessments, released Thursday for public comment by the U.S Nuclear Regulatory Commission, has been in the works for six years, but gained urgency with the nuclear accident at Japan's Fukushima Daiichi nuclear installation in March and smaller earthquakes in Virginia in the past two weeks that sidelined two reactors.

On Thursday, a 3.4-magnitude aftershock was felt at the North Anna nuclear power station, which was shut down Aug. 23 after suffering damage from a 5.8-magnitude earthquake, the biggest in Virginia in more than a century. Owner Dominion Resources Inc. recently told the NRC that it believed the initial quake might have exceeded the level for which the nuclear plant was designed.

The Nuclear Energy Institute, a trade group that represents owners of nuclear plants, said it was analyzing the NRC proposal and would respond by Oct. 31, the public comment deadline.

In the late 1990s, the NRC told plant owners to take a fresh look at seismic issues. In a 2002 report, the NRC said that almost all plant owners reported "no plant vulnerabilities" beyond those already taken into account when plants were built.
In 2005, the NRC said that applications for new reactors—often proposed for the same sites as existing reactors—included earthquake-risk assessments that were worse than previously understood in several cases, and suggested some existing plants could be in jeopardy.

At that time, the NRC stepped up efforts to develop a better seismic risk model for the central and eastern U.S., working with the U.S. Geological Survey and the Electric Power Research Institute in Palo Alto, Calif. A new model is expected to be available next year that utilities would use in their new assessments.

Thursday's proposal would give plant operators up to two years to finish their work. It is expected to be a difficult task, because it will require plant operators to get intricate details on many components and systems not previously analyzed in such great depth.
Once the NRC has updated seismic reports in hand, the agency will decide whether to order upgrades. The effort to enact those changes, however, could be hampered by a federal requirement that any costly upgrades be justified by commensurate, tangible improvements in safety. Since earthquakes are hard to predict, that could become contentious.

Thursday's proposed rule comes in the midst of continuing analysis of earthquake damage at the North Anna plant. This week, the NRC said the quake, centered nearby, shifted several 110-ton casks that store used fuel.

Write to Rebecca Smith at rebecca.smith@wsj.com

ATTACHMENT E

Massachusetts Institute of Technology

MIT Nuclear Reactor Laboratory

MIT respectfully provides answers, below, to the questions submitted via e-mail by a Cambridge citizen, Mr. Brad Bellows. About a dozen of these questions were asked by Mr. Bellows at the 9/13/11 hearing of the City Council Committee on Cable TV, Telecommunications, and Public Utilities on the safety and security of the MIT reactor. We note that although a number of the questions do not pertain to the safety and security of the MIT reactor, we have answered all of questions to the extent that we have relevant information.

Safety & Security Questions

1. ***How does MIT's 6 kW reactor compare in size to other research reactors in the US?***

   The MIT reactor is 6 MW. There are about 25 research reactors located on university campuses across the United States and another few at the various National Laboratories. These range in power from a few Watts to 250 MW.

2. ***How many research reactors the size of MIT's are located in an urban area in the US?***

   Most research reactors are located on university campuses hence are in highly populated settings.

3. ***Are there any other nuclear facilities in the US located within 50' of both an active railroad line and a public street?***

   The MIT reactor is located 80' from the railroad and 100' from Albany Street. We do not have such information for other reactors.

4. ***How many safety violations have occurred at the MIT NRL since it began operation, and what has been their severity?***

   The MIT reactor has operated safely since 1958 without a release that affected the general public. There have been some reportable occurences, mostly procedural. These are rare (about one per year) and have had no radiological consequences.

5. ***What changes were made following the discovery of an operator asleep and unreachable while on duty at the MIT NRP on June 30, 2003?***

   The changes that were made are those that were provided to the Nuclear Regulatory Commission in our report on this event. Our training program was revised to include a module on operator alertness and how to prepare physically for night shifts; routine activities such as data logging were split up so that the operator is required to do some physical activity every thirty minutes; and management reviewed research done on human factors to improve methods for assigning operators to the night shifts.

6. ***What changes were made following the exposure of a worker to excessive levels of radiation in 2007, when the NRC cited MIT for Severity Level IV safety violations?***

   No one was exposed to "excessive" radiation levels. The event involved a badge exposure that was above normal but still below the safe limit. Both MIT and the Nuclear Regulatory Commission (NRC) carefully review all such exposures even when legal limits are not reached. The changes made included: improved training on the work in question, new radiation monitoring

equipment with both local and remote alarms, and electronic dosimetry that allows real-time monitoring of one's dose. The NRC citation was not for the radiation exposure, but rather for procedural errors.

7. ***Does the MIT reactor meet all current provisions of the Massachusetts Building Code, particularly regarding seismic design?***

   The building was designed and built in the late 1950s and conformed to all building regulations at that time. It is regularly inspected by civil authorities/insurer for compliance on certain issues including fire, elevator safety, air compressor tanks, and the crane. The integrity of the containment building is verified annually with the results of the test being reviewed, also annually, by the NRC. The seismic design was reviewed by the NRC as recently as 2010.

8. ***Has a comprehensive seismic analysis and risk assessment been performed by a qualified engineering firm with no affiliation to MIT or the NRC, and if so, by whom and how recently?***

   No. However, seismic analyses were performed by MIT personnel both for the license renewal in the early 1970s and for the more recent one in 2010. Both were reviewed by the NRC.

9. ***Has this analysis included seismic and blast damage evaluation of all equipment, both internal and external, including backup power, water, communication and other systems?***

   A summary of the analysis is contained in the MIT reactor's safety analysis report (chapter two) which is a public document on file with the NRC.

10. ***If so, has the blast analysis included the risk posed by explosive contents of freight railroad cars passing within 50' of the facility?***

    The MIT reactor is located 80' from the railroad and 100' from Albany Street. Blast analysis was performed subsequent to 9/11 by a qualified individual who was not affiliated with the MIT reactor. The study showed that the building that surrounds the MIT reactor might be damaged but the reactor core would not be damaged and there would be no radiation release to the general public. That analysis was provided to the cognizant government authorities including the City of Cambridge (Department of Emergency Management at the time).

11. ***Has a risk assessment evaluated the potential for negligent or malicious acts by operators, including both students and employees, i.e., Fort Hood, etc.?***

    Yes. The nature of the checks is detailed in the Code of Federal Regulations (Part 10) and entails fingerprint checks by the FBI as well as a criminal background check for anyone having unrestricted access to the facility.

12. ***Are there fail-safe mechanisms in place to assure that operators follow established procedures and to limit damage if they do not?***

    Yes. The MIT reactor achieves safety through use of a defense in depth strategy. The first element of this strategy is good design and use of passive safety. For example, the core is designed for natural circulation should off-site electricity be lost. The second layer is a well-trained, qualified, licensed operator. All of our operators are licensed by the NRC. The third layer is administrative - procedures and well-designed control systems. The fourth layer is a safety system that will cause an automatic shutdown if certain license conditions are not met.

13. ***What is the age of the oldest components of the cooling system, including piping,***

valves, and the heat exchangers which transfer heat from the reactor to the external cooling tower?

The oldest components in the cooling systems date to the early 1970s. However, most of the internal cooling system was replaced in 2010. Also, most of the external system (including the cooling towers) was replaced within the last few years. The MIT reactor is in excellent material condition.

14. ***How often is this piping inspected by X-ray or other means?***

The frequency of inspections depends on the safety significance of the piping in question. For example, in-core components are inspected monthly. Other systems are inspected on either a quarterly or annual basis.

15. ***Is the NRL connected to the public water supply and sewage systems?***

The building is connected to public water and sewer. These connections incorporate special safety features. For example, the ones for city water all use backflow preventers and the ones for discharges employ physical separation between the reactor building and the pubic sewer.

16. ***How is ventilation air provided to plant operators, and how long can the facility function without a connection to the outdoor atmosphere?***

Ventilation is provided by intake and exhaust ducts that will be sealed automatically if abnormal radiation levels are detected in the building. Each duct has redundant dampers and the instruments that would initiate closure are quadruply redundant. In addition, the option exists for manual closure and the ducts seal automatically on loss of off-site electricity. Our operating procedures direct that the facility be shutdown on loss of ventilation.

17. ***Is the NRL located in a federally designated Flood Plain?***

No.

18. ***How long is the facility capable of operating safely with the access door below water level?***

Such a water level has never occurred, and the facility would not be operated under such circumstances.

19. ***How often is the reactor containment inspected for corrosion or other deterioration between the concrete and steel jacket***

We perform an integral containment building leak test every year. That test would identify any incipient deterioration of the building.

20. ***What radiation exposure would be created if Highly Enriched Uranium or spent fuel were vaporized outside the reactor core during delivery or removal?***

Neither of these scenarios is a credible event. There is no mechanism for vaporizing the fuel and there is a strong security presence. In the case of delivery, the fuel would be unirradiated and hence it is not a radiation hazard. In the case of spent material, the fuel is sealed in a DOT-approved shipping container before it is removed from our building.

We note that there is no question #21 in the list received from Brad Bellows.

22. ***How long would the radiation persist, and how long would it take and cost to clean up?***

Not applicable given that the situation envisioned in question #20 is not credible.

23. ***What is the likely evacuation radius and duration following a worst-case radiation event?***

valves, and the heat exchangers which transfer heat from the reactor to the external cooling tower?

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We note that there is no question #21 in the list received from Brad Nelson.

22. How long would the radiation persist, and how long would it take and cost to clean up?

Not applicable given that the situation envisioned in question #20 is not credible.

23. What is the likely evacuation radius and duration following a worst-case radiation event?

The worst case event is the reactor's design basis accident which is described and analyzed in the Safety Analysis Report (public document on file with the NRC). The reactor building is designed to contain completely the radiation from this event. Thus, there would be no "likely evacuation radius" and no "duration." The public would not be affected because the MIT reactor is enclosed by a full containment building and that building would be sealed if such an event were to occur. The NRC mandates emergency planning for research reactors for a zone of only 100 meters around the site. This small radius is indicative of the low risk posed by such facilities.

24. ***Is the MIT NRL participating in the latest NRC-mandated seismic upgrades which were implemented following the 2011 Virginia earthquake?***

No, thus far the NRC has mandated actions only for the power plant community. Research reactors do not pose a significant risk to the community.

25. ***How much Highly Enriched Uranium is present at the MIT NRL, and how does this amount compare to the minimum amount needed to construct a functioning nuclear weapon?***

That figure is given in our license which is a public document that is on file with the NRC. We see no value to discussing what is required to build a weapon. We do note that (1) the MIT reactor does "just-in-time" refuelings so that our inventory of fresh fuel is almost always zero, (2) that the amount of fresh fuel brought in for any given refueling is always significantly less than what would be required to construct a weapon, and (3) it is not possible to construct a weapon from spent fuel given the presence of highly radioactive fission products.

26. ***What is the status of MIT NRL's plans to convert to less enriched Uranium 235 (originally to have been completed by 2014)?***

We are enthusiastic to implement the conversion and have a very active program in progress. We are awaiting qualification of low enriched uranium (LEU) fuel suitable for use at the MITR by the U.S. Department of Energy.

27. ***Is adequate (military level) security provided during delivery and removal of bomb-grade materials?***

Yes. Details of the security that is provided are "safeguards information." That information is shared with the cognizant civil agencies including those of the City of Cambridge and the Commonwealth of Massachusetts, as well as federal authorities.

28. ***Is the MIT NRL participating in the latest Homeland Security upgrades to secure weapons grade or "dirty bomb" materials?***

Yes, again details are "safeguards information." The City of Cambridge (Fire and Police) have been briefed on our upgrades under this federal program.

29. ***What is the maximum amount of spent fuel that is permitted to be stored at the MIT NRL, and what is the maximum amount that has actually been stored?***

We minimize the spent fuel that is stored on site by regular off-site shipment. The U.S. Department of Energy retains title to the fuel and they arrange for its return to a DOE site at a regular frequency. Again, shipment details are "safeguards information" that is shared with city and state authorities.

Economic Risk Questions

30. ***Has there been any comprehensive, independent analysis of the economic impact which would result from a radiation leak at the MIT facility?***

No, because the worst-case event does not produce a radiation leak. Please see response to question #23 above.

31. ***Is the facility subject to the liability caps imposed by the Price-Anderson Act, and if so, what is that amount of the cap?***

    According to the provisions of Price-Anderson, the government-sponsored insurers pay claims above $250k for nuclear incidents.

32. ***What is the current amount of liability insurance carried by MIT for the NRL?***

    We have $3M in nuclear liability coverage

33. ***What is the current Assessed Value of property in the City of Cambridge, including both taxable and non-taxable properties?***

    This information is available on the City's Assessing Department website.

34. ***What is the current value of the MIT Endowment, and is the University prepared to indemnify neighbors for all direct and indirect losses they might incur as the result of a leak?***

    MIT endowment was $9.9B at the end of fiscal year 2011. MIT exercises appropriate levels of controls and best practices in managing the activities of and access to our Nuclear Reactor Lab that are consistent with regulatory and insurer requirements and guidelines. To the extent that there is a nuclear incident resulting in a leak, MIT is prepared, through the Price-Anderson Act, to address all claims.

35. ***What is the potential value and alternative uses of the property currently occupied by the MIT NRL and its buffer zones?***

    Given our education and research mission, the current use is the highest and best use.

36. ***What is the cost to the of the public safety coordination that the City provides to the MIT NRL, and how does this compare to that provided for other research groups and property owners?***

    This question should be directed to the City of Cambridge Fire and Police Departments. We believe that our impact on those Departments is minimal. Our interaction primarily consists of cross-training of our people and their officers.

37. ***What costs and benefits would result if the MIT NRL were located elsewhere (for example, at another existing nuclear facility, such as Pilgrim Station, Plymouth MA (40 miles from Boston) or Seabrook Station, Seabrook NH (45 miles from Boston)?***

    The reactor is located on the MIT Campus to achieve synergy with the faculty and students. The reactor could not be relocated (one of the conditions of its license is its present location) and to do so would not benefit either education or research.

38. ***Has MIT formally investigated alternative locations for the MIT NRL (at either the Departmental or University level), and if so, how recently?***

    No

39. ***What is the remaining "Useful Life" of the MIT NRL?***

    The current license, which was issued in the fall of 2010, runs until the fall of 2030. So, the minimum useful life is 19 more years. In 2025 or thereabouts, a decision will be made as to the facility's additional future life.

40. ***What is the plan for decommissioning the facility, and when is this likely to occur?***

    MIT has no plans for decommissioning the reactor.

Submitted by David Moncton, Director, MIT Nuclear Reactor Laboratory and Sarah Gallop, Co-Director, MIT Office of Government and Community Relations.

11/2/11