Tritium at Fermilab

Fermilab Community Advisory Board

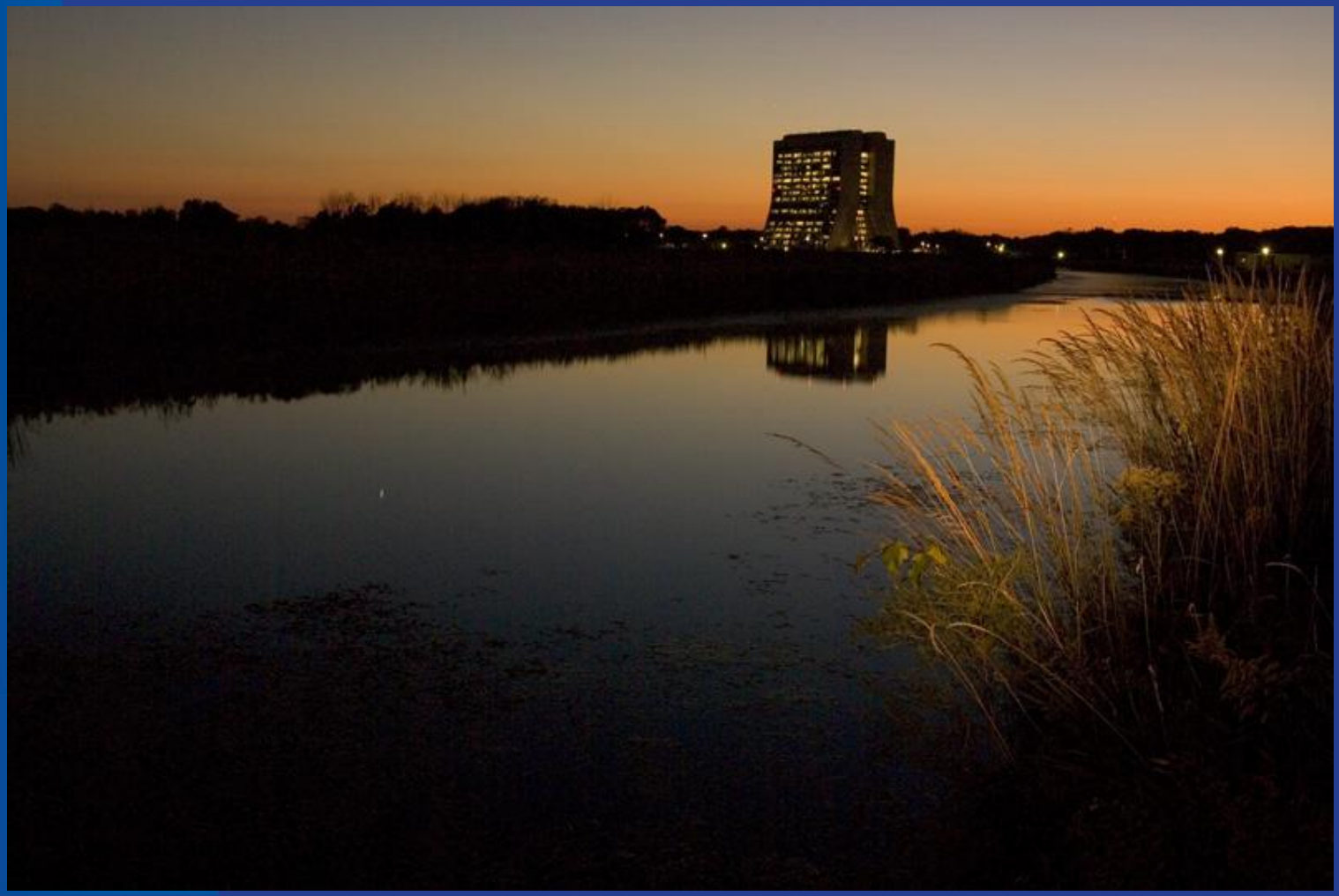
September 23, 2010

Rob Plunkett, Fermilab

U.S. DEPARTMENT OF ENERGY

Fermilab

Got water?

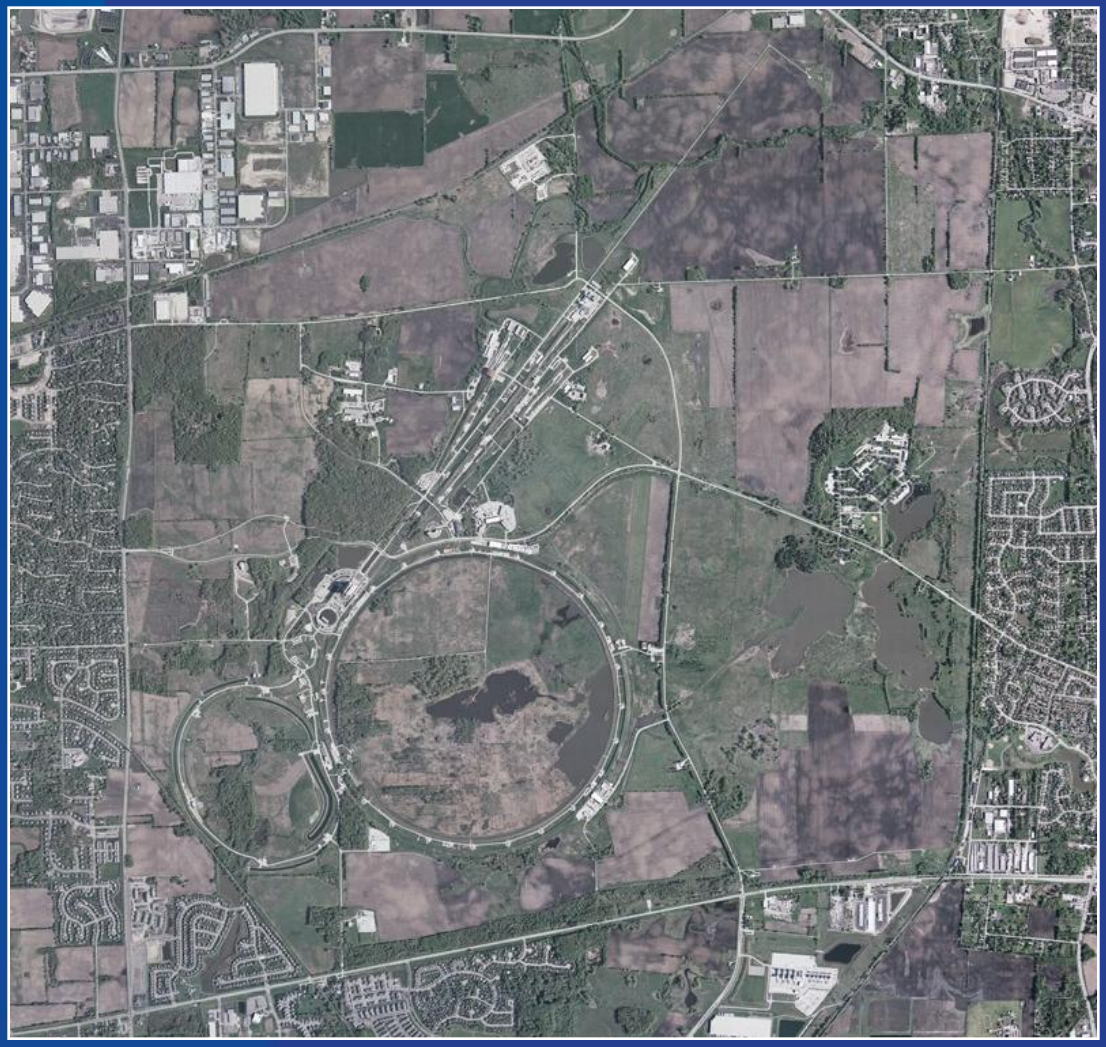


Fermilab has plenty

The Fermilab site has numerous ponds and is the origin of Indian Creek and Ferry Creek.

Fermilab uses water to cool accelerators and other equipment.

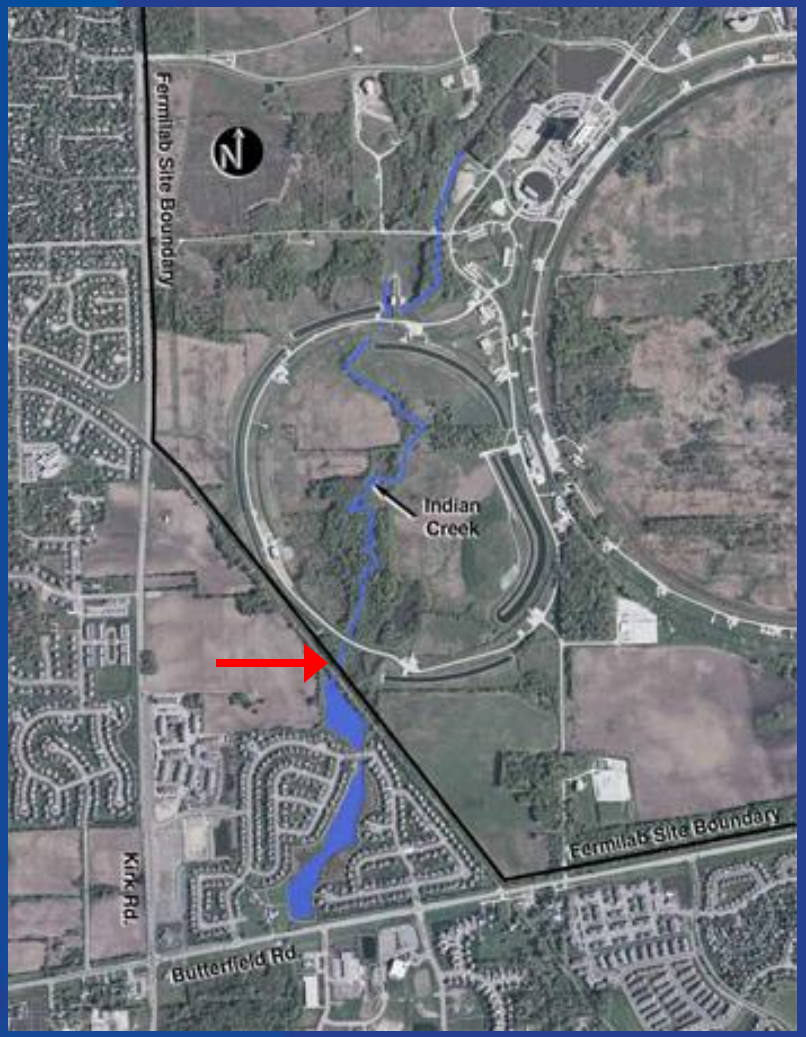
Fermilab, before Nov. 2005



Tritium is produced as part of accelerator operations.

It had never been detected in Fermilab surface water before Nov. 2005.

Nov. 2005: Tritium detected



Our routine testing of surface water at Fermilab revealed low levels of tritium:
3-4 picocuries per milliliter

Surface water limit:
2000 pCi/ml

Drinking water limit:
20 pCi/ml

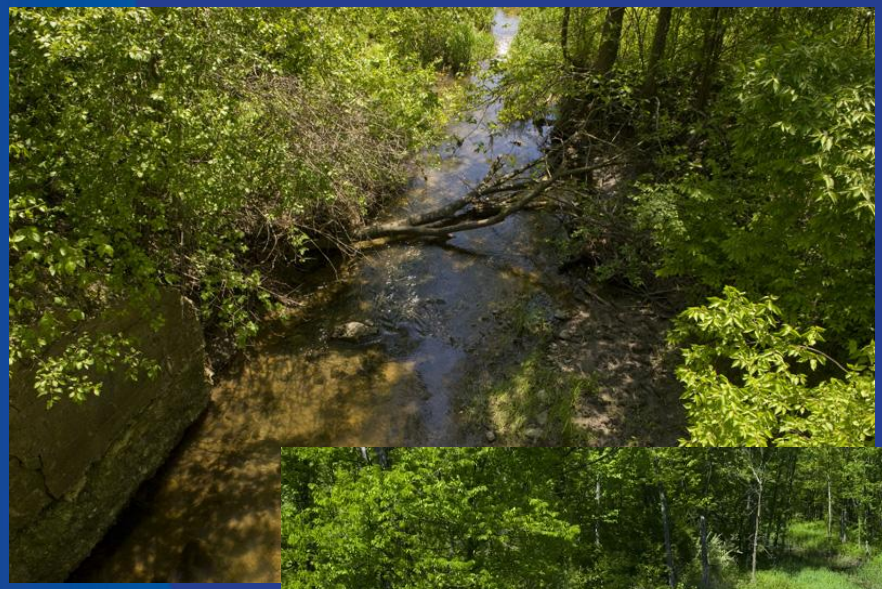
Detection limit:
1 pCi/ml

Indian Creek in Dec. 2005

At the same time, we also detected small amounts of tritium in surface water leaving the Fermilab site:

3-4 picocuries/ml found at site boundary in Indian Creek. The creek runs into a pond in the Savannah subdivision.

Indian Creek during summer



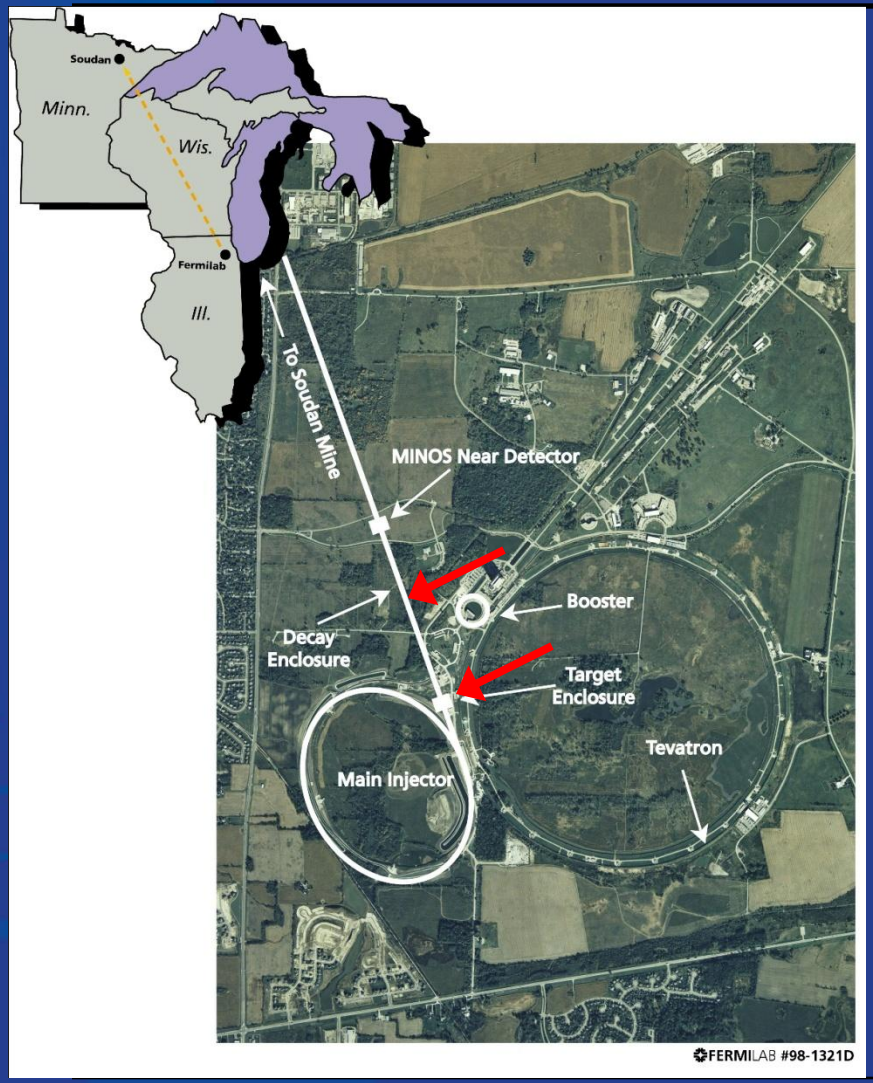
Creek starts on Fermilab site.

During dry months, very little water flows off Fermilab site through Indian Creek.

What is tritium?

- Weakly radioactive isotope of hydrogen with 12.3 year half life.
- Cannot penetrate skin.
- Does not “accumulate” in body when ingested.
- Prolonged exposure by drinking tritiated water over many years poses cancer risk.

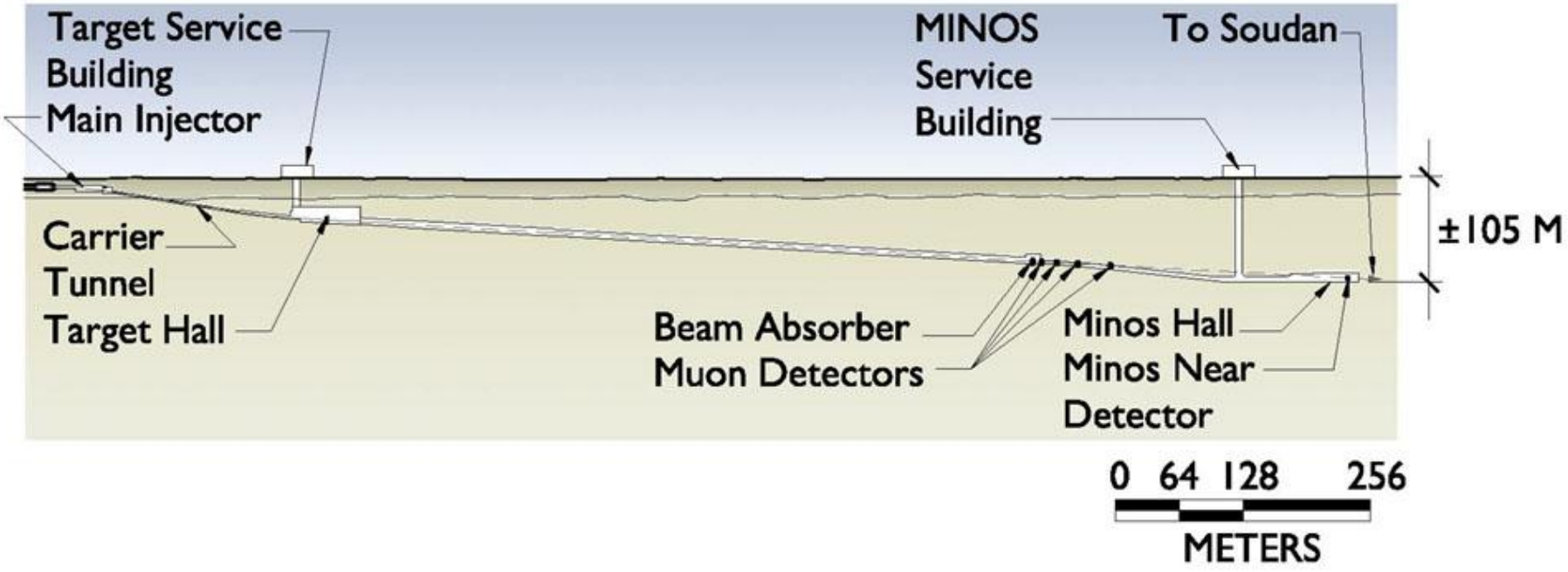
Where is it coming from?



When high-energy protons hit other particles or matter, they can produce tritium.

In March 2005, Fermilab started operating a new proton beam line to create neutrinos for the MINOS experiment. It is the main source of tritium at Fermilab.

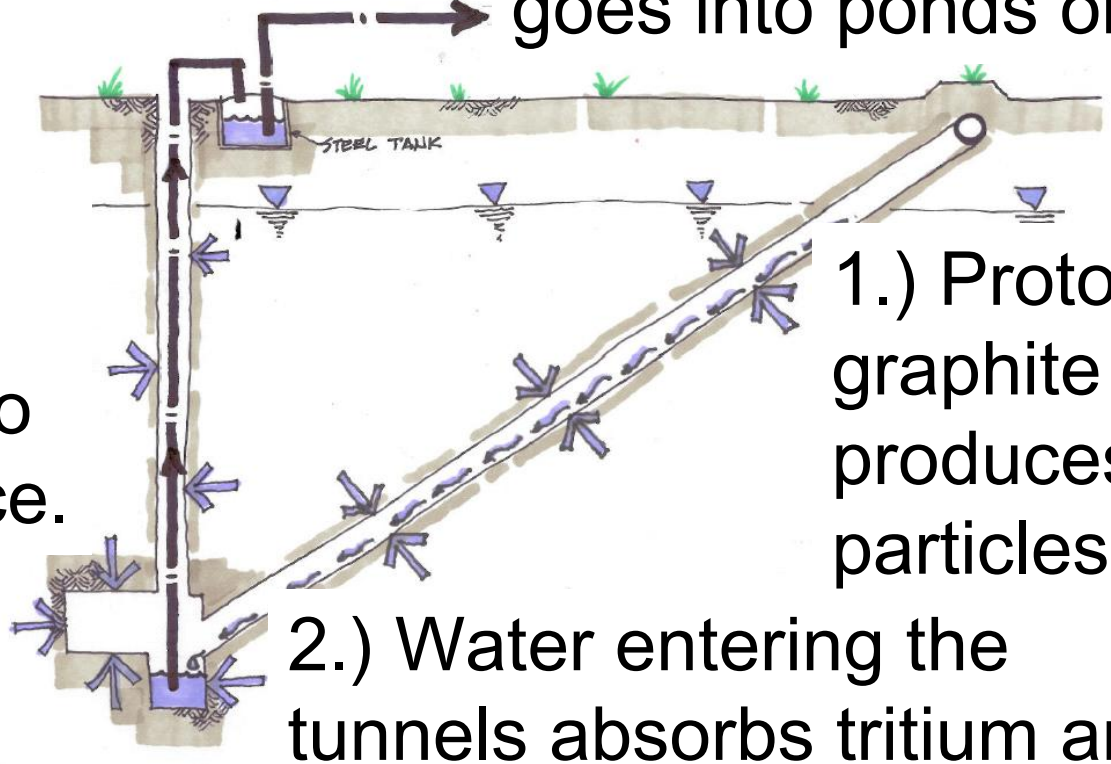
The NuMI/MINOS Tunnel



Cross section of the beam line for the MINOS experiment

From underground to surface

4.) Water is used in Fermilab cooling water system, then goes into ponds on site.



3.) Water is being pumped to the surface.

1.) Proton beam hits graphite target and produces other particles, incl. tritium.

2.) Water entering the tunnels absorbs tritium and flows to sump pump.

The Task Force helps…

Fermilab Community Task Force On Public Participation

- Task: How should Fermilab interact with the community when issues arise that affect us both?
- Began March 2004
- Reported December 2004
- Gathered for a “tritium meeting” in December 2005

Community Task Force

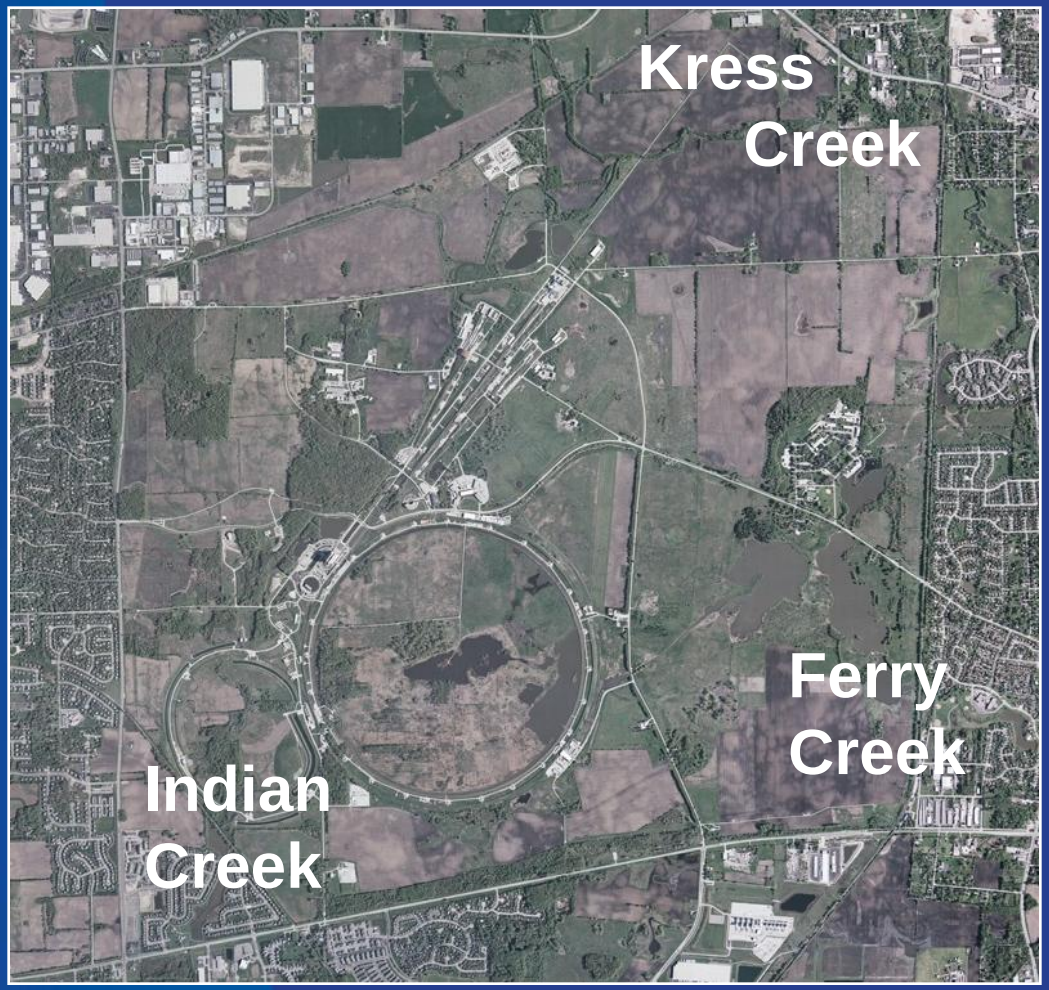
Questions for the Task Force posed in 2004:

How should Fermilab interact with the community, based on the type of issue being addressed?

How should Fermilab keep the community informed about these types of issues?

Realization: Decisions made with public participation will be better decisions not just for the community but for Fermilab and for particle physics. Public participation is key to Fermilab's future.

Actions taken in Dec. 2005



We checked our measurements.

We identified the source of the tritium.

We informed regulators.

We informed our neighbors and employees.

Simultaneously, we told the Community Task Force and got their advice.

Through the snow…

- On Thursday, Dec. 8, 2005, eight Fermilab employees trudge through the snow to deliver letters to each house in Savannah subdivision.
- Thursday, not Friday, so that neighbors can contact us with questions before the weekend.

Next day's email (Dec. 9, 2005)

Subject: Tritium

Hi. My name is Nanette Casto. I live in the neighboring Savannah subdivision. I received a letter today from Fermilab explaining about the tritium. I want to thank you folks at Fermilab for being so forthright, open and responsible in the handling of this matter. If everyone showed responsibility to their fellow man as you folks have, and businesses showed more interest in the well-being of their neighbor and environment rather than the almighty dollar, the world would be a better place. Thanks again.

Director's Corner, Dec. 9

Director's message in Fermilab Today to inform employees, media, public.

We form a Water Task Force to find ways to reduce the levels of tritium in the Fermilab ponds.

From the Director’s message

…

Although we are addressing the problem, and although the tritium levels in Indian Creek were very small, we want Fermilab's operations to be completely transparent to you, our employees; to our community; our sponsors; and our government representatives. That is why we delivered 300 letters to our neighbors in the snow yesterday afternoon, and why the Director's Corner is coming to you a few days early this week.

We have created a Website where you can read our letter to the neighbors and find more information: http://www.fnal.gov/pub/about/community/IndianCreek.html

Pier Oddone

10 December 2005

In the News

From *The Beacon News*, December 10, 2005:

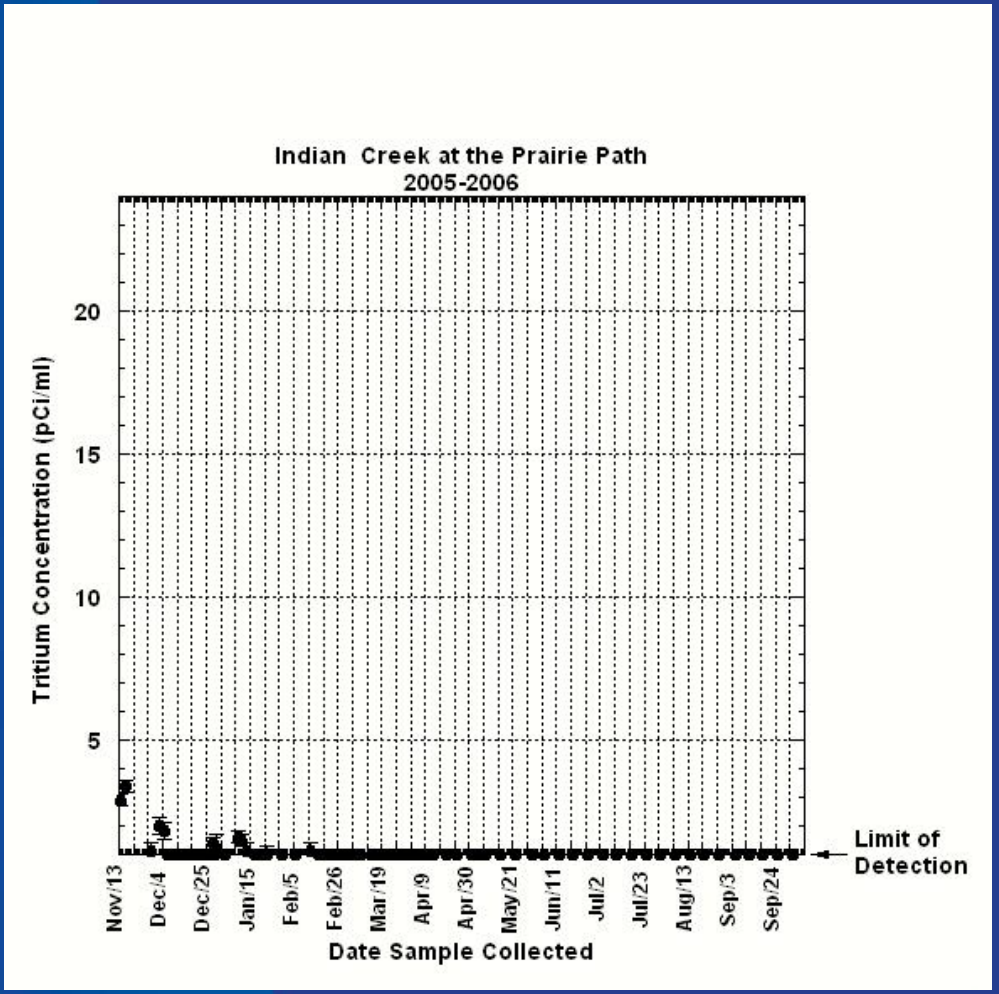
Fermilab: No cause for alarm. Small amounts of tritium found in Indian Creek

BATAVIA — Staff members from Fermilab trudged through the falling snow Thursday, delivering letters to every home in the Savannah subdivision on Aurora's northeast side, alerting residents to the presence of radioactive materials in Indian Creek.
But don't be alarmed, officials say. There's really nothing to worry about.

Tritium link on home page

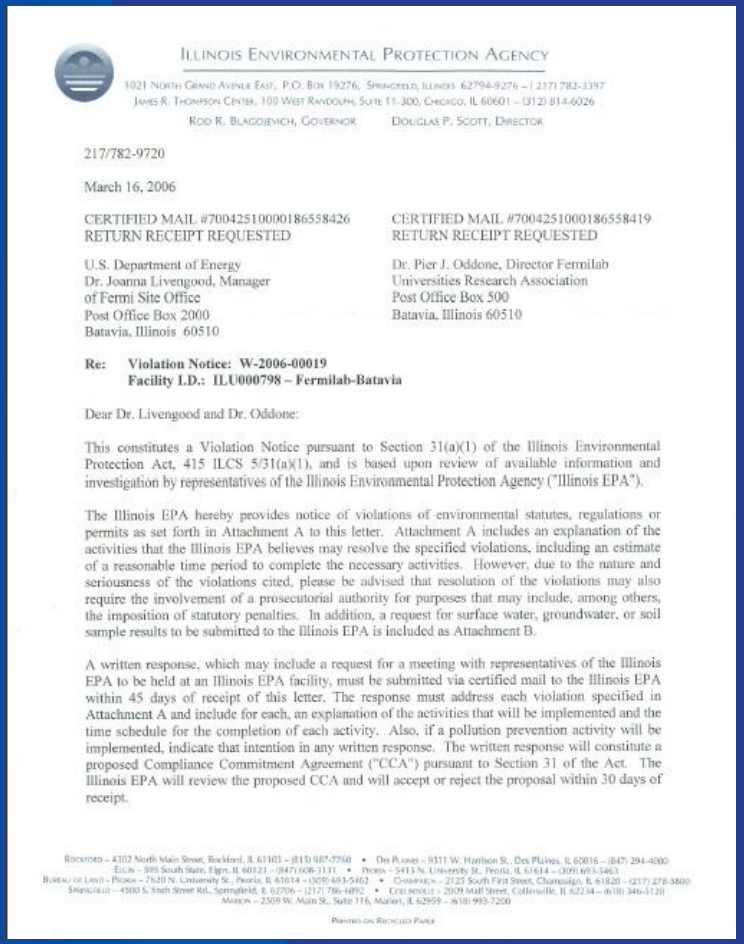
Fermilab home page in 2006: link to tritium information

Results posted on Web site



Our steps to reduce tritium in surface water are effective. Since March 2006, we have not detected tritium in Indian Creek. But we know that discharges could happen again.

Notice of Violation



ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 North Grand Avenue East, P.O. Box 19276, Springfield, Illinois 62794-9276 – (217) 782-3397
James R. Thompson Center, 100 West Randolph, Suite 11-300, Chicago, IL 60601 – (312) 814-6026

Rod R. Blagojevich, Governor Douglas P. Scott, Director

217/782-9720

March 16, 2006

CERTIFIED MAIL #7004251000018655842 6
RETURN RECEIPT REQUESTED

U.S. Department of Energy
Dr. Joanna Livengood, Manager
of Fermi Site Office
Post Office Box 2000
Batavia, Illinois 60510

CERTIFIED MAIL #7004251000186558419
RETURN RECEIPT REQUESTED

Dr. Pier J. Oddone, Director Fermilab
Universities Research Association
Post Office Box 500
Batavia, Illinois 60510

Re: Violation Notice: W-2006-00019
Facility I.D.: ILU000798 – Fermilab-Batavia

Dear Dr. Livengood and Dr. Oddone:

This constitutes a Violation Notice pursuant to Section 31(a)(1) of the Illinois Environmental Protection Act, 415 ILCS 5/31(a)(1), and is based upon review of available information and investigation by representatives of the Illinois Environmental Protection Agency ("Illinois EPA").

The Illinois EPA hereby provides notice of violations of environmental statutes, regulations or permits as set forth in Attachment A to this letter. Attachment A includes an explanation of the activities that the Illinois EPA believes may resolve the specified violations, including an estimate of a reasonable time period to complete the necessary activities. However, due to the nature and seriousness of the violations cited, please be advised that resolution of the violations may also require the involvement of a prosecutorial authority for purposes that may include, among others, the imposition of statutory penalties. In addition, a request for surface water, groundwater, or soil sample results to be submitted to the Illinois EPA is included as Attachment B.

A written response, which may include a request for a meeting with representatives of the Illinois EPA to be held at an Illinois EPA facility, must be submitted via certified mail to the Illinois EPA within 45 days of receipt of this letter. The response must address each violation specified in Attachment A and include for each, an explanation of the activities that will be implemented and the time schedule for the completion of each activity. Also, if a pollution prevention activity will be implemented, indicate that intention in any written response. The written response will constitute a proposed Compliance Commitment Agreement ("CCA") pursuant to Section 31 of the Act. The Illinois EPA will review the proposed CCA and will accept or reject the proposal within 30 days of receipt.

Rockford – 4302 North Main Street, Rockford, IL 61103 – (815) 987-7760 • Des Plaines – 9511 W. Harrison St., Des Plaines, IL 60016 – (847) 294-4000
Elgin – 595 South State, Elgin, IL 60123 – (847) 608-3131 • Peoria – 5415 N. University St., Peoria, IL 61614 – (309) 693-5463
Bureau of Land – Peoria – 7620 N. University St., Peoria, IL 61614 – (309) 693-5462 • Champaign – 2125 South First Street, Champaign, IL 61820 – (217) 278-5800
Springfield – 4500 S. Sixth Street Rd., Springfield, IL 62706 – (217) 786-6892 • Collinsville – 2009 Mall Street, Collinsville, IL 62234 – (618) 346-5120
Marion – 2309 W. Main St., Suite 116, Marion, IL 62959 – (618) 993-7200

Printed on Recycled Paper

The Illinois Environmental Protection Agency regulates and approves the types and amounts of discharges an organization can make.

In March 2006, IEPA notifies Fermilab that it needs to request a discharge permit that includes tritium.

The good news

- Positive response from neighbors, press, DOE
- Mostly positive response from employees, but some initially question the decision to go public
- We have come to understand tritium source, water, releases, permits much better.
- Our permit, issued by the Illinois Environmental Protection Agency, now is up to date and includes the monitoring of tritium discharges.

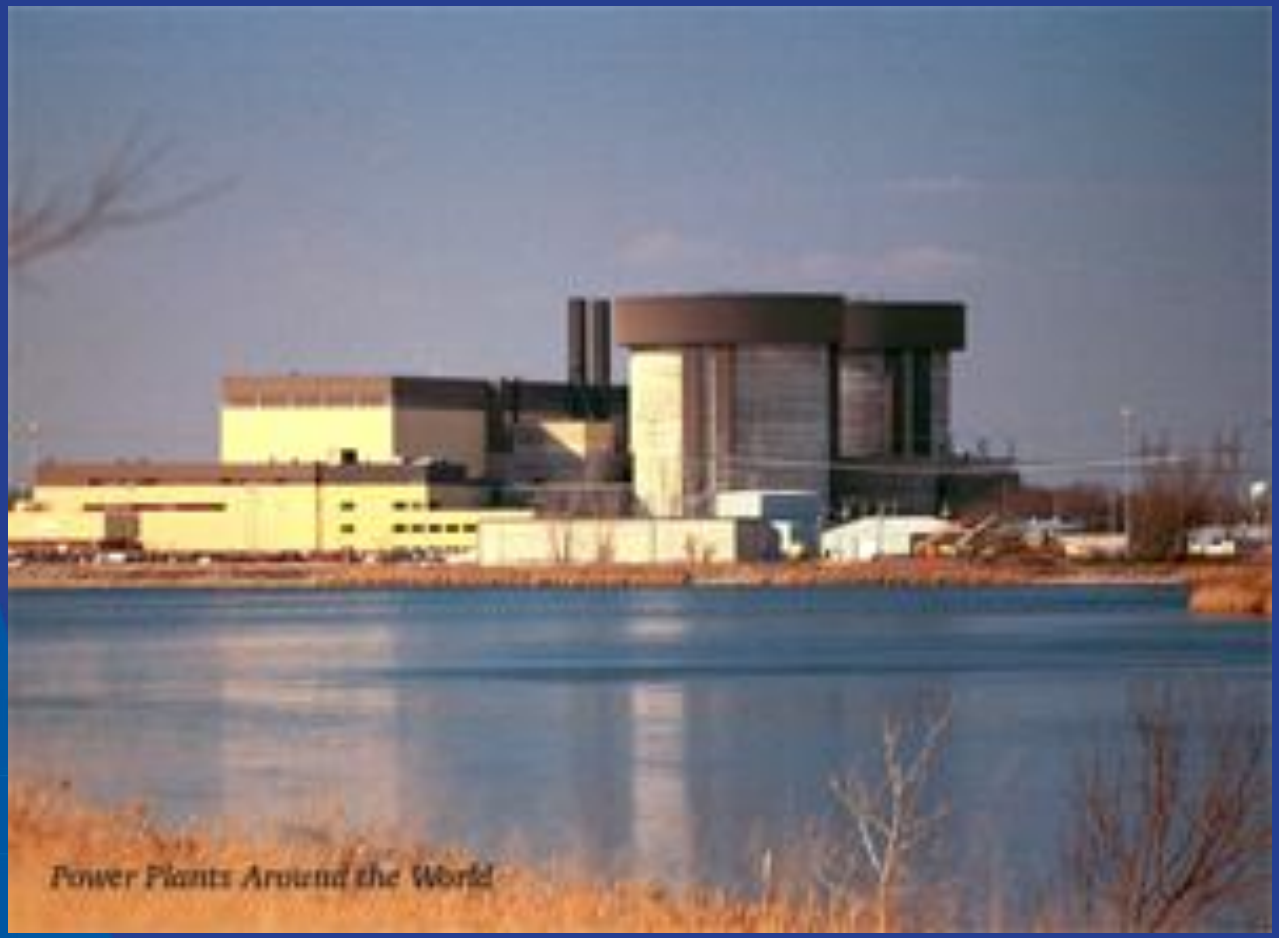
But…

- We know that we are going to be dealing with tritium long term.
- We continue to increase the intensity of the proton beams and hence the amount of tritium produced.
- We know there is potential for occasional discharges of tritium in the future. We make ongoing efforts to keep these discharges small.
- We must continue to communicate a long-term tritium message.

Fortunately…

- Tritium is a conversation opener. It gets people's attention.
- Long-term continuing conversation with the community is necessary anyway.
- So far, response is positive.
- It's the conversation itself that seems to count.
- It has helped us to build trust and accountability.

Lack of communication: Exelon



Braidwood Nuclear Power Plant, Illinois

Leaks…and lack of trust

The Herald News

SATURDAY
February 18, 2006

Serving Will and Grundy counties since 1839

50 cents

More tests in tritium case

■ Reed-Custer schools:

Higher-than-normal concentrations of tritium have been discov- its playing fields, but the drinking water is city water, officials said.

water. A level of 200 picocuries is normal in the environment, officials said. But anything above 20,000 picocuries is deemed unsafe for drinking water.

Company officials revealed their discovery in December and said they would begin a cleanup program.

Subsequent tests of the private residential wells closest to the site showed no tritium amounts above the naturally occurring amount. A sample of water from a pond 50 yards north of the plant property line had 2,400 picocuries of tritium per liter.

The highest concentration of tritium discovered was 226,000 picocuries per liter, in a remote area far from private drinking wells, officials said.

One monitoring well, at the Braidwood Dunes, revealed a tritium level of 25,000 picocuries per liter, Exelon officials said. A second well revealed a level of 2,700 picocuries.

❖ Turn to TRITIUM, A9

FEBRUARY 16, 2006 THURSDAY

EXELON: Exposure ups risk of cancer,

…response to that leak, Exelon replaced a portion of underground pipe and installed more monitoring wells.

On Monday, a monitoring well showed tritium at levels 34 times higher than the federal limit, according to a NRC document.

Exelon said it suspects the new leak occurred in a portion

Chicago Tribune

METRO

WEST

THURSDAY
FEBRUARY 16, 2006

2 more leaks at nuclear sites

Exelon discloses radioactive spills

By Hal Dardick
Tribune staff reporter

Radioactive tritium leaks have been found at two more

Generating Station in Grundy County and Byron Nuclear Generating Station, about 25 miles southwest of Rockford.

So far, no tritium has been detected in groundwater off Exelon property near those plants, and the leaks "pose no health or safety threat," Exelon stated in its announce-

that assessment.

The disclosures come weeks after Exelon publicly revealed water containing tritium spilled four times between 1996 and 2003 from vacuum breakers on an underground pipe at Braidwood Generating Station in far southwest Will County.

Contamination found at two more plants

NEW TRITIUM LEAKS ANNOUNCED

TRITIUM FACTS

What it is: A radioactive form of hydrogen that forms water when it meets oxygen.

Uses: In nuclear, military program, as a source of light for safety signs, in biochemical research.

How it enters body: Mostly in the form of water.

Dangers: Exposure can increase risk of cancer, birth defects and genetic damage.

1 Generating Station, Byron, Ill.
Employees: 790
Began operating: 1985

2 Generating Station, Morris, Ill.
Employees: 700
Began operating: 1970

Sources: Exelon Corp., U.S. EPA

Chicago Tribune

U.S. orders nuke plant inspections

Chicago Tribune, Feb. 21, 2006

Inquiry in Illinois to follow leaks, alarm at LaSalle

By Hal Dardick
Tribune staff reporter

IN BUSINESS
■ CUB backs plan to freeze state electric rates. PAGE 2

After ordering an investigation of a rare emergency Monday at Exelon's LaSalle County nuclear plant, federal regulators said they would inspect all Illinois nuclear power plants because of the company's recent disclosures about radioactive leaks.

The Nuclear Regulatory Commission action came just hours after Exelon Nuclear declared the first "site-area emergency" in the nation since 1991 at LaSalle County Generating Station, about 75 miles southwest of Chicago.

State and federal regulators said no radioactivity was released during the emergency. And the reactor, one of two at the site, remained stable, they said.

"All the indications are that it was an instrumentation problem" that did not threaten public health, said David Lochbaum, director of nuclear safety for the Union of Concerned Scientists, which advocates safety in the nuclear industry.

U.S. Rep. Jerry Weller (R-Ill.) requested NRC inspections last Wednesday, the day Exelon Nuclear announced radioactive tritium had leaked at Dresden Generating Station in Grundy County and Byron Nuclear Generating Station, about 25 miles southwest of Rockford.

Earlier, Exelon had disclosed four tritium spills at Braidwood Generating Station in far southwest Will County between 1996 and 2003. As a result, tritium was found in groundwater outside the plant at levels that exceed U.S. Environmental Protection Agency standards.

Braidwood, Dresden and LaSalle all are in Weller's district.

"All being in the news at the same time . . . all within a mat-

PLEASE SEE NUCLEAR, BACK PAGE

TRITIUM

From page A1

And at Exelon's Dresden station near Morris, tritium found last month measured 500,000 picocuries per liter in one test well

Exelon kept leaks quiet, files show

By Hal Dardick
Tribune staff reporter

Exelon officials took several steps that for years kept the public in the dark about radioactive tritium spills at a Will County nuclear power plant and the groundwater contamination the spills caused, public records obtained by the Tribune show.

Recent company disclosures about four tritium spills between 1996 and 2003 at Braidwood Generating Station came only after the Illinois Environmental Protection Agency pressured Exelon Nuclear to test for contamination, following prodding from the plant's neighbors.

The disclosures of spills triggered lawsuits last week by the Will County state's attorney, the Illinois attorney general and neighbors of the plant accusing the company of not being forthcoming.

The public documents show Exelon Nuclear officials in 2001 and 2002 opposed public discussion of tritium and the release of documents about tritium spills. They also opposed legislation to mandate groundwater monitoring at

PLEASE SEE EXELON, PAGE 3

Tribune photo by Zbigniew Bzdak

'We drank the water. We bathed in the water. We swam in the water. They never told us.'

—Bob Keca, with his wife, Linda, who live near a Will County nuclear power plant, in an area where elevated tritium levels were found in groundwater

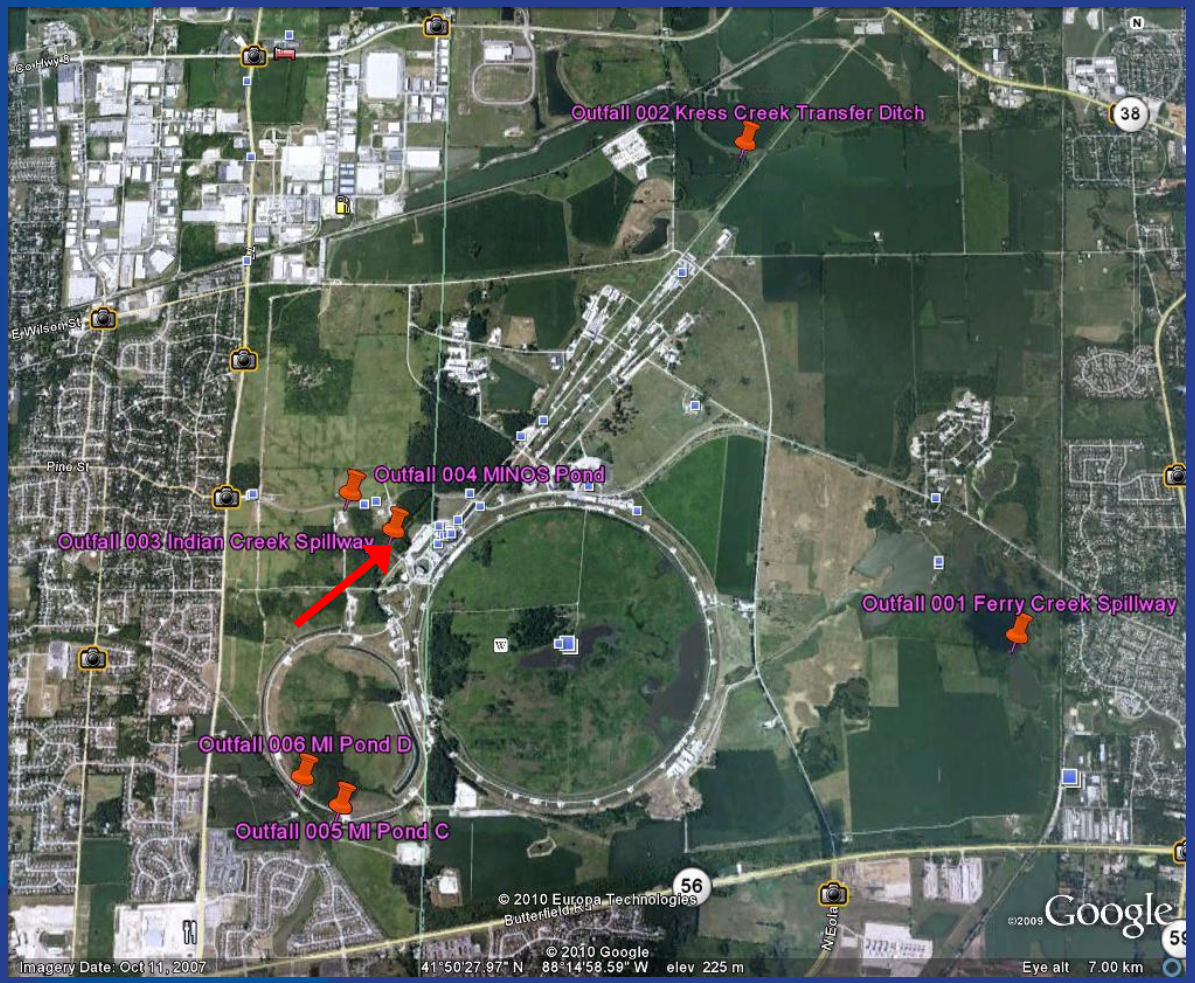
Consequences of Exelon's approach

- "Exelon's incompetence in dealing with its tritium leak problems…is matched only by its reticence to inform the public and local officials of the leaks for eight years…"
  - » Chicago Sun Times letter to editor
- Lawsuits, investigations, big fines, antinukes, public outrage…..
- Fortunately, Exelon's problems in 2005 did not distort the reporting on tritium discharges at Fermilab that fall.

What's next for Fermilab?

- We received approval for and started construction of the NOvA neutrino experiment. We are increasing proton beam intensity and are starting up the experiment in 2013. The environmental assessment led to "finding of no significant impact."
- We propose to build a new proton/neutrino beam line for the Long-Baseline Neutrino Experiment (LBNE), which would produce tritium
- We hope to build Project X, which would further increase proton intensity and create more tritium
- We need to get the tritium issue right to be allowed to do future projects.

Extensive monitoring



With regulators, we identified "outfall" points on the Fermilab site that we regularly test.

We also do additional measurements at the site boundary.

Discharges remain possible

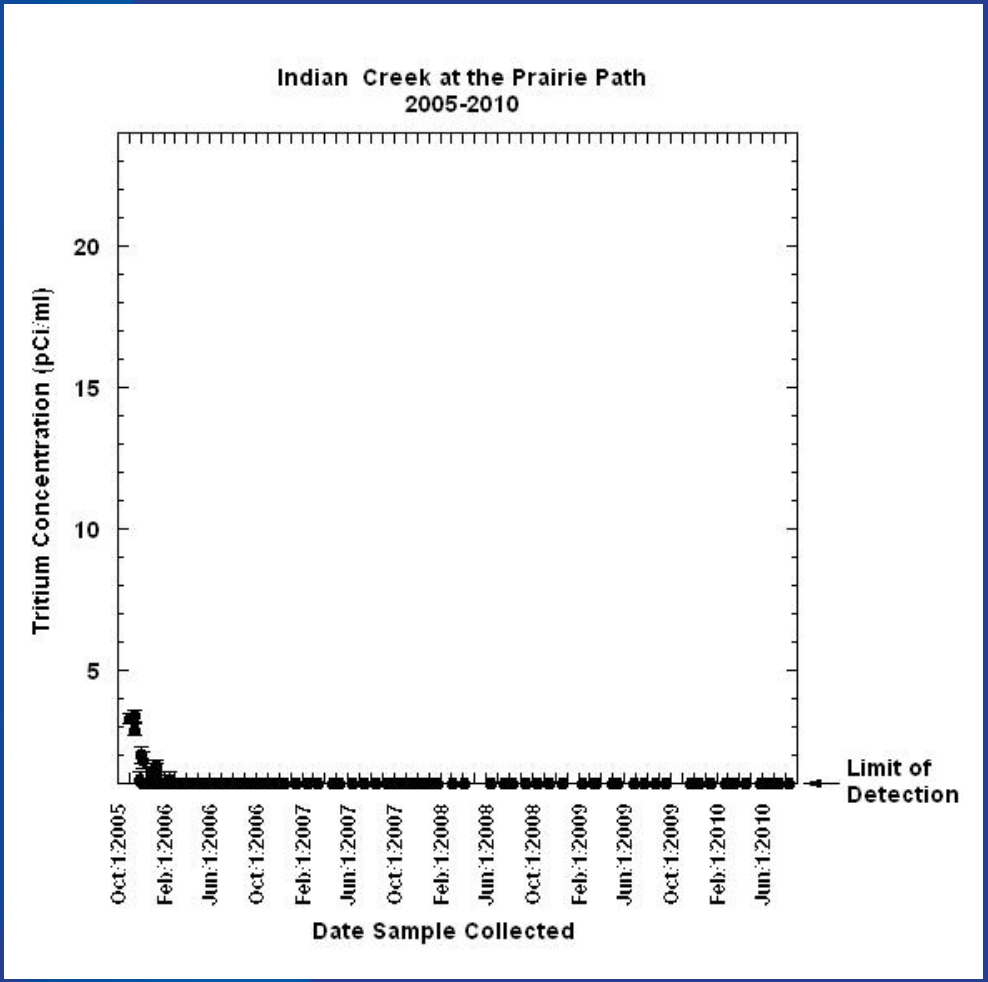
At Indian Creek spillway (weir in photo), close to Wilson Hall:

June 2010:
2.2 pCi/ml

July 2010:
4.3 pCi/ml

But we have not detected tritium at site boundary since 2006.

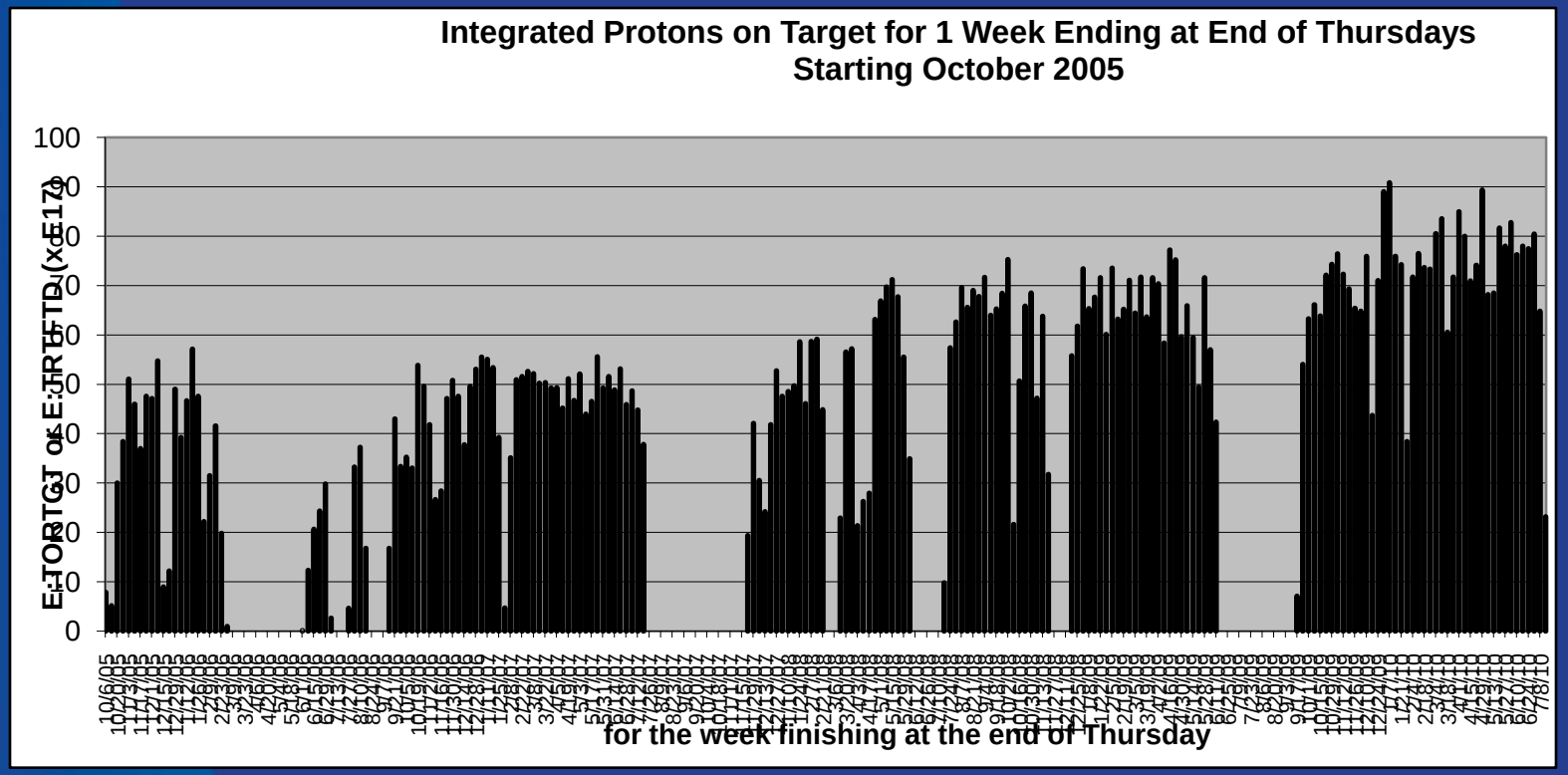
Results for Indian Creek



Monitoring at the site boundary: we have not detected tritium since 2006.

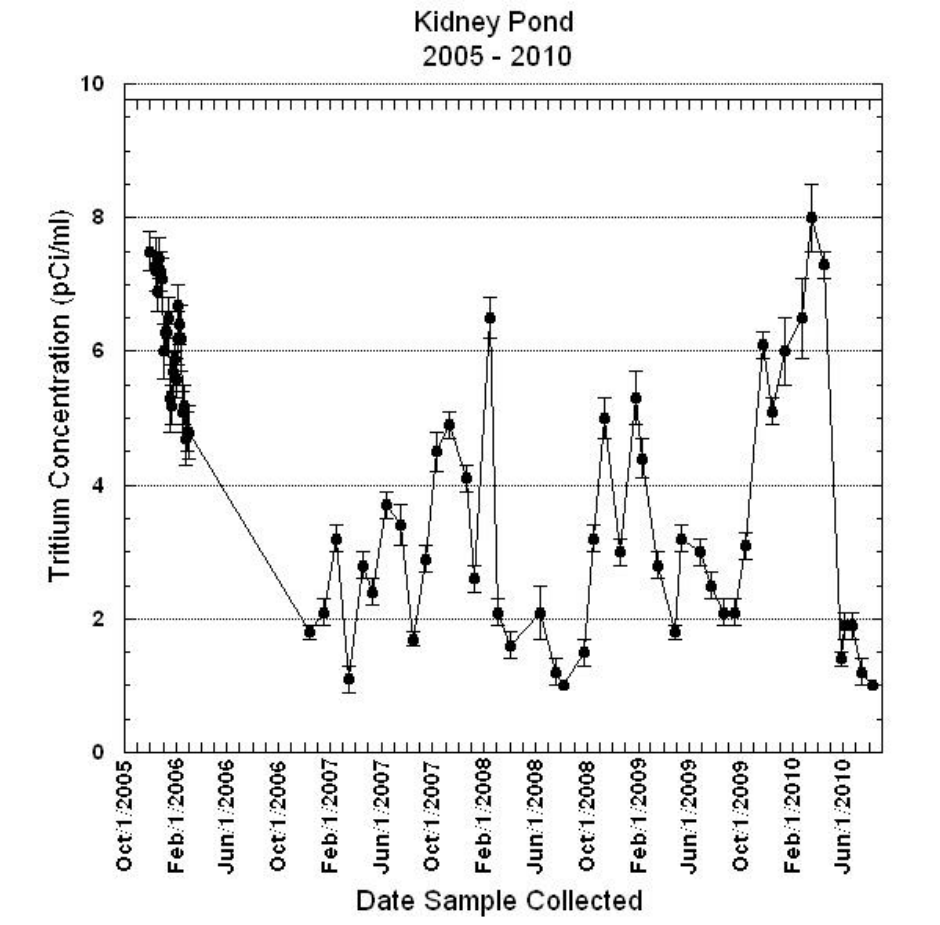
Detectable discharges could happen again, in compliance with our permit.

Operating at higher intensity



Since 2005, the proton beam intensity for NuMI/MINOS approximately doubled.

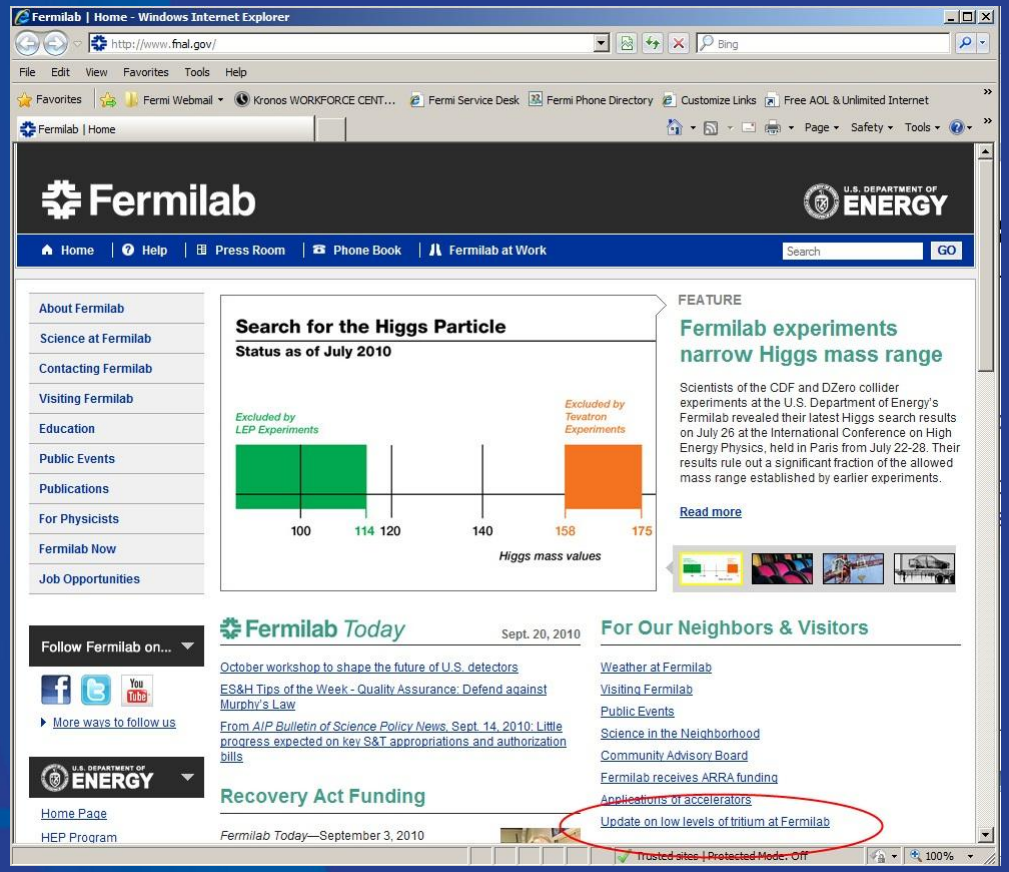
More beam, not more tritium



Despite the doubling of the beam intensity, we managed to keep the amount of tritium entering the Fermilab pond system for most of the time below the 2005 levels.

Valuable lessons for LBNE!

Keep public informed



We regularly post the results of our tritium measurements at the site boundary on the Fermilab Web site.

A link is on the Fermilab home page.

What else should we do?

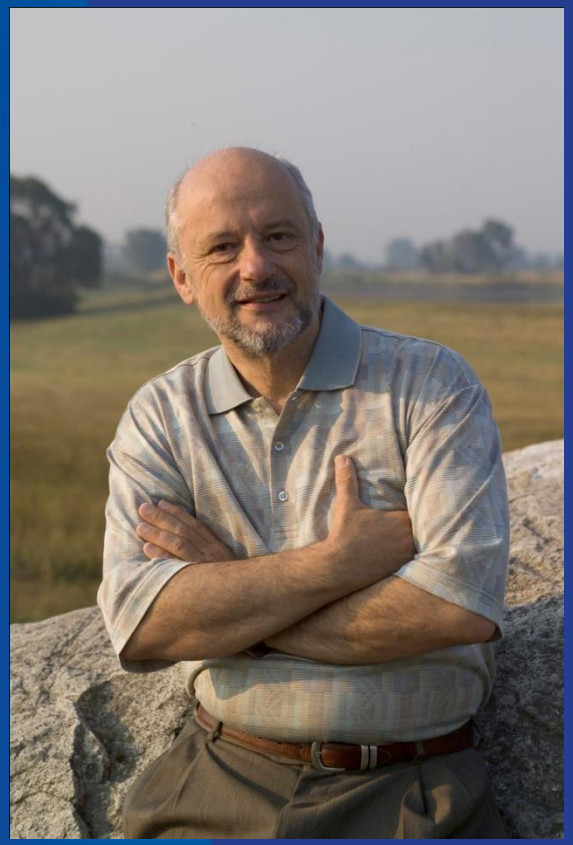
Fermilab's future

- Fermilab hopes to construct new accelerators and experiments for research at the Intensity Frontier.
- Openness, honesty and transparency (about tritium, about everything) are key to that future.

Lessons learned.

- Communication with full transparency helps everyone and builds trust.
- Get help from experts. You don't have to do it by yourself.
- It's not as bad as you think.
- Question every experiment!!!! (more than once)
- It's good to have a community group behind you when you need them.

More lessons…



Fermilab Director
Pier Oddone

Support for open communication must come from the top.

You can't pick and choose the issues: open or not open, those are the options.

Openness is a culture, not an isolated event.

There may (will) be problems along the way, but ultimately openness means nothing to fear.

How the CAB can help

Members of the Community Advisory Board are one of Fermilab's connections to the community.

- How should we keep the community informed and maintain a dialogue? (A lot of time has passed since the newspaper articles in 2005.)
- What recommendations do you have, in particular regarding the proposed LBNE, Project X?
- Does the community consider Fermilab a good steward of our site? Which stakeholders should we keep informed? Can you help us communicate with stakeholders?