Tritium and the Lawrence Livermore National Laboratory

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INTRODUCTION:

Tonight I'm going to talk about tritium and, in about 15 minutes, I will briefly cover 4 things:

1. What is tritium and how is it biologically harmful?
2. What is the history of tritium use at Livermore Lab and how has tritium gotten into our environment?
3. What are the plans at Livermore Lab to increase tritium use, and how might that affect us in the future? And,
4. What are some actions we in the community can take to protect our health and environment?

WHAT IS TRITIUM?

Tritium is radioactive hydrogen; essentially it is the hydrogen of the hydrogen bomb. At the atomic level, tritium has 1 proton and 1 electron (same as regular hydrogen) plus two neutrons. This makes tritium slightly heavier than ordinary hydrogen – and also unstable, i.e. radioactive.

Tritium has a radioactive half-life of just over 12 years. A radioactive half-life is the amount of time it takes for one half of the material to decay into another element. Tritium decays to helium and emits a beta particle (and a neutrino) in the decay process. So, you will hear tritium referred to as a beta emitter (See Abel's slide).

HOW IS IT BIOLOGICALLY HARMFUL?

Biological damage is caused by the beta particle (which is the ionizing radiation part of the damage) and additional damage can be caused by the helium3 particle, which imparts what is called "point mutation" to the organism. The bottom line here is that radioactive tritium, if incorporated into the body, causes cellular and genetic damage that can lead to a wide range of diseases and death.

HOW HAS THE TOXICITY OF TRITIUM BEEN UNDERSTATED?

Tritium radiobiology is complex. To summarize much of the recent literature on the impacts of tritium to biological systems, I've brought a paper by Tore Struame, who used to work at Livermore Lab. This paper was published in Health Physics in 1993 – and I have copies of the abstract to hand out.

Straume writes: "It is clear from the wealth of tritium data now available that relative biological effectiveness values for tritium beta rays are higher than the 'quality factor' of unity generally used in radiation protection."

Struame's research and analysis suggests the so-called quality factor for tritium should be set between 2 and 5 – I would say at least 3 -- and certainly not at 1 which is currently the case.

In 2001, Dr. John Gofman sent me a memo (copies are on the table) citing some of the same research along with his own research -- and commenting that tritium is 4 to 5 times more mutagenic than had previously been believed.

In plain English, this means that (a) tritium is dangerous, and (b) current regulations for tritium emissions are set way too permissively. I'll come back to the issue of regulatory agencies and regulations in a minute. For now, I want to highlight simply that any Livermore Lab official, or anyone else for that matter, who tells you that tritium is "not that dangerous" is not correct – and is not taking the scientific research done over the past 15 years into account.

I brought about a dozen major studies on tritium toxicity that I grabbed from the office before I came tonight. Feel free to take them from the table, or make arrangements to borrow copies from the TVC office in the future.

TRITIUM'S INCREASED TOXICITY AS HTO; INCORPORATION INTO BODY:

The International Commission on Radiological Protection (ICRP) and other scientific bodies state unequivocally that tritium becomes 25,000 times more biologically toxic when it is in the form of tritiated water or vapor, called HTO, than when it is in its gaseous form. The studies show that almost all tritium, once it enters the environment, no matter what form it started out as – ultimately becomes tritiated water, or HTO, in the environment.

Moreover, the studies show that when tritiated water enters the body its absorption is essentially 100%, the same as regular, non-radioactive H2O. The ICRP, for example, says that the absorption of tritium from the gut into the blood of a human is instantaneous and complete. Within minutes of exposure, the tritium can be found in various concentrations in multiple organs and fluids throughout the body. This ability of tritium to get into body organs just like regular water also means that tritium can cross the placenta in a pregnant woman to her unborn child.

The amount of time it takes for one-half of the tritium that gets into your body to leave ranges between 4 days and 550 days, depending on the organ. Then, it takes another 4 days to 550 days for one-half of what's left to leave – and so on.

This is called the biological half-life (as distinct from the radioactive half-life). The entire time that tritium is in the body, it is, of course, decaying and throwing off beta particles and forming helium 3 – both causing biological damage. A cell that has been caused to mutate may then replicate wrong – or may send signals to other cells that causes them to go awry – this is a very, very simplified description of the biological impacts of ionizing radiation, which Abel more comprehensively described.

The bottom line here is the fact that tritium is so quickly and completely absorbed by the body once you are exposed to it. This is very important in understanding the true biological and health risks of tritium – and in understanding why we must prevent Livermore Lab from dumping more of it into our community's air, soil and water.

TRITIUM – DIFFUSES THROUGH ANYTHING, HARD TO CAPTURE:

To quote from Okada and Momoshima, Health Physics, 1993: Overview of Tritium: Characteristics, Sources and Problems: (hand out) "Tritium has certain characteristics that present unique challenges for dosimetry and health-risk assessment. For example, in the gas form, tritium can diffuse through almost any container, including those made of steel, aluminum and plastic. In the oxide form, tritium can generally not be detected by commonly used survey instruments. In the environment, tritium can be taken up be all hydrogen-containing molecules."

TRITIUM USE AT LIVERMORE LAB:

Tritium has routinely been used for nuclear weapons and other experiments at Livermore Lab. For example, until 1991, Livermore Lab filled the reservoirs here for its nuclear bomb tests in Nevada. This operation involved using tritium under very high pressures (which is relevant to the current Livermore Lab proposal to fill the tritium targets for the National Ignition Facility here on site – as that would involve high pressures too).

Put simply, tritium use at Livermore Lab has always meant tritium emissions into the surrounding area – no exceptions. More tritium use at Livermore Lab in the future will mean higher levels of tritium contamination in the future. Let me cite a few examples – feel free to ask additional questions about Livermore Lab's many tritium releases following the presentations.

Two of the three biggest tritium accidents that I have seen documented anywhere happened here at the Livermore Lab main site. In 1965 and 1970, Livermore Lab released about 650,000 curies of tritium into the air from the stacks of the tritium facility (Building 331). Note: one curie is equal to 37 billion radioactive disintegrations per second.

Not much data about wind pattern, rainfall etc. is available from the 1965 accident, but after the 1970 accident, Livermore Lab scientists found elevated levels of tritium that they associated with their 1970 accident as far away as Fresno (about 200 miles away!).

Dr. John Gofman's memo in 2001 points out that with a radioactive half-life of just over 12 years, much of that tritium is still in the environment today. Gofman originally estimated that those two releases would be associated with 120 cancers and 60 cancer deaths. In his 2001 memo, Gofman stated that if he were to redo those calculations using present-day scientific knowledge, the predicted cancer outcomes would be much worse!

Further, the work done by Abel and his colleague Dr. Rob Goble showed that if Livermore Lab and ATSDR had used the federal EPA health protective guidelines to analyze the impact of those two accidents, they would have found what's termed a "health concern." Some of you may recall that the Lab and ATSDR touted an analysis that had a plethora of scientific and analytical defects, including that it violated the basic principle of health physics – which is that there is no safe dose. And, the ATSDR study did not use the mainstream-accepted linear-no threshold model to calculate effects.

Further, on the table, I have provided copies of a DOE memo of 12/22/88. It reveals that the "routine" releases from the Livermore Lab tritium facility between 1981 and 1988 averaged "about 3,000 curies per year."

That's a huge amount of radiation. There are several other things notable about the memo. (1) It touts a new tritium capture system THAT WE NOW KNOW DID NOT WORK. It simply did not operate as planned. It did not effectively capture tritium. This underscores my point that the more tritium they use at Livermore Lab, the more will get out into the environment. (2) You will also notice in the memo that DOE used the high number of 100 millirem/year as OK – calling it "DOE's primary radiation protection standard for the public." Again this is much higher that the EPA recommendation.

I also have a DOE report from 1991 that listed a number of tritium accidents at Livermore Lab. Most of these released between 100 and 600 curies of tritium at a time, and many were for reasons that would be relevant to the present plan to fill tritium targets for NIF on-site. Some of the accidents were due to pump failures, cryogenic vessel breaches, stack monitor malfunctions, improper pressure relief of a container, etc. You can find

a more complete list in Tri-Valley CAREs' 63-page comment on the DOE's SWEIS on Livermore Lab operations – which is up on our web site.

TRITIUM AT LIVERMORE LAB MAIN SITE – WHAT'S IN THE ENVIRONMENT:

The groundwater at the Livermore Lab main site contains tritium, principally near the old radioactive materials storage and treatment yard off East Ave., and near Building 292, the old rotating neutron target source facility (east of Vasco Road) – though tritium has been detected at other locations in groundwater as well.

The airborne tritium has been measured in rainfall at the main site at a concentration of up to 187,000 pCi/Liter -- which is roughly 9 times the state and federal maximum contaminant level (MCL) for tritium in water.

High levels of tritium have been found historically in Livermore Valley wines. In 1989, Livermore wines that Livermore Lab bought off the shelf and analyzed had nearly 4 times more tritium than other CA wines. Honey and milk also showed elevated levels of tritium.

It is worth noting that in the past decade or so, Livermore Lab had begun using LESS tritium in its operations – and the levels of tritium in our community environment have gone down correspondingly. This is the right trend!

And, this is why it is so unconscionably dangerous for DOE and Livermore Lab to now propose to dramatically INCREASE activities with tritium on site – thereby threatening the future health of our community.

PLANNED TRITIUM ACTIVITIES AT LIVERMORE LAB:

As active TVC members know, the DOE at the end of last year published a Record of Decision on Livermore Lab operations following publication of a Site Wide Environmental Impact Statement (SWEIS). What is planned for tritium at Livermore Lab is truly shocking.

First, the DOE increased the tritium storage limit at Livermore Lab from 30 to 35 grams. Additionally, DOE increased the "at risk" limit for tritium nearly 10-fold -- from 3.5 grams to 30 grams!

"At risk" is the term used to describe the amount of a radioactive material that the Lab is allowed to have in use in a single room at any given time. In short, "at risk" means the amount most vulnerable to being released in an accident at any given time.

Further, the SWEIS admits that Livermore Lab expects to increase workers' radiation exposure 3-fold and also the Lab expects to increase community exposures more than 3-fold, meaning that the radiation exposures will be more than three times higher than at present. Much of this increase will be because of tritium activities and releases.

What is Livermore Lab planning to do with this tritium? One activity mentioned in the SWEIS will be to manufacture and fill the targets for the NIF here at the Livermore Lab. According to a review of the NIF by the JASONs, Livermore Lab is planning to attach "fill tubes" to each tiny target and attempt to get the deuterium-tritium fuel mix under extreme pressures into each target by that method. Marion Fulk, a retired physicist from Livermore Lab, and others have pointed out to me that this operation is likely to result in a large percentage of the gaseous tritium getting airborne.

A related activity, also mentioned in the SWEIS, is to add plutonium to the mix of shots in NIF. According to

the SWEIS, some of the shots may have plutonium and tritium collocated on the same target. These special targets will also have to be fabricated in the Lab's tritium facility and, like the D-T fusion fuel targets, they will be transported from Bldg. 331 across the Lab to the NIF where they will then have to be inserted into the NIF target chamber (a complex and difficult task) before being blasted by the laser light from the 192 laser beams.

From manufacture and filling of targets, to loading the shots, to exploding the targets, to the radioactive debris and waste that will be the end result -- there are many opportunities for both accidental and "routine" releases of tritium with the NIF project.

In order to carry out these NIF activities, the Livermore Lab is undertaking a massive new project, called the "Tritium Facility Modernization" project. The DOE gave this project a "Categorical Exclusion" (CX) which means that the DOE did not conduct any detailed analysis of this project in the SWEIS. (I have placed copies of the Categorical Exclusion document on the table -- and more are available from the TVC office).

Tri-Valley CAREs used the Freedom of Information Act to obtain documents outlining the Tritium Facility Modernization Project. It is truly a major and very dangerous operation -- for both Livermore Lab workers and the surrounding public. Let me describe some of what is in these documents.

1. In the name of "modernizing" the Lab is actually tearing down much of the interior of the existing tritium building (which is hazardous because the piping, pumps, gloveboxes, hoods and ducts that Livermore Lab says it will demolish are so heavily contaminated with tritium from past operations).

2. Modification of the labs in the tritium facility will include what Livermore calls "enhancing access" for large cryotransporters -- which are for NIF -- and large doorways can mean easy exit for tritium.

3. Construction for the Tritium Facility Modernization Project includes Increment 1 (which is for actinide research -- meaning plutonium work in the tritium facility -- again, related to the decision to use plutonium with tritium in NIF. Then, Increment 2 is for enhanced tritium operations. According to the Categorical Exclusion (CX) document, this will result in about 7,000 square feet of tritium lab space in Building 331.

4. In addition, the CX includes mention of a Butler building approximately 6,000 square feet in size to be installed in the paved area on the east side of Building 331. This Butler building will be for staging, storage and maintenance of "large user devices." (Show blueprints).

Other documents we obtained through FOIA suggest that the doors and windows in the Tritium Facility will only be rated for a 20-minute fire. The document, called the Basis for Design 35% Review, also says that doors between Building 331 and the pre-engineered metal building will be similar (20 minute fire protection) but "non-rated." (The documents don't say for certain, but I suspect the pre-engineered metal building in the later set of documents is what the CX was calling a Butler building -- although it appears to be fewer square feet.)

Another document discusses a floor drain being added to the design for the pre-engineered metal building -- and it talks about contaminated water from the cryogenic transporters going down the drain.

Other documents we received from FOIA say is that construction has been delayed one year -- and will now start early next year -- in spring 2007.

A June 13, 2005 project report contains this description -- (hand out). "The Tritium Facility Modernization project (TFM) will provide enhanced hydrogen isotope research capabilities to meet the growing programmatic

need to perform R&D work at elevated pressures, high purities, and cryogenic-to-high temperatures. The project includes upgrading and modernizing the tritium handling capabilities in the existing Tritium Facility, B331. Approximately 3,100 sq. feet of laboratory space will be modified and renovated to support installation of gloveboxes, support equipment, utilities and other services necessary for handling tritium, deuterium, and deuterium-tritium (D-T) mixes. A pre-fabricated metal building, approximately 2,200 sq. feet in size, will be installed on the east side of the building to stage materials and equipment prior to entry into B331. The project scope also includes removal of contaminated parts and equipment such as gloveboxes, hoods, piping, pumps and cable trays."

In short, this is a HUGE project -- with major potential for tritium releases -- even the short, 5-page CX admits increases in tritium emissions because of the project and the activities I described -- and yet the whole thing is going forward with essentially no environmental review and NO public hearings or public input into decision-making.

WHAT CAN THE COMMUNITY DO

Fortunately, there are things we can do to prevent more tritium from getting into our community. Here are several ideas:

1. Most of the increases proposed for tritium use at the Livermore Lab are for the National Ignition Facility mega-laser -- the biggest project being the filling of the tritium targets on-site. So, one way to address this problem is to stop the National Ignition Facility. This mega-laser has cost about $4 billion in construction and construction-related R&D so far -- and it is not finished. The life-cycle price tag for NIF is estimated to be more than $30 billion -- and the cost is still rising. Moreover, most independent scientists believe that NIF will never achieve its scientific goal of ignition -- making it the mega-billion dollar National Almost Ignition Facility. And, finally, the plan to add plutonium to the experiments on NIF reveals what we have always known to be true -- its major purpose if for nuclear weapons. Therefore, one action people can take is to ask Congress to stop funding the NIF.

2. The Tritium Facility Modernization Project is, as I said, a huge undertaking -- and the Lab is proceeding without public hearings or a stringent environmental review. We, the people in the community, can insist that the project be halted while Livermore Lab analyzes the health and environmental impacts. Further, we can insist that public input be made part of decision-making. After all, it is our health and our community. Ethically-speaking, Livermore Lab ought to be consulting in an open and democratic fashion with the surrounding community on issues that could impact us and our families -- and I don't see that happening here.

3. We can work together to strengthen the California state and federal limits for tritium contamination in the environment. As you may know, the present state and federal maximum contaminant level (MCL) for tritium in drinking water is 20,000 pCi/Liter -- which Tri-Valley CAREs believes is way too high. -- and the scientific evidence I discussed at the beginning of my talk supports TVC in saying that a 20,000 pCi/liter concentration limit is set too high.

   So, here is the good news -- as some of you know, Tri-Valley CAREs has been working on the Superfund cleanup of polluted soil and groundwater at Livermore lab including tritium contamination issues. And, we have attended CA state workshops on creating more health protective standards for tritium and other contaminants in our environment.

The State of California Office of Environmental Health Hazard Assessment of the CA Environmental Protection Agency has just promulgated a new "Public Health Goal" for tritium in drinking water. The state's new public health goal has just been posted on the web -- and it is 400 pCi/Liter -- which is 50 Times LOWER than the current MCL. I have just gotten word from one of the regulators that the CA Regional Water Quality Control Board has adopted the new Public Health Goal of 400 pCi/Liter as a state "water quality objective."

This new Public Health Goal is backed by a 29-page technical statement that summarizes a number of the recent scientific studies I mentioned earlier (hand out).

While having a new Public Health Goal does not in and of itself change the state's maximum contaminant level -- it DOES give us as community members a 'handle' to talk to the state and federal government about changing the legal limits and making them more stringent.

So, for those of you who are Tri-Valley CAREs members, I appreciate your continuing participation in making our community -- and the world -- a more peaceful and healthy place.

And, to community members who have not met us before this evening's workshop-- I welcome your participation. Call us for more info -- and feel free to come to our office, come to a monthly meeting (there will be one here tomorrow) or check us out on the web at www.trivalleycares.org.

With that, I'd like to turn the floor over to Loulena Miles, TVC staff attorney, who will discuss plutonium and its use at Livermore Lab…

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