Vermont Department of Health

Proposed Changes to the Radiological Health Rule

Guidance • Support • Prevention • Protection

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VERMONT
DEPARTMENT OF HEALTH

This Presentation

- I will broadly discuss radiological health protection and then specific components of the rule change.
- I will NOT describe each component of the proposed revision to the Rule tonight for purposes of time, but all components are open for comment at the March 9 meeting or in writing until March 23.
- I cannot go into every slide of this presentation in detail tonight, but copies as a handout are available to all to take home and read.
- I will answer questions after this presentation both tonight and by email at: wirwin@vdh.state.vt.us

The Fundamentals of Radiological Protection and Radiation Dose

Radiological Health Protection

- Perhaps no other potential source of risk to human health is more studied and better understood than is the risk from exposure to radiation.
- Multiple generations of tens of thousands of persons have been studied to define the mechanisms and magnitude of these risks.
- Numerous international and national panels of experts have helped promulgate ever more protective radiological health guidance over more than 100 years.

Human Health Risks from Radiation

- Ionizing radiation is a known human carcinogen - leukemia and cancers of the thyroid are particular concerns.
- Generally, the younger a person is, the more protection must be provided. Children's cells are more sensitive to radiation effects, and there is more time for effects to develop.
- Acute exposure effects are a risk with medical radiation therapy and major nuclear accidents.

Risks from Radiation Exposure

- People exposed to very high radiation doses in a short time may suffer acute effects (tens of thousands of millirem in minutes or hours).
- This is only likely as a result of medical therapy or the most severe nuclear emergencies.
- People exposed to low levels of radiation may have an increased risk of cancer.

Absorbed Dose

- People do not absorb all the radiation to which they are exposed.
- The amount of radiation absorbed is the dose.
- It is the dose that is monitored to assess the level of risk.
- The lower the dose, the lower the risk.
- Though no dose is absolutely without risk, doses for a lifetime at or below the public limits established by Federal regulators are unlikely to have any measurable adverse health consequences.

Managing Radiation Risks

- Radiation doses are limited under Federal law from highest to lowest doses according to whether a person is:
  - A radiation worker (occupational dose);
  - A radiation worker who is also a declared pregnant woman;
  - A radiation worker or student under the age of 18; or
  - A member of the public.

Public Dose Limitation

- Patient doses for medical therapy are managed by physicians.
- Public radiation doses from nuclear reactors in the US are regulated by the US Nuclear Regulatory Commission (NRC) and the US Environmental Protection Agency (EPA).
- Only one state has separate public dose limits for a nuclear reactor, and that is Vermont.
- Vermont's dose limits for the Vermont Yankee Nuclear Power Station (VYNPS) site boundary are one-fifth those established by the NRC.
- The site boundary dose limit west of VYNPS in Vermont is 20 millirem per year, while the limit east of the station in New Hampshire is 100 millirem per year.

Radiation Dose Determination

- Radiation dose limits are expressed in units of dose equivalent (rem or millirem).
- Dose equivalent is not directly measured. Typically,
  - External radiation exposures in air are measured, the absorbed dose in tissue is calculated based on numerous variables, and the dose equivalent in human tissues is calculated on the basis of radiation type.
  - Internal radiation exposures from radioactive materials in the body or on a path to the body are measured, the actual or potential absorbed dose from those materials is calculated based on numerous variables, and the dose equivalent in human tissues in calculated based on the radiation type.
- The total effective dose equivalent is determined by adding the internal and external dose equivalents.

External Exposure Measurement

- External exposures are measured in air with:
  - Instruments assigned individually to a person, or
  - Instruments that characterize radiation levels in locations where people may be exposed.

External Exposure Measurement

- A common unit of external radiation exposure is the roentgen.
  - One roentgen is equal to 2.58×10^{-4} coulombs per kilogram of air at standard temperature and pressure.
  - The radiation energy measured in air is not equal to that absorbed in air.
  - The energy absorbed in air is not equal to the energy absorbed in human tissues.

Internal Exposure Measurement

- Internal exposures may be determined by
  - Measuring the radiation from radioactive materials within a person's body,
  - Measuring the radioactivity in samples taken from their body, or
  - Measuring the radioactivity in samples from the environment that people may ingest.
- The unit of measure for radioactive materials or radioactivity is the curie (Ci), the number of radioactive disintegrations per second (dps).
  - 1 Ci = 3.7×10^{10} dps.

Calculating Absorbed Dose

- From the measured exposure in air or from samples, the absorbed dose in tissues of the body is determined.
- Extensive, well-tested guidance from international and national experts has been published for this purpose. Most is from the National Council for Radiation Protection and Measurements (NCRP) and its collaborating organizations, one of which is the American Nuclear Society (ANS).
- In the end, the absorbed dose is the specific amount of radiation energy absorbed divided by the specific mass of material that absorbed it.
- Absorbed dose is measured in joules per kilogram (J/kg). The unit of absorbed dose is the rad. 1 rad = 0.01 J/kg.

Factors in the Calculation of Dose from Instrument Measurements

- The ***type of radiation*** and the ***energy or spectrum of energies*** measured;
- The ***size and shape of the source*** of radiation ***and*** the ***detector***;
- The ***scattering*** characteristics in the radiation/detector environment;
- Differences in ***temperature, humidity and atmospheric pressure*** of the detector and the radiation environment;
- Inherent ***limitations of the detector*** including its lower limit of detection;
- ***Characteristics of the different tissues*** (varying thicknesses and densities of muscle, fat and bone) that may absorb the detected radiation;
- The ***physiological responses*** of the tissue, organ or whole body absorbing the radiation, including those of damage and repair.

Calculating Internal Dose

- Internal dose is called committed dose equivalent (CDE).
  - Because the radioactive material is inside the body, the person must get dose from it (is committed to it).
  - Materials are physiologically and kinetically traced throughout the body for dose effects.
  - The 50 year dose is calculated for each of the organs affected and summed (a 50 year time frame for dose delivery within the body is considered adequate for the majority of radioactive materials).

Calculating Internal Dose

- Before any internal dose is added to any external dose to come up with a total whole body dose, the organ doses must be converted to equivalent whole body doses.
  - The dose to an organ, for example the thyroid, may present risk to the organ and to the person as a whole.
  - The effective dose to the whole body from an organ dose is calculated using organ weighting factors, and is called committed effective dose equivalent (CEDE).
  - For example 3% of the thyroid dose (CDE) is assigned as a whole body dose (CEDE).

Calculating Dose Equivalent

- This is actually the simplest step; calculating absorbed dose from exposures is the most complicated.
- Dose equivalent accounts for the fact that for each kind of radiation – alpha, beta, gamma, X-ray or neutron – the same absorbed dose in rads has a different biological effect.
- Dose equivalent is calculated using what are called quality factors.
  - Alpha 20*
  - Beta, gamma, X-ray 1
  - Neutron 10*
- The dose equivalent in rem is equal to the absorbed dose in rads times the quality factor.

*A rad of alpha radiation harms the body 20 times worse than beta, gamma and X radiation, and twice as much as neutron radiation.

Total Effective Dose Equivalent

- Calculated absorbed doses and dose equivalents from internal exposure measurements and from external exposure measurements are summed to arrive at total effective dose equivalent (TEDE).
- Occupational and public dose limits are expressed in terms of TEDE.
- The unit of TEDE is the rem.

Dose Regulation

Federal Regulation

- The primary regulators of radiation sources for health and safety purposes are the US Nuclear Regulatory Commission (NRC), the US Environmental Protection Agency (EPA) and the States.
  - The NRC regulates all aspects of nuclear reactor sources of radiation, as well as many other sources of radiation. The regulations are in Title 10 of the Code of Federal Regulations (10 CFR)
  - The NRC ensures its licensees comply with EPA regulations on public doses in 10 CFR Part 50.
  - EPA's relevant regulations are in 49 CFR.

NRC and EPA Reactor Dose Limits

- The NRC has a site boundary dose limit of 100 millirem (0.1 rem) per year.
  - This is from all sources, not just direct gamma radiation.
  - It controls doses on the basis of area restriction.
  - It is why the dose at the site boundary in NH is often well above 40 – 50 millirem (0.04 – 0.05 rem) per year.

NRC and EPA Reactor Dose Limits

- The EPA has a dose limit of 25 millirem (0.025 rem) per year.
  - This is also for all sources, not just direct gamma radiation.
  - The NRC enforces this in its regulations as well.
  - For VYNPS, nearly 100% of the calculated public dose in annual reports to the NRC is from direct gamma radiation.
  - This is the dose as calculated for a real person, not that calculated for an area such as a site boundary.

State Regulation

- 35 States regulate all other sources of radiation in their State under an agreement with the NRC.
- 15 States share regulation of the sources of radiation within the State with the NRC.
  - Vermont is one of these states.
  - In Vermont, the NRC regulates 41 accelerator-produced and reactor byproduct radioactive material uses, while the VDH regulates another 400 or so medical and industrial users of radiation.
- Vermont statute provides that the Department of Health regulate sources of radiation not regulated by the NRC.

Vermont Regulation

- The Department of Health is the designated state agency with authority to regulate sources of ionizing and nonionizing radiation.

Vermont Regulation

- The Department of Health regulations establish maximum limits.
  - For Vermont Yankee, the limits are essentially identical to the EPA for a real person – 25 millirem (0.025 rem) per year from all sources.
    - *However, Vermont only allows 5 millirem (0.005 rem) from direct gamma radiation*
    - *The EPA limits allow all 25 millirem from direct gamma radiation if there was no dose from other sources.*

Vermont Regulation

- The Department of Health regulations establish maximum limits.
  - For Vermont Yankee, the NRC and State limits for the site boundary are vastly different:
    - *The NRC allows 100 millirem (0.1 rem) per year from all sources, and most comes from direct gamma radiation; while*
    - *The State of Vermont allows only 20 millirem (0.02 rem) from direct gamma radiation.*

VDH Regulation of VYNPS

- The Department is revising its Radiological Health Rule.
- The proposed Rule and a copy of the annotated (marked up) original Rule may be found at (www.healthvermont.gov) under Radiological Health.
- The Department is holding a hearing for public comments from 6 – 9 PM on March 9 at Vernon Elementary School.
- The Department is also taking written public comments until March 23, 2009.

Sections of the Rule

- Section 5-301 Purpose
- Section 5-302 Scope
- Section 5-303 Definitions
- Section 5-304 Exemptions
- Section 5-305 Standards
- Section 5-306 Inspections
- Section 5-307 Enforcement
- Section 5-308 Registration
- Section 5-309 Transportation

Key Changes in the Rule

Purpose

- Sets maximum limits in terms of the dose an individual receives from ionizing radiation.
- Retains the maximum limit at one-fifth that of the NRC site boundary dose limit.
- Explicitly recognizes scientific methods of determining these doses from surveillance activities, including the use of dose conversion factors.

Definitions

- Adds new of definitions from the NRC's regulations in Title 10 CFR Part 20.
  - Provides consistency with other states and the NRC; and
  - Clarifies the regulatory language by expanding from the 11 definitions in the current Rule to 44 in the proposed revision of the Rule.
  - Many of these definitions were explained in the opening fundamentals section of this presentation.

Non-VY Dose Limits

- Improves organization of the rule - all the annual dose equivalent limits for sources other than VYNPS are contained in one section of the Rule:
  - 0.1 rem (100 millirem) for workers under age 18;
  - 0.1 rem (100 millirem) for members of the public;
  - 0.5 rem (500 millirem) for the fetus of a declared pregnant worker; and
  - 5.0 rem (5000 millirem) for other workers.

VYNPS Dose Limits

- Similar to the EPA limit of 25 millirem (0.025 rem) per year from all sources, VY is limited to no more than 5 millirem (0.005 rem) per year from each of the following sources of dose:
  - Gaseous discharges;
  - Liquid discharges;
  - Radioiodine discharges;
  - Radioactive particulate discharges; and
  - Emanations of direct gamma radiation.

VYNPS Direct Gamma Radiation Limits

- A calculated dose equivalent of 20 millirem per year at any point on the site boundary bordered by land shall be considered equivalent to a 5 millirem dose equivalent at the nearest residence in Vermont.

- There is a further restriction that no quarterly calculated dose equivalent at the site boundary shall exceed 10 millirem.

Determinants of Compliance

- VYNPS submittals to VDH:
  - Annual reports on all discharges and direct gamma radiation.
  - Monthly reports detailing surveys and calculations of direct gamma radiation.
  - Site boundary dose instrument calibration records.
  - All reports relevant to its Off-site Dose Calculation Manual (ODCM).
  - Reports of calculated doses from all sources using its ODCM.
  - Other information relevant to site boundary dose as requested by VDH.
- Independent measurements for determination of dose by VDH through its environmental surveillance program.
- Ongoing compliance evaluation using the VYNPS calculations of off-site dose and the VDH determinations of site boundary dose.

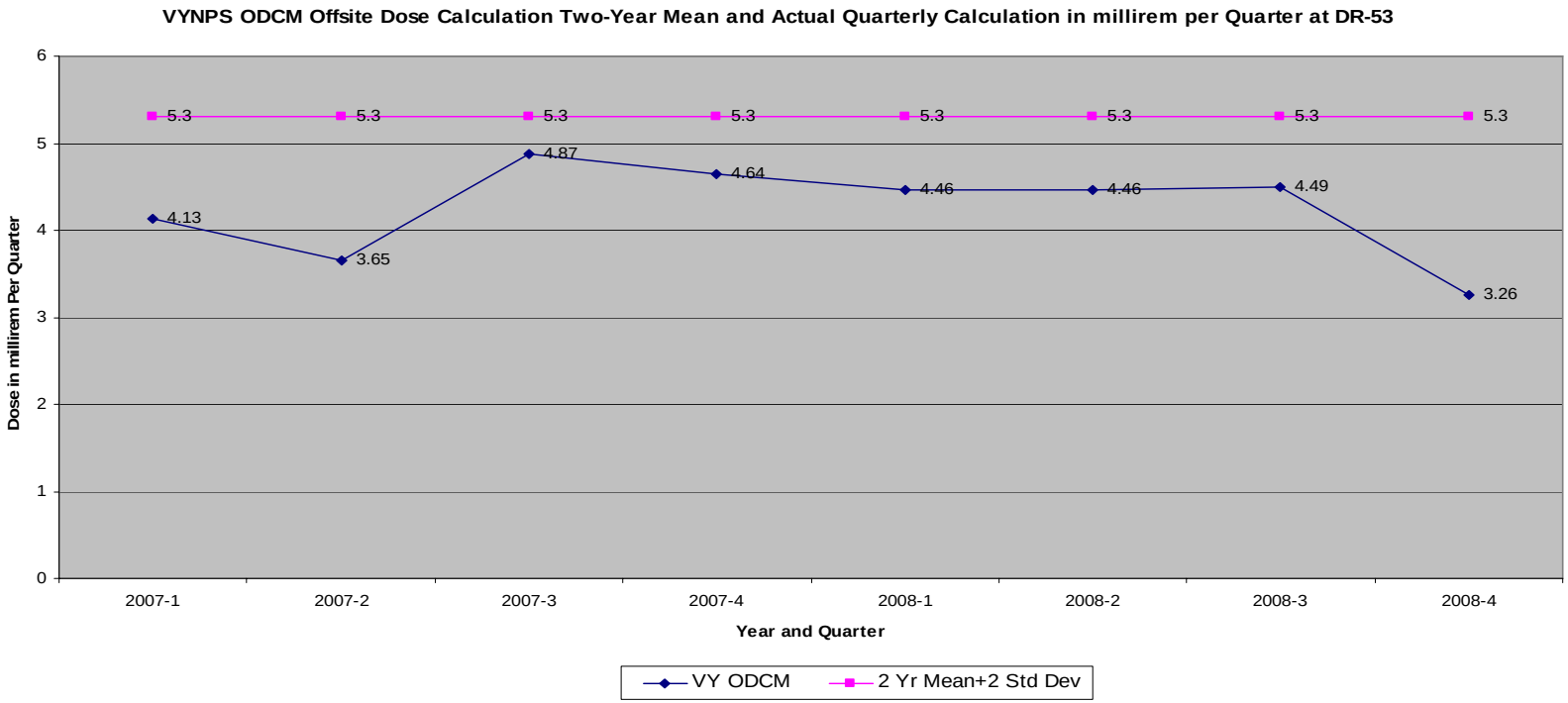
On-going Compliance Monitoring for Direct Gamma Radiation Dose

- Mean VYNPS ODCM calculated offsite doses, calculated doses from VDH measurements at the site boundary for the preceding 24 months and the ratio of the two are computed.

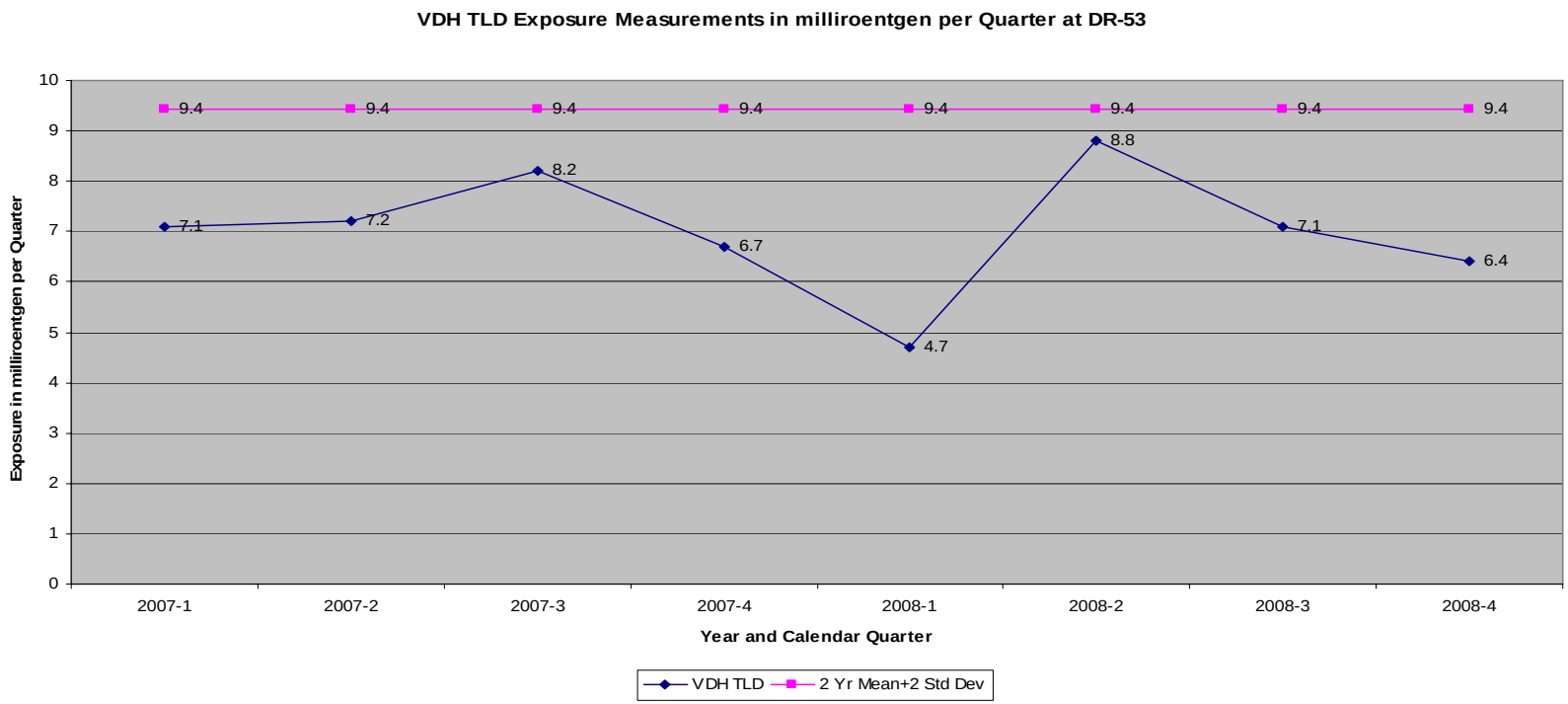
- Actual ODCM calculated doses, actual VDH calculated doses and the ratio of the two are compared to the past mean values to verify actual radiation levels are within limits.

- If the on-going comparisons indicate VYNPS calculations and VDH determinations are not consistent (within two standard deviations of the previously calculated means), enforcement actions are taken by VDH.

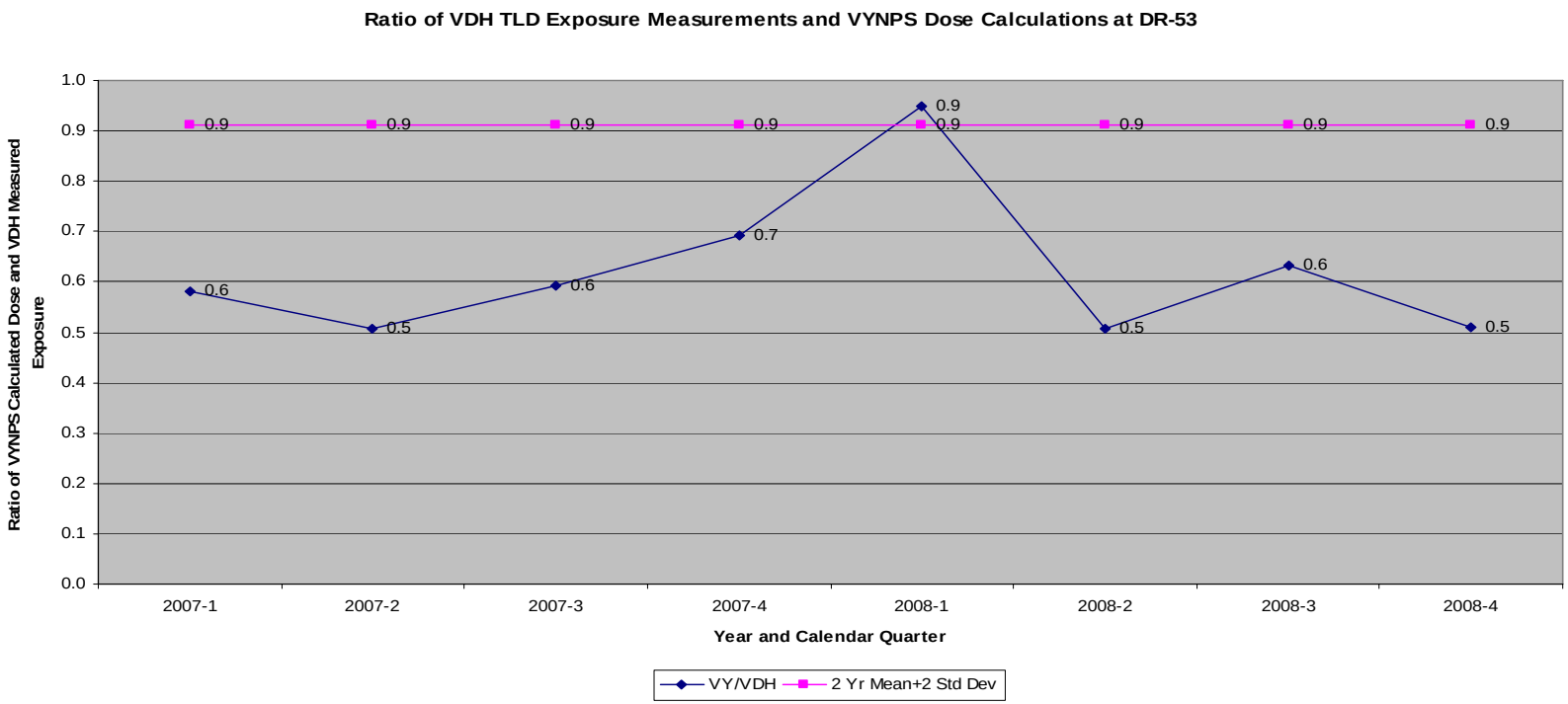
Sample Comparison of Actual and Two Year Mean Quarterly Doses From VYNPS ODCM Calculations



Sample Comparison of Actual and Two Year Mean Quarterly Exposures From VDH TLDs



Sample of Actual and Two Year Mean Ratios of VYNPS ODCM Calculated Doses and VDH TLD Exposures



Enforcement Actions

- Notification to radiation user of indicated noncompliance which identifies:
  - Required actions to take to regain compliance, including:
    - *Interim actions,*
    - *Further investigation of circumstances giving rise to the notice, or*
    - *Ceasing use of the source of radiation*
  - Time frame within which required actions must be completed.

Enforcement Actions

- If the regulated entity fails to comply, VDH may:
  - Refer the matter to the Attorney General for injunction proceedings;
  - Take immediate corrective actions for emergency situations;
  - Initiate proceedings before the Board of Health where an order may be issued; or
  - Take other actions as the Commissioner finds appropriate.

The VDH Environmental Surveillance Program

A Program of Depth and Breadth

- The Department has been evaluating the environment around VYNPS and potential risks to the public from operations since before the plant starting operating in 1972.
- Today, more than 1300 samples and measurements are made each year of radioactivity in air, groundwater, drinking water, dairy milk, wild and cultivated vegetation, soil and sediments.
- There is extensive public reporting of the measurements and their relationship to public dose limits from discharges and direct gamma radiation. This year's report may be found at healthvermont.gov.
- Analysis of samples has consistently demonstrated that there have been no significant doses from liquid, gaseous, particulate and radioiodine discharges.
- Direct gamma radiation has always been the highest source of public dose at the site boundary, so the Department employs an extensive network of independent compliance monitoring instruments.

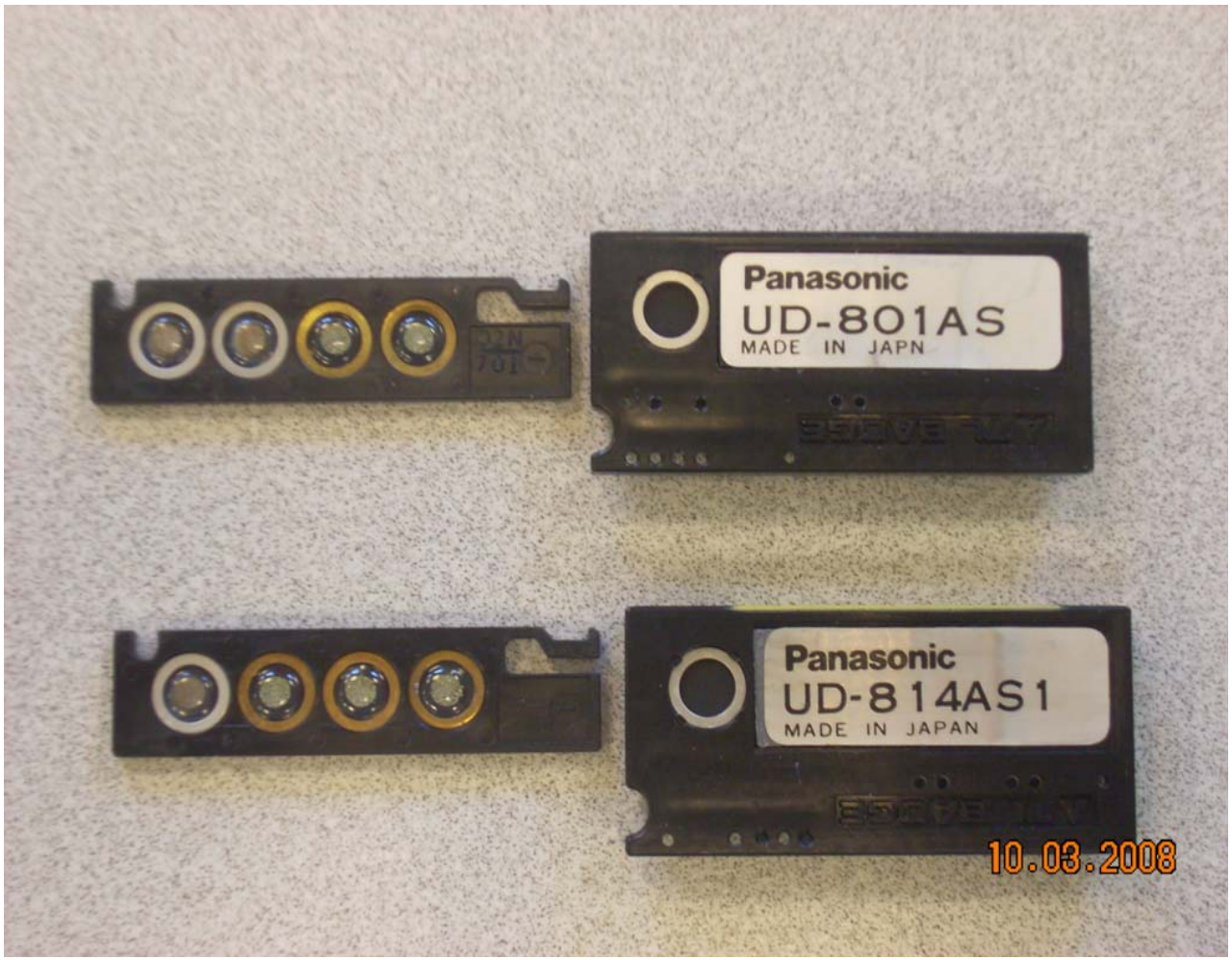
VDH Determination of Site Boundary Dose

- **The TLDs are deployed for calendar quarters and sent to a vendor for processing.**
- **The vendor sends exposure reports after processing. The exposures are reported in milliroentgen per calendar quarter.**
- **Using the appropriate dose conversion factor from ANSI/ANS 6.1.1-1991, doses are calculated from the raw exposure measurements.**
- **A mean background dose from the 34 background TLDs is subtracted from all 71 TLD results to estimate the net radiation dose to members of the public.**
- **Uncertainty is calculated at the 95 percent confidence level and propagated from quarterly gross values to annual net values.**
- **Both the exposure measurements in milliroentgen and the calculated doses in millirem are presented in the annual report with extensive descriptions of other monitoring practices.**

A VDH TLD and its 8” Field Cage

TLD Badges, 2 of 2 Types in Each Cage

TLD Chips, 4 in Each of 2 Badges



TLD Deployment – 71 Total

- There are 26 “site boundary” TLDs, most of which are on a fence that is not actually coincident with the site boundary. 16 are both on the fence and the site boundary.
  - In 2004, there were 3.
- There are 11 plant area TLDs, where most of them gauge radiation exposures between the site boundary and the Vernon Elementary School.
  - In 2004, there were 3.
- There are 34 background TLDs scattered in the six towns around Vermont Yankee, but unaffected by direct gamma radiation from the plant.
  - In 2004, 2 TLDs were used to estimate background radiation exposures.

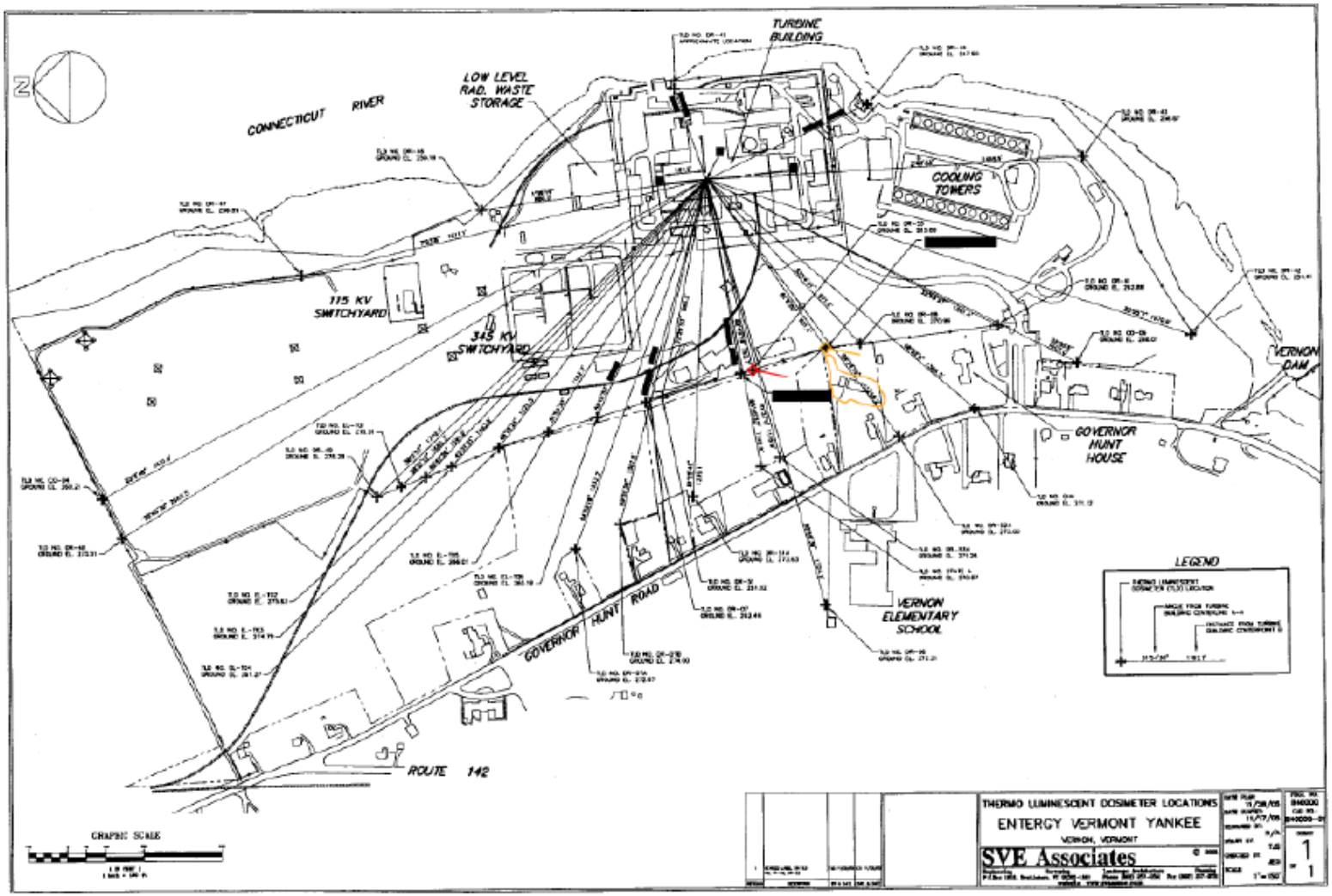


Figure 5. VYNPS Site Map

Dose Conversion Factors

Dose Conversion Factors

•Dose conversion factors are determined empirically in the research laboratory by, for example, inserting well-characterized detectors inside life-like human phantoms and exposing the phantom to well-characterized sources of radiation under well-characterized environmental conditions.

•The American Nuclear Society, one of the NCRP Collaborating Organizations, has for decades sponsored research that resulted in tables of dose conversion factors for different energies of gamma radiation and for different physical orientations of the body relative to the source of radiation exposure.

•These dose conversion factors are found in ANSI/ANS 6.1.1-1991, *Neutron and Gamma-Ray Fluence-to-Dose Factors,* ANSI/ANS 6.1.1-1977, its predecessor, and will be found in the next revision ANSI/ANS 6.1.1-200X to be published.

ANSI/ANS 6.1.1-1991

- **Relative to the American National Standards Institute (ANSI), the document is an historical standard. This means it was not revised within ten years of its original publication.**
- **It is still a current, useful standard that is used by scientists in industry and medicine today.**
- **It is still available for purchase from the American National Standards Institute.**
- **ANSI/ANS 6.1.1-1991 itself was an update of research documented in ANSI/ANS 6.1.1-1977. It, too, was not revised within ten years of its original publication.**
- **The American Nuclear Society committee (ANS 6) responsible for this standard is actively working on the next revision, and may publish it in 2009.**

ANSI/ANS 6.1.1-1991

- **This kind of research does not need to be published in revisions every ten years, but only when advances in nuclear instrumentation, computer codes and scientific knowledge require it. It was recently updated for errata in neutron dosimetry. No changes were made for gamma dose conversion factors.**

- **ANSI/ANS 6.1.1-1991 has been judged to be particularly useful in the highly unique science of nuclear power plant radiations and the assessment of small amounts of biological dose from short-term radiation measurements in the natural environment using instruments that are not well characterized nor standardized for these specific circumstances.**

ANSI/ANS 6.1.1-1991

This judgment that ANSI/ANS 6.1.1-1991 is appropriate for Vermont Yankee dose assessment is supported by five independent sets of highly trained physicists and engineers:

- **State regulators from the Vermont Department of Heath Radiological Health Program,**
- **Consultants from Oak Ridge Associate Universities after thirteen months of focused analysis,**
- **Federal regulators from the United States Nuclear Regulatory Commission,**
- **Consultants from private laboratories, and**
- **Professionals at Entergy Nuclear Vermont Yankee.**

The Oak Ridge Report

- **The Department of Health initiated the investigation because Vermont Yankee disagreed that it had exceeded annual and quarterly limits for site boundary dose in 2004.**
- **Two scientists at the Department of Health were joined by dozens of masters and doctoral scientists and engineers from Oak Ridge Associated Universities, Vermont Yankee and private laboratories.**
- **The team reviewed and analyzed thousands of pages of nuclear instrument readings, mathematical models, engineering reports and historical documents.**
- **The investigation consumed more than thirteen months and had direct costs of $156,000.00 to Oak Ridge and perhaps double that for VDH staff time, and the time of other scientists and engineers involved.**
- **Resulted in a 188 page analytical report published on healthvermont.gov for the public in March 2007 where it remains available today.**

The Oak Ridge Report Findings

- The Department of Health has consistently verified Vermont Yankee compliance to its limits independently, and this would remain by the insistence of the Department.
- The Off-site Dose Calculation Manual (ODCM) methods used by Vermont Yankee were cited as the most accurate to determine compliance.
- Numerous recommendations were made so both the Department of Health and Vermont Yankee could more accurately measure site boundary exposures, calculate site boundary dose and evaluate compliance to the limits.
- The empirically validated ANSI/ANS 6.1.1-1991 dose conversion factors should be used by both Vermont Yankee and the Department of Health to calculate public doses from exposure measurements.
- This will allow the department to accurately, and independently, verify site boundary doses.

Vermont Yankee's Off-Site Dose Calculation Manual

- Vermont Yankee is required to account for off-site dose and compliance with its NRC 100 millirem dose limit at it site boundary, and has been since originally licensed in 1972.

- Prior to 2001, off-site dose was partially related to electrical power created at the turbine generator. A simple equation related that:

  More electric power = more radiation at the site boundary.

- Vermont Yankee, like other plants, began injecting hydrogen and noble metals into the reactor coolant system to prevent component corrosion in 2001, and this equation was no longer correct.

Vermont Yankee's Off-Site Dose Calculation Manual

- Vermont Yankee hired a nuclear laboratory to measure the new radiation levels and the spectrum of energies radiated, and a new equation was created in the off-site dose calculation manual.

- The ODCM Revision 30 uses the ANSI/ANS 6.1.1-1991 dose conversion factor and was accepted in 2002 by the U.S. NRC as a means of determining compliance to federal limits on public dose.

- ODCM Revisions 31 and 32, accepted by the US NRC in 2008 incorporate the 0.6 millirem per milliroentgen dose conversion factor.

Applying ANSI/ANS 6.1.1-1991

- The new model mathematically related months of actual measurements at:
  - The site boundary with the best low level exposure rate instruments and a gamma ray spectrometer; and
  - The main steam lines from the reactor with well-characterized and well-suited instruments.
- The methodology eliminates complications of fluctuations in background.
- When one looks at the tables in ANSI/ANS 6.1.1-1991, there is no one specific dose conversion factor used.
- Instead, thousands of iterative interpolations among and between many of the energy-specific dose conversion factors are integrated to arrive at one particular dose conversion factor.

The VYNPS Gamma Ray Spectrum of Energies

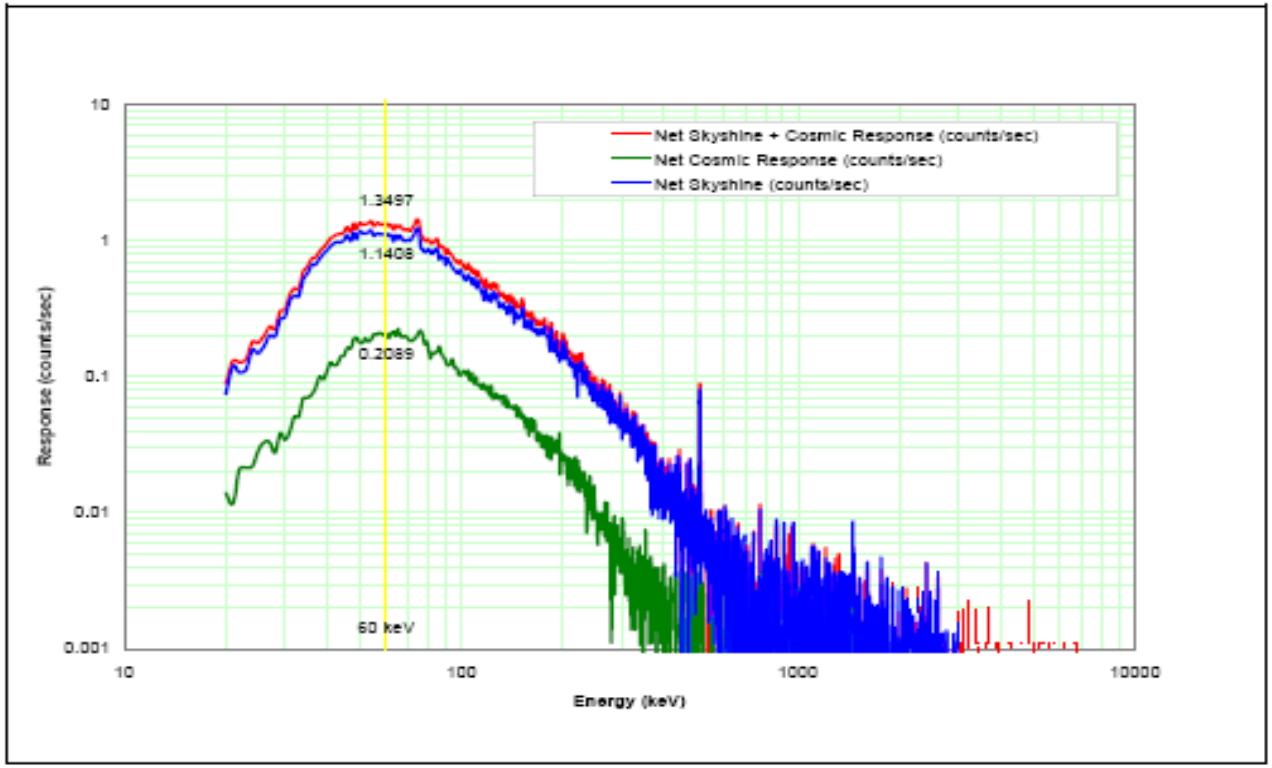


Figure B.2. VYNPS Measured Gamma Ray Spectra at DR-53

The Integrals for Determining the VYNPS Gamma Ray Flux-to-Dose Conversion Factor

Citing the methods described in ANSI/ANS-6.1.1-1991, the measurement property of interest is dose equivalent, expressed in the unit "rem". Of particular interest is the spectrum weighted average conversion factor. Given a multi-group energy flux measurement, each energy bin (or energy interval from E_l to E_u) of interest, the dose equivalent for the ith energy interval is calculated as the integral of the product differential flux times the flux to dose factor, $h_E(E)$, divided by the group flux:

$$< h_{E_i} > \quad = \quad \frac{\int_{El}^{Eu} h_E(E)\phi(E)dE}{\int_{El}^{Eu} \phi(E)dE}$$

Equation 1

where the mean dose equivalent over the ith energy bin, $<h_{E_i}>$ is the spectrum-weighted average of the dose equivalent over the ith energy bin of interest. The total dose equivalent is then this average value for the ith energy bin summed as the product of the group fluxes (Equation 2), and shown in Equation 3.

It is the energy group structure of the flux described for each ith interval that is represented as:

$$\phi_i = \int_{El}^{Eu} \phi(E)dE$$

Equation 2

The energy group structure and h_E values are provided in Table 3 of ANSI/ANS-6.1.1-1991, Fluence-to-Dose Factor (h_E) for Gamma Rays Incident in Various Geometries on an Anthropomorphic Phantom (plotted below). VYNPS measured $\phi(E)dE$ with a gamma ray

Exposure Rates at the Main Steam Lines After Leaving the VYNPS Reactor

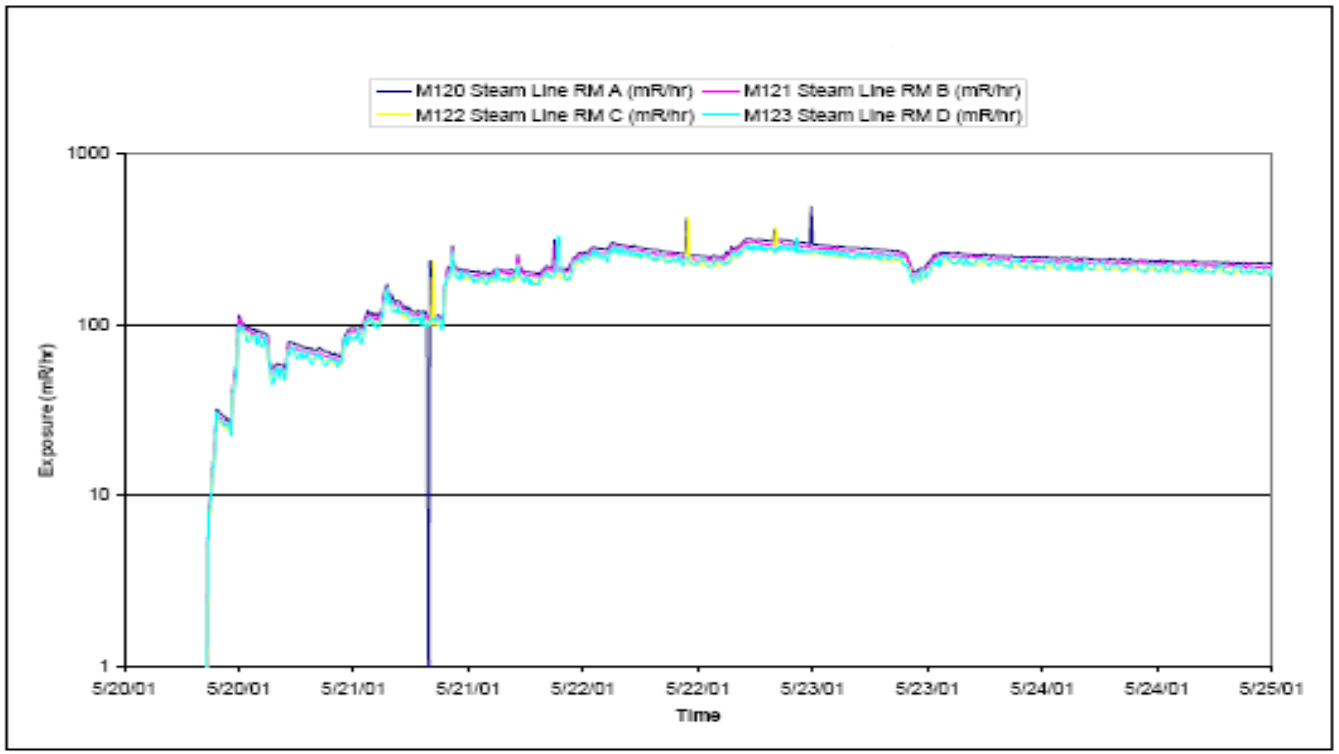


Figure 24. Steam Line Monitor Response

High Pressure Ion Chamber Exposure Measurements at the Site Boundary

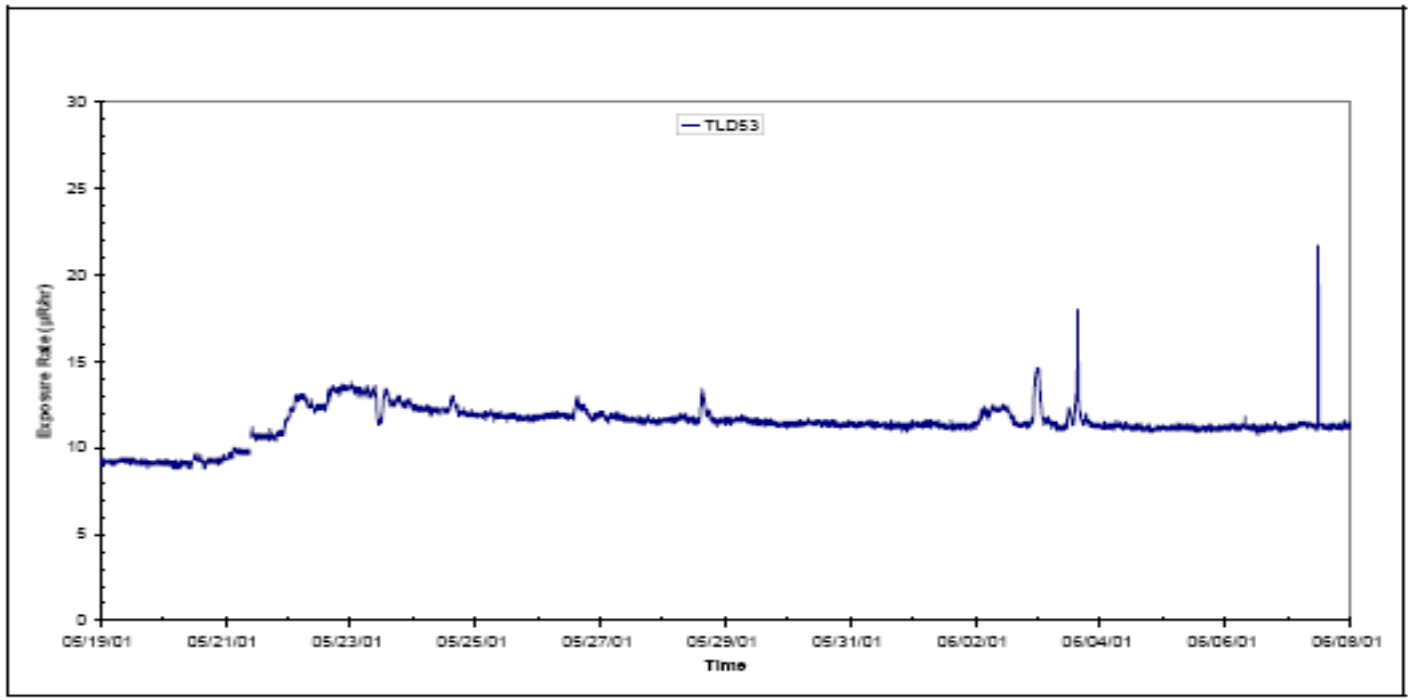


Figure 25. HPIC Detector Response Located at DR-53

Plot of Dose Conversion Factors Versus Gamma Ray Energy

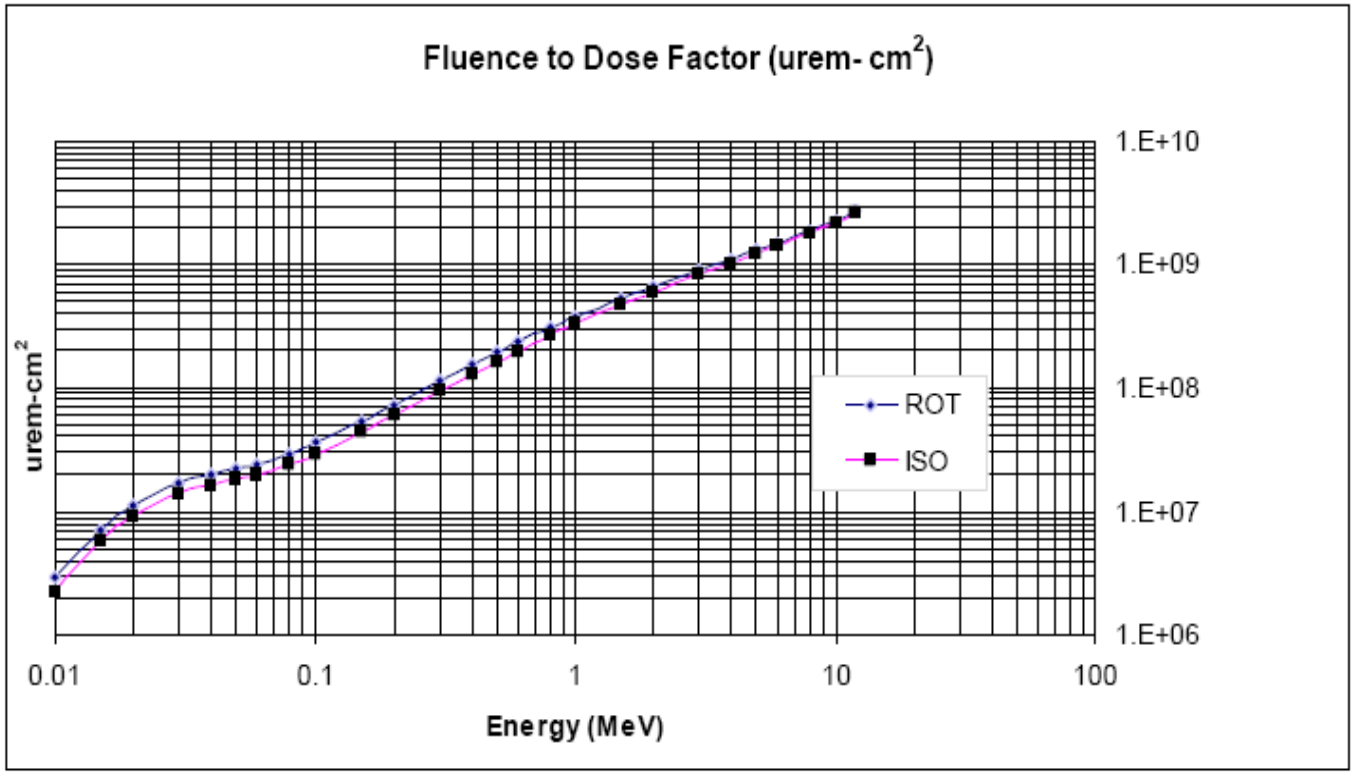


Figure B.1. ANSI/ANS 6.1.1 Fluence to Dose Factors for Rotational (ROT) and Isotropic (ISO) Geometries

The Final Equation Relating Vermont Yankee Nitrogen-16 Radiation Skyshine and Direct Gamma Radiation to Public Off-Site Dose from the ODCM

$$D_d = K_{N-16} K_{tissue} K_{calib} D_{MSLRM}$$

Parameter	Description	ORAU Analysis
K_{N-16}	A factor determined by calibration of a PIC measurement placed at DR-53 and the average of the MSLRM detectors placed on the main steam line. In VYC-2167 this factor was determined to be 1.31E-5.	The calibration equation for establishing this factor is correct.
K_{tissue}	The exposure to dose conversion factor. In 2002, the ODCM uses as a factor 0.71 mrem/mR.	The origin of this factor is not specifically known. ORAU evaluated the set of in situ, high resolution gamma ray spectrometry measurements, and concludes that a nominal value for this parameter is 0.60 (see Appendix B)

Parameter	Description	ORAU Analysis
K_{calib}	A calibration factor for the detector	This calibration factor is reasonable based on the data reviewed. A more extensive review of the actual calibration protocol would likely lead to a few additional recommendations. For the moment, ORAU agrees.
D_{MSLRM}	The average reading of the four MSLRM detectors	This is the dependent variable in the calibration equation. A separate equation is shown to examine the dwell time of the MSLRM detector – the dwell time (or integrating time) for this measurement is adequate.

Applying ANSI/ANS 6.1.1-1991

- This original mathematical model was obtained:
  - In 2001 for hydrogen injection and noble metals chemistry, and approved by the US NRC;
  - In the summer of 2008 for the effects of extended power uprate and installation of a new turbine shield. The Oak Ridge Associated Universities dose conversion factor recommended in 2007 was empirically validated with instruments in the field.
- The 0.6 millirem per milliroentgen dose conversion factor is the result of years worth of measurements and mathematical modeling.

Table 5a. Net VYNPS Site Boundary TLD Exposure Results for 2007 in Milliroentgen

	Vendor 1 TLDs										AREVA, NP TLDs									
	Q 1	2 SD	Q 2	2 SD	Q 3	2 SD	Q 4	2 SD	2007	2 SD	Q 1	2 SD	Q 2	2 SD	Q 3	2 SD	Q 4	2 SD	2007	2 SD
Location	Net	Error	Net	Error	Net	Error	Net	Error	Net	Error	Net	Error	Net	Error	Net	Error	Net	Error	Net	Error
VDH T01	0.0	0.0	0.4	0.0	1.4	1.1	0.0	1.1	1.7	1.6	0.0	0.0	0.8	0.0	0.6	1.1	0.5	0.0	1.9	1.1
VDH T02	0.0	2.3	2.4	0.0	0.0	1.1	0.0	2.3	2.4	3.4	0.1	2.3	0.6	0.0	1.0	1.1	0.4	1.1	2.1	2.7
VDH T03	0.4	1.1	1.0	1.1	0.0	0.0	0.0	3.0	1.4	3.4	0.0	1.1	0.9	1.1	0.6	0.0	0.9	2.3	2.4	2.8
VDH T04	1.1	0.0	0.0	1.1	1.4	1.1	1.4	0.0	3.8	1.6	1.2	0.0	1.5	1.1	1.5	1.1	0.6	2.0	4.8	2.5
VDH T05	0.1	5.7	1.7	0.0	2.4	3.0	1.4	0.0	5.5	5.9	1.3	5.7	2.6	0.0	2.3	3.0	2.0	2.0	8.3	6.2
VDH T06	0.4	1.1	2.0	2.0	5.4	0.0	3.7	4.1	11.5	4.7	2.2	1.1	2.9	2.0	3.6	0.0	2.3	2.3	10.9	3.2
VDH DR07	1.4	1.1	3.0	1.1	4.0	1.1	4.7	1.1	13.2	2.2	4.0	1.1	4.8	1.1	3.7	1.1	3.7	2.0	16.1	2.7
VDH DR08	2.4	1.1	5.7	1.1	6.4	1.1	5.4	2.0	19.8	2.7	5.7	1.1	5.2	1.1	6.2	1.1	6.3	1.1	23.4	2.2
VDH DR41	0.7	0.0	2.0	1.4	0.4	1.1	0.0	1.1	3.2	2.1	1.7	0.0	1.8	1.4	2.0	1.1	1.3	2.3	6.8	2.9
VY SW Fence	0.0	1.1	0.0	2.3	0.0	0.0	0.0	1.1	0.0	2.8	0.0	1.1	0.1	2.3	0.6	0.0	0.2	1.1	0.8	2.8
VY SW Fence #2	0.0	1.1	0.7	2.0	0.0	0.0	0.0	1.1	0.7	2.5	0.2	1.1	0.6	2.0	0.7	0.0	0.3	1.1	1.8	2.5
VDH DR42	0.0	0.0	0.7	1.1	0.7	1.1	0.0	1.1	1.4	1.9	0.6	0.0	0.6	1.1	1.1	1.1	0.4	1.1	2.7	1.9
VDH DR43	1.4	0.0	2.4	1.4	3.4	1.1	3.4	3.9	10.5	4.3	2.5	0.0	2.8	1.4	2.6	1.1	2.8	1.1	10.6	2.1
VDH DR44	4.4	1.1	5.0	1.1	5.4	4.1	5.0	1.1	19.8	2.8	6.6	1.1	5.7	1.1	6.3	4.1	7.7	1.1	26.3	2.8
VDH DR45	10.7	3.0	17.7	1.1	14.7	2.3	21.0	4.1	64.2	5.4	17.8	3.0	18.4	1.1	19.8	2.3	22.4	2.0	78.4	4.0
VDH DR46	3.7	2.0	4.0	2.0	5.7	2.0	5.0	1.1	18.5	3.3	6.3	2.0	5.6	2.0	7.2	2.0	6.4	1.1	25.5	3.3
VDH DR47	1.1	1.1	2.7	0.0	3.0	2.0	1.7	1.1	8.5	2.1	3.1	1.1	2.8	0.0	5.7	2.0	1.9	2.0	13.5	2.7
VDH DR48	1.4	1.1	2.4	1.1	0.7	1.1	2.7	3.0	7.2	3.6	0.6	1.1	1.6	1.1	1.4	1.1	0.7	1.1	4.3	2.2
VY North Fence	0.2	1.4	1.7	0.0	0.7	1.1	1.4	2.0	4.0	2.6	0.0	1.4	0.8	0.0	1.7	1.1	1.2	0.0	3.7	1.7
VY North Fence #2	0.7	0.0	0.7	1.1	0.0	1.1	0.7	1.1	2.1	1.9	1.0	0.0	1.1	1.1	1.4	1.1	1.2	0.0	4.7	1.6
VDH DR49	0.0	1.1	0.0	1.1	0.0	3.0	0.7	3.0	0.7	3.8	0.0	1.1	0.0	1.1	0.8	3.0	0.0	1.1	0.8	2.6
VDH DR51	3.4	0.0	3.7	1.1	4.4	0.0	5.0	4.1	16.5	4.2	4.1	0.0	5.3	1.1	6.5	0.0	4.6	1.1	20.4	1.6
VDH DR52	4.1	1.1	5.4	0.0	4.4	2.3	5.4	2.8	19.2	3.4	7.2	1.1	6.3	0.0	7.9	2.3	7.6	1.1	29.0	2.2
VY Parking Lot	4.7	1.1	4.4	2.3	5.7	2.0	5.7	4.5	20.5	5.4	5.2	1.1	6.8	2.3	8.8	2.0	5.9	1.1	26.8	3.1
VY Parking Lot #2	4.7	1.1	6.0	0.0	8.0	1.1	6.4	2.0	25.2	2.5	5.0	1.1	7.1	0.0	8.1	1.1	6.8	2.3	27.0	2.7
VDH DR53	4.7	1.1	6.0	1.1	6.4	0.0	5.0	1.1	22.2	2.0	7.1	1.1	7.2	1.1	8.2	0.0	6.7	1.1	29.2	2.0

DR42, DR 43, DR 44, DR 45, DR 46 and DR 47 are along NH's Connecticut River and Subject to 100 millirem per Year Limit.

Table 5b. Net VYNPS Site Boundary Dose Equivalent Results for 2007 in Millirem

	Vendor 1 TLDs										AREVA, NP TLDs									
	Q 1	2 SD	Q 2	2 SD	Q 3	2 SD	Q 4	2 SD	2007	2 SD	Q 1	2 SD	Q 2	2 SD	Q 3	2 SD	Q 4	2 SD	2007	2 SD
Location	Net	Error	Net	Error	Net	Error	Net	Error	Net	Error	Net	Error	Net	Error	Net	Error	Net	Error	Net	Error
VDH T01	0.0	0.0	0.2	0.0	0.8	0.7	0.0	0.7	1.0	0.9	0.0	0.0	0.5	0.0	0.4	0.7	0.3	0.0	1.2	0.6
VDH T02	0.0	1.4	1.4	0.0	0.0	0.7	0.0	1.4	1.4	2.0	0.1	1.4	0.3	0.0	0.6	0.7	0.3	0.7	1.2	1.6
VDH T03	0.2	0.7	0.6	0.7	0.0	0.0	0.0	1.8	0.9	2.0	0.0	0.7	0.5	0.7	0.4	0.0	0.5	1.4	1.4	1.7
VDH T04	0.6	0.0	0.0	0.7	0.8	0.7	0.8	0.0	2.3	0.9	0.7	0.0	0.9	0.7	0.9	0.7	0.4	1.2	2.9	1.5
VDH T05	0.0	3.4	1.0	0.0	1.4	1.8	0.8	0.0	3.3	3.6	0.8	3.4	1.6	0.0	1.4	1.8	1.2	1.2	5.0	3.7
VDH T06	0.2	0.7	1.2	1.2	3.2	0.0	2.2	2.4	6.9	2.8	1.3	0.7	1.7	1.2	2.2	0.0	1.4	1.4	6.6	1.9
VDH DR07	0.8	0.7	1.8	0.7	2.4	0.7	2.8	0.7	7.9	1.3	2.4	0.7	2.9	0.7	2.2	0.7	2.2	1.2	9.7	1.6
VDH DR08	1.4	0.7	3.4	0.7	3.8	0.7	3.2	1.2	11.9	1.6	3.4	0.7	3.1	0.7	3.7	0.7	3.8	0.7	14.1	1.3
VDH DR41	0.4	0.0	1.2	0.8	0.2	0.7	0.0	0.7	1.9	1.2	1.0	0.0	1.1	0.8	1.2	0.7	0.8	1.4	4.1	1.7
VY SW Fence	0.0	0.7	0.0	1.4	0.0	0.0	0.0	0.7	0.0	1.7	0.0	0.7	0.0	1.4	0.3	0.0	0.1	0.7	0.5	1.7
VY SW Fence #2	0.0	0.7	0.4	1.2	0.0	0.0	0.0	0.7	0.4	1.5	0.1	0.7	0.3	1.2	0.4	0.0	0.2	0.7	1.1	1.5
VDH DR42	0.0	0.0	0.4	0.7	0.4	0.7	0.0	0.7	0.8	1.2	0.4	0.0	0.4	0.7	0.7	0.7	0.3	0.7	1.6	1.2
VDH DR43	0.8	0.0	1.4	0.8	2.0	0.7	2.0	2.4	6.3	2.6	1.5	0.0	1.7	0.8	1.6	0.7	1.7	0.7	6.4	1.2
VDH DR44	2.6	0.7	3.0	0.7	3.2	2.4	3.0	0.7	11.9	1.7	4.0	0.7	3.4	0.7	3.8	2.4	4.6	0.7	15.8	1.7
VDH DR45	6.4	1.8	10.6	0.7	8.8	1.4	12.6	2.4	38.5	3.2	10.7	1.8	11.0	0.7	11.9	1.4	13.5	1.2	47.1	2.4
VDH DR46	2.2	1.2	2.4	1.2	3.4	1.2	3.0	0.7	11.1	2.0	3.8	1.2	3.4	1.2	4.3	1.2	3.8	0.7	15.3	2.0
VDH DR47	0.6	0.7	1.6	0.0	1.8	1.2	1.0	0.7	5.1	1.3	1.9	0.7	1.7	0.0	3.4	1.2	1.2	1.2	8.1	1.6
VDH DR48	0.8	0.7	1.4	0.7	0.4	0.7	1.6	1.8	4.3	2.1	0.4	0.7	0.9	0.7	0.9	0.7	0.4	0.7	2.6	1.3
VY North Fence	0.1	0.8	1.0	0.0	0.4	0.7	0.8	1.2	2.4	1.6	0.0	0.8	0.5	0.0	1.0	0.7	0.7	0.0	2.2	1.0
VY North Fence #2	0.4	0.0	0.4	0.7	0.0	0.7	0.4	0.7	1.3	1.2	0.6	0.0	0.7	0.7	0.8	0.7	0.7	0.0	2.8	0.9
VDH DR49	0.0	0.7	0.0	0.7	0.0	1.8	0.4	1.8	0.4	2.3	0.0	0.7	0.0	0.7	0.5	1.8	0.0	0.7	0.5	1.6
VDH DR51	2.0	0.0	2.2	0.7	2.6	0.0	3.0	2.4	9.9	2.5	2.4	0.0	3.2	0.7	3.9	0.0	2.7	0.7	12.2	1.0
VDH DR52	2.4	0.7	3.2	0.0	2.6	1.4	3.2	1.7	11.5	2.0	4.3	0.7	3.8	0.0	4.7	1.4	4.6	0.7	17.4	1.3
VY Parking Lot	2.8	0.7	2.6	1.4	3.4	1.2	3.4	2.7	12.3	3.2	3.1	0.7	4.1	1.4	5.3	1.2	3.5	0.7	16.1	1.9
VY Parking Lot #2	2.8	0.7	3.6	0.0	4.8	0.7	3.8	1.2	15.1	1.5	3.0	0.7	4.3	0.0	4.8	0.7	4.1	1.4	16.2	1.6
VDH DR53	2.8	0.7	3.6	0.7	3.8	0.0	3.0	0.7	13.3	1.2	4.2	0.7	4.3	0.7	4.9	0.0	4.0	0.7	17.5	1.2

DR42, DR 43, DR 44, DR 45, DR 46 and DR 47 are along NH's Connecticut River and Subject to 100 millirem per Year Limit.

2008 TLD Exposures in milliroentgen

AREVA Dosimeter mR Location	Qrtr 1 F Gross	1 SD Error	BKGD	Net	Corr >=0	2 SD Error	Qrtr 2 F Gross	1 SD Error	BKGD	Net	Corr >=0	2 SD Error	Qrtr 3 Gross	1 SD Error	BKGD	Net	Corr >=0	2 SD Error	Qrtr 4 F Gross	1 SD Error	BKGI	Net	Corr >=0	2 SD Error	2008 Net	2 SD Error
Mean Background	11.6						**15.2**						**14.9**						**14.7**							
Site Boundary																										
VDH T01	11.3	0.6	11.6	-0.3	0.0	1.2	15.5	0.6	15.2	0.3	0.3	1.3	15.2	0.5	14.9	0.3	0.3	1.0	15.0	1.0	14.7	0.3	0.3	1.9	0.8	2.7
VDH T02	11.2	0.8	11.6	-0.3	0.0	1.5	15.9	0.7	15.2	0.7	0.7	1.4	15.1	0.7	14.9	0.2	0.2	1.3	15.1	1.0	14.7	0.4	0.4	2.0	1.3	3.2
VDH T03	11.6	0.7	11.6	0.0	0.0	1.3	16.3	0.7	15.2	1.1	1.1	1.3	15.2	0.9	14.9	0.3	0.3	1.7	15.4	0.7	14.7	0.7	0.7	1.3	2.0	2.8
VDH T04	11.2	0.6	11.6	-0.4	0.0	1.2	16.3	0.9	15.2	1.1	1.1	1.7	16.6	0.7	14.9	1.7	1.7	1.4	15.7	0.6	14.7	1.0	1.0	1.2	3.8	2.8
VDH T05	12.9	0.8	11.6	1.3	1.3	1.5	17.5	1.0	15.2	2.3	2.3	1.9	16.5	0.9	14.9	1.6	1.6	1.8	16.3	1.0	14.7	1.6	1.6	1.9	6.7	3.5
VDH T06	12.8	0.8	11.6	1.2	1.2	1.5	18.6	0.9	15.2	3.4	3.4	1.8	17.8	0.8	14.9	2.9	2.9	1.5	16.9	0.6	14.7	2.2	2.2	1.3	9.7	3.0
VDH DR07	13.6	0.9	11.6	2.0	2.0	1.8	20.2	1.0	15.2	5.0	5.0	1.9	19.4	0.8	14.9	4.5	4.5	1.5	18.0	0.7	14.7	3.3	3.3	1.4	14.8	3.4
VDH DR08	**17.1**	**1.5**	**11.6**	**5.5**	**5.5**	3.0	**21.6**	**1.0**	**15.2**	**6.4**	**6.4**	2.0	**20.6**	**0.8**	**14.9**	**5.7**	**5.7**	1.5	**19.3**	**0.7**	14.7	**4.6**	**4.6**	1.3	**22.2**	4.1
VDH DR41	12.9	0.9	11.6	1.3	1.3	1.8	17.3	1.1	15.2	2.1	2.1	2.2	16.8	1.2	14.9	1.9	1.9	2.3	16.3	0.9	14.7	1.6	1.6	1.7	6.9	4.0
VY SW Fence	11.4	0.7	11.6	-0.2	0.0	1.4	15.3	0.7	15.2	0.1	0.1	1.4	14.6	0.6	14.9	-0.3	0.0	1.2	14.4	0.6	14.7	-0.4	0.0	1.1	0.1	2.5
VY SW Fence #2	10.9	0.6	11.6	-0.7	0.0	1.1	15.3	0.8	15.2	0.2	0.2	1.5	15.0	0.6	14.9	0.1	0.1	1.1	14.9	0.7	14.7	0.1	0.1	1.4	0.4	2.6
VDH DR42	10.8	0.8	11.6	-0.8	0.0	1.6	16.4	0.9	15.2	1.2	1.2	1.7	15.9	0.6	14.9	1.0	1.0	1.2	15.4	0.7	14.7	0.7	0.7	1.3	2.9	3.0
VDH DR43	12.6	0.7	11.6	1.0	1.0	1.4	18.6	0.7	15.2	3.4	3.4	1.4	17.6	0.8	14.9	2.7	2.7	1.5	16.6	0.7	14.7	1.9	1.9	1.4	8.9	2.9
VDH DR44	**20.6**	**1.9**	**11.6**	**9.0**	**9.0**	3.6	**22.3**	**1.4**	**15.2**	**7.2**	**7.2**	2.7	**20.9**	**0.7**	**14.9**	**6.0**	**6.0**	1.4	**20.1**	**1.2**	14.7	**5.3**	**5.3**	2.3	**27.6**	5.3
VDH DR45	**33.1**	**2.5**	**11.6**	**21.5**	**21.5**	4.9	**36.1**	**2.8**	**15.2**	**20.9**	**20.9**	5.5	**31.9**	**1.9**	**14.9**	**17.0**	**17.0**	3.8	**37.3**	**2.0**	14.7	**22.6**	**22.6**	4.0	**81.9**	9.2
VDH DR46	**18.0**	**0.9**	**11.6**	**6.4**	**6.4**	1.8	**21.0**	**0.8**	**15.2**	**5.8**	**5.8**	1.6	**20.2**	**0.9**	**14.9**	**5.3**	**5.3**	1.7	**19.6**	**1.0**	14.7	**4.9**	**4.9**	2.0	**22.4**	3.5
VDH DR47	13.3	0.7	11.6	1.8	1.8	1.3	18.4	0.7	15.2	3.3	3.3	1.5	17.5	0.8	14.9	2.6	2.6	1.5	17.0	0.8	14.7	2.3	2.3	1.5	10.0	2.9
VDH DR48	11.5	1.0	11.6	-0.1	0.0	1.9	17.1	0.8	15.2	1.9	1.9	1.6	16.3	0.8	14.9	1.4	1.4	1.5	16.0	0.7	14.7	1.3	1.3	1.3	4.6	3.1
VY North Fence	11.6	0.7	11.6	0.0	0.0	1.4	16.5	0.8	15.2	1.3	1.3	1.5	16.0	0.9	14.9	1.1	1.1	1.8	15.6	0.5	14.7	0.9	0.9	1.0	3.3	2.9
VY North Fence #2	11.3	0.6	11.6	-0.3	0.0	1.3	16.3	1.2	15.2	1.2	1.2	2.3	15.9	0.6	14.9	1.0	1.0	1.3	15.8	0.5	14.7	1.1	1.1	0.9	3.2	3.0
VDH DR49	10.9	0.8	11.6	-0.7	0.0	1.6	15.6	0.7	15.2	0.4	0.4	1.3	14.4	0.9	14.9	-0.5	0.0	1.7	14.4	0.6	14.7	-0.3	0.0	1.2	0.4	2.9
VDH DR51	13.5	0.9	11.6	1.9	1.9	1.7	20.8	1.3	15.2	5.6	5.6	2.5	20.3	0.9	14.9	5.4	5.4	1.7	18.7	1.1	14.7	4.0	4.0	2.1	16.9	4.1
VDH DR52	**18.2**	**0.9**	**11.6**	**6.6**	**6.6**	1.7	**22.5**	**0.9**	15.2	**7.3**	**7.3**	1.7	**21.4**	**0.8**	**14.9**	**6.5**	**6.5**	1.6	**19.7**	**0.8**	14.7	**5.0**	**5.0**	1.5	**25.3**	3.2
VY Parking Lot	**17.3**	**1.2**	**11.6**	**5.7**	**5.7**	2.4	**23.1**	**1.0**	**15.2**	**7.9**	**7.9**	1.9	**22.4**	**0.9**	**14.9**	**7.5**	**7.5**	1.8	**20.7**	**1.1**	14.7	**6.0**	**6.0**	2.2	**27.0**	4.1
VY Parking Lot #2	**17.5**	**1.0**	**11.6**	**5.9**	**5.9**	2.0	**23.4**	**0.8**	**15.2**	**8.2**	**8.2**	1.6	**22.8**	**0.8**	**14.9**	**7.9**	**7.9**	1.5	**20.4**	**0.6**	14.7	**5.6**	**5.6**	1.1	**27.7**	3.2
VDH DR53	**16.3**	**1.2**	**11.6**	**4.7**	**4.7**	2.3	**24.0**	**0.9**	**15.2**	**8.8**	**8.8**	1.8	**22.0**	**1.0**	**14.9**	**7.1**	**7.1**	1.9	**21.1**	**1.0**	14.7	**6.4**	**6.4**	2.0	**27.0**	4.0
Plant Area																										
VDH T07A	12.0	0.7	11.6	0.4	0.4	1.3	16.8	0.8	15.2	1.6	1.6	1.6	16.5	0.6	14.9	1.6	1.6	1.2	16.0	0.7	14.7	1.2	1.2	1.4	4.9	2.8
VDH T07B	12.0	1.1	11.6	0.4	0.4	2.2	17.1	0.8	15.2	2.0	2.0	1.6	16.5	0.8	14.9	1.6	1.6	1.6	16.0	0.8	14.7	1.3	1.3	1.6	5.3	3.5
VDH DR51A	12.3	0.7	11.6	0.7	0.7	1.5	18.0	1.7	15.2	2.8	2.8	3.3	17.0	0.8	14.9	2.1	2.1	1.6	16.6	0.7	14.7	1.8	1.8	1.4	7.6	4.1
VY PARKING LOT A	13.8	1.1	11.6	2.2	2.2	2.2	18.7	0.7	15.2	3.5	3.5	1.5	17.7	1.1	14.9	2.8	2.8	2.2	17.9	0.8	14.7	3.2	3.2	1.6	11.7	3.8
VDH DR53A	14.1	1.1	11.6	2.6	2.6	2.1	19.7	0.8	15.2	4.6	4.6	1.5	19.3	1.0	14.9	4.4	4.4	1.9	18.4	0.7	14.7	3.7	3.7	1.4	15.2	3.5
Gov Hunt Road # 39	13.6	0.9	11.6	2.0	2.0	1.7	18.1	0.8	15.2	2.9	2.9	1.5	17.1	0.9	14.9	2.2	2.2	1.7	17.0	1.6	14.7	2.2	2.2	3.1	9.3	4.2
Vernon School Nurse	17.0	0.9	11.6	5.4	5.4	1.8	18.6	1.2	15.2	3.5	3.5	2.3	17.8	0.9	14.9	2.9	2.9	1.8	18.1	0.7	14.7	3.4	3.4	1.3	15.1	3.7
VDH DR06	12.4	0.9	11.6	0.9	0.9	1.8	16.6	0.8	15.2	1.4	1.4	1.5	15.6	0.5	14.9	0.7	0.7	0.9	15.1	0.5	14.7	0.4	0.4	0.9	3.4	2.7
Vernon Elem School A/S	12.2	0.8	11.6	0.6	0.6	1.6	16.6	0.7	15.2	1.4	1.4	1.3	15.2	0.7	14.9	0.3	0.3	1.4	15.5	0.6	14.7	0.7	0.7	1.2	2.9	2.8
VSH DR52A	14.1	0.8	11.6	2.5	2.5	1.6	17.7	1.0	15.2	2.5	2.5	1.9	17.3	0.9	14.9	2.4	2.4	1.7	16.7	0.9	14.7	2.0	2.0	1.7	9.3	3.5
Vernon School Pole	12.0	0.6	11.6	0.4	0.4	1.2	16.2	0.8	15.2	1.0	1.0	1.5	15.0	1.1	14.9	0.1	0.1	2.2	15.0	0.8	14.7	0.3	0.3	1.5	1.8	3.3

Summary

- The Department of Health proposed rule changes:
  - Add clarity;
  - Add definitions consistent with federal regulatory requirements;
  - Consolidate VY and other use limits in separate sections;
  - Address the use of dose conversion factors; and
  - Enhance compliance monitoring and enforcement.

Summary

- Public comment afforded by:
  - A public hearing at Vernon Elementary School, 6 – 9 PM on March 9, 2009.
  - Written comments up to March 23, 2009 to:

    Dr. William Irwin, Sc.D., CHP
    Vermont Department of Health
    108 Cherry Street
    Burlington, VT 05402