

**United States of America**  
before the  
**Nuclear Regulatory Commission**

In the Matter of

YANKEE ATOMIC ELECTRIC COMPANY

(Yankee Nuclear Power Station)

Docket No. 50-029-DCOM

**AFFIDAVIT OF PETER S. LITTLEFIELD**

Peter S. Littlefield, being first duly sworn, deposes and says as follows:

1. My name is Peter S. Littlefield. I am a resident of the Commonwealth of Massachusetts residing in Holliston in the County of Middlesex. I am the Manager of the Radiological Engineering Group of Yankee Atomic Electric Company, 580 Main Street, Bolton, Massachusetts. I received a Bachelor of Science Degree in Chemical Engineering from Northeastern University in 1962 and a Master of Science Degree in Radiation Biology from the University of Rochester in 1963.
2. From 1963 to 1967, I was employed by Brookhaven National Laboratory with a two-year leave of absence to serve in the U.S. Army. While at Brookhaven I worked in the Applied Research Section of the Health Physics Department on such projects as mixed field dosimetry, linear energy transfer analysis, and low-level radioactive gas monitoring. In 1967, I joined the Quincy Shipyard Division of General Dynamics Corporation as a Radiological Engineer and became the Health Physics Supervisor later that year. In 1968 I joined Yankee Atomic Electric Company as a Safety Analysis Engineer in the Nuclear Services Division. In this position I worked on process radiation monitoring, environmental monitoring, radioactive waste processing, and accident analysis for several of the nuclear power stations in New England. In 1973, I was appointed as Manager of

9610250098 961009  
PDR ADDCK 05000029  
G PDR

WPGKANT451.TGS

the Radiological Engineering Group with responsibility for radiological dose calculations, meteorological monitoring, environmental monitoring, and radiological accident analysis.

3. I am certified in Health Physics by the American Board of Health Physics. I am a member of the Health Physics Society and the American Nuclear Society.

#### I. Public Exposure from Station Effluents

4. The individual doses to members of the public are calculated for station liquid and gaseous effluents and reported on an annual basis to the Nuclear Regulatory Commission (NRC). These doses are conservatively estimated by hypothesizing a "most exposed" individual, who resides in the area of highest offsite exposure and who also raises food for his/her own consumption in this same area.

#### Start of Decommissioning Activities through June 30, 1996

5. The public exposure to radiological effluents from the Yankee Nuclear Power Station (YNPS), since the start of decommissioning activities in April 1993, have remained well below both the limits of 10CFR20 (100 mrem/year), and the ALARA dose objectives of 10CFR50, Appendix I (10 mrem/year to the maximum organ from liquids, 15 mrem/year to the maximum organ from airborne releases). These limits and objectives are reflected in the plant's license. From 1993 through June 30, 1996, the calculated maximum organ doses from liquid and gaseous effluents to a hypothetical maximum exposed individual in the public totaled approximately 0.0055 mrem and 0.0079 mrem, respectively. This results in annual average doses of about 0.0016 mrem/year for liquids, and 0.0022 mrem/year for airborne emissions. These calculated doses are approximately a factor of 5,000 below the ALARA dose objectives. They are also well below the natural variability in background dose rates as discussed below.

6. The background radiation exposure that is received by all members of the public is made up of external sources such as cosmic and terrestrial radiation, internal sources such as radioactive potassium, and inhaled sources such as radon decay products. The total exposure from all background sources in the United States averages 300 mrem/year according to the National Council on Radiation Protection and Measurements [Reference 1]. The largest component of this is the inhalation of radon decay products which contributes 200 mrem/year. The gamma radiation component of background in the vicinity of YNPS was measured at twenty-two thermoluminescent dosimeter (TLD) locations (NRC monitoring network). These measurements made between 1987 and 1993, show an overall site area annual background gamma dose rate of about 69 mrem/year, with a standard deviation of about 9 mrem/year (most measurements fall within 2 standard deviations of the mean or between 51 and 87 mrem/year).

7. These TLD dose measurements are consistent with an aerial radiological survey of the surrounding site area performed by EG&G for the Department of Energy in August of 1989 which reported dose rate measurements averaging between 56 to 93 mrem/year (6 and 10  $\mu$ R) [Reference 2].

Projection from July 1, 1996 through December 31, 1998

8. From July 1996 to the end of decommissioning activities, the projected hypothetical maximum organ doses to a member of the public have been estimated to be 0.0007 mrem and 0.0039 mrem for liquid and gaseous exposure pathways, respectively. Most of the projected radioactivity discharges are associated with the release of tritium in plant water that is released through evaporation of water from the Spent Fuel Pool or through the liquid waste processing system. For this reason radioactive effluents are somewhat insensitive to decommissioning activities. The projected dose impacts during this period are consistent with the historical dose impacts associated with the shutdown period 1993 through June 1996.

II. Public Exposure from Transportation of Low Level Waste

A. Collective Dose

9. The YNPS Decommissioning Environmental Report, in Table 4.2-1, provided an early conservative estimate of the transportation doses to two segments of the population - a *general public* which was assumed to reside or work near the transportation routes used by the transport vehicles, and *onlookers* which were assumed to spend some time in close proximity to the transport vehicle. These estimates were re-evaluated to reflect more current data and are described below.

10. The total collective dose to the *general public* from transportation of YNPS low level waste from decommissioning was estimated to be 1.1 person-rem, using actual and projected waste survey data. This dose is approximately a factor of four times less than the early conservative estimate provided in the Decommissioning Environmental Report, which identifies transportation doses to the *general public* of <1 person-rem for the Component Removal Project (treated as 1 in the Environmental Report) and 4 person-rem for the remainder of decommissioning. This early conservative estimate was made based on the estimated number of low level waste shipments and the expected destination of these shipments. The estimate also assumed the maximum allowed dose rate on the outside of the transport vehicle.

11. The total collective dose to *onlookers* from transportation of YNPS low level waste from decommissioning was estimated to be 0.22 person-rem, using actual and projected waste survey data. The Decommissioning Environmental Report identified transportation doses to *onlookers* of <1 person-rem for the Component Removal Project, and <1 person-rem for the remainder of decommissioning. (These values were each assumed to be 1 person-rem and summed to 2 person-rem for conservatism in the Environmental Report.)

12. Two shipment periods were considered in determining these doses:

- a. Start of decommissioning activities (April, 1993) to June 30, 1996,
- b. Projected shipments from July 1, 1996 through December 31, 1998.

13. Decommissioning collective transportation doses to the *general public* were based on the following assumptions:

- Actual 2 meter dose rates from each low level waste shipment were used for waste shipped from the start of decommissioning to June 30, 1996. The 2 meter dose rate measurement was made to demonstrate compliance with 10CFR Part 71.47.
- The 2 meter dose rate from each projected low level waste shipment was based on the average 2 meter transport vehicle dose rate from start of decommissioning to the present.
- The population density for the collective transportation dose was assumed to be 422 persons/sq. mile uniformly dispersed along the route. This is the average population density of the east coast states based on 1990 U.S. Census data. [Reference 3]
- The radioactive waste shipment was assumed to be a point source for distances beyond 100 feet based on WASH-1238. [Reference 4]
- For the collective dose to the *general public* there were no people assumed to be closer than 100 feet, and the dose to persons farther than 2600 feet was determined to be negligible based on WASH-1238.
- A total of 211 people were uniformly distributed between 100 feet and 2600 feet on each side of the route, based on the approach in WASH-1238 of dividing the population exposed equally along both sides of the shipping route.
- The collective dose to the *general public* from transportation of YNPS decommissioning waste was calculated using  $2.48 \times 10^{-6}$  person-rem/mile, a value which was normalized to 1 mrem/hr at a distance of 6 feet from the transport vehicle. This was determined from the value of  $1.2 \times 10^{-5}$  person-rem/kilometer used by NUREG/CR-0130, and corrected for population density and dose rate (NUREG/CR-0130 used a population density of 330 persons/mile<sup>2</sup> and a dose rate of 10 mrem/hour at 6 feet from the vehicle).

14. Decommissioning collective transportation doses to the *onlookers* were based on the above, except for the following assumption:

- The *onlooker* dose from all shipments was calculated on the basis that 10 people spend an average of 3 minutes each at a distance of about 6 feet from a shipment, based on NUREG/CR-0130 [Reference 5].

#### Start of Decommissioning through June 30, 1996

15. *General Public* - The collective transportation dose to the *general public* from the start of decommissioning to June 30, 1996, was calculated by multiplying the *general*

public transportation cumulative dose of  $2.48 \times 10^{-6}$  person-rem/mile/mR/hr, by the dose rate at 2 meters (approximately 6 feet) from the transport vehicle, times the shipment distance traveled by truck or rail, and summing over the total number of shipments. This dose was estimated to be 0.75 person-rem.

16. *Onlookers* - The collective transportation dose to *onlookers* from the start of decommissioning to the June 30, 1996, was calculated by multiplying the dose rate at 2 meters from the transport vehicle, times 3 minutes, times 10 people for each shipment, and summing over all shipments. This dose to *onlookers* was estimated to be 0.15 person-rem.

#### Projection from July 1, 1996 through December 31, 1998

17. *General Public* - The projected incremental collective transportation dose to the *general public* from decommissioning activities from July 1, 1996 to December 31, 1998, was calculated by multiplying the *general public* transportation cumulative dose of  $2.48 \times 10^{-6}$  person-rem/mile/mR/hr, by 1.8 mR/hr. This is the average 2 meter dose rate from the transport vehicles based on the period from the start of the decommissioning to June 30, 1996. Estimates were made of the number and destination of all low level waste shipments to be made until the end of decommissioning. The projected dose was estimated to be 0.38 person-rem.

18. *Onlookers* - The projected incremental collective transportation dose to *onlookers* from decommissioning from July 1, 1996 to December 31, 1998, was calculated by multiplying the 1.8 mrem/hour discussed above by 3 minutes, times 10 people for each shipment estimated until the end of decommissioning. The projected dose was estimated to be 0.072 person-rem.

19. Based on the above, the collective dose to the *general public* from transportation of YNPS low level waste from decommissioning was estimated to be 1.1 person-rem, using actual and projected waste survey data, and the total collective dose to *onlookers* was estimated to be 0.22 person-rem. Both estimated doses are significantly less than that reported in the Decommissioning Environmental Report.

#### B. Individual Doses

20. Doses to individuals were estimated based on two scenarios:

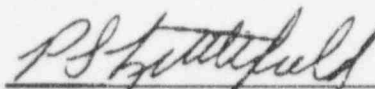
- a. The onlooker, as discussed above for collective dose, that spends 3 minutes at a distance of 6 feet from the transport vehicle, and
- b. An individual that follows the transport vehicle in his or her car at a distance of 50 feet for a period of 1 hour.

21. In both cases the highest measured transport vehicle dose rate from the start of decommissioning to the present was used for the estimate. This measured dose rate was 8.5 mrem/hour at 6 feet. This value, when extrapolated to 50 feet, would be approximately 0.21 mrem/hour.



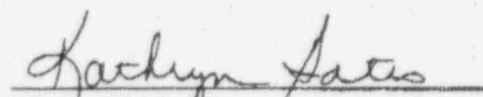
REFERENCES

- [1] Exposure of the Population in the United States and Canada from Natural Background Radiation, NCKP Report No. 94, December 30, 1987.
- [2] P. K. Boyns, C. M. Bluit, An Aerial Radiological Survey of the Rowe Nuclear Power Station and Surrounding Area, EGG 10617-1233, September 1993.
- [3] 1990 Population Data, <http://www.census.gov/ftp/pub/population/census>.
- [4] Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants, WASH-1238, December, 1972.
- [5] R. I. Smith, G. J. Konzek, W. E. Kennedy, Jr., Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station, "NUREG/CR-0130, Volume 1, June, 1978.

  
\_\_\_\_\_  
Peter S. Littlefield

Commonwealth of Massachusetts  
County of Worcester, ss:

Then appeared Peter S. Littlefield, before and personally known to me, who, being first duly sworn, deposed that the foregoing statements are true, this 9<sup>th</sup> of October, 1996:

  
\_\_\_\_\_  
Notary Public  
My commission expires: 1/24/97