UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 10, 2004

MEMORANDUM TO: Daniel S. Collins, Acting Section Chief
Project Directorate LPD 1-2
Division of Licensing Project Management, NRR

/RA/

FROM: Theodore R. Quay, Chief
Plant Support Branch
Division of Inspection Program Management, NRR

SUBJECT: VERMONT YANKEE - INPUT TO SAFETY EVALUATION REPORT RELATING TO PROPOSED 20% POWER UPRATE (TAC MC0761)

By letter dated September 10, 2003, as supplemented by letter dated January 31, 2004, Vermont Yankee proposed to amend their Operating License No. DPR-28 and Technical Specifications that would permit a 20 percent increase in the power level. This amendment would increase the current maximum authorized power level of 1593 megawatts thermal (MWT) to an uprated power level of 1912 MWT. My staff has completed its review of the impact of this proposed on plant radiation source terms, radiation protection design features and radiation protection, in accordance with the NRR Review Standard for Extended Power Uprates, RS-001.

On the basis of our review, we find that, although the activity of the reactor coolant and radiation levels in parts of the plant may increase slightly as a result of the proposed extended power uprate (EPU), the conservative margins in the plant radiation protection design features, and the licensee's ALARA and exposure control programs, are sufficient to compensate for these increases. The enclosed safety evaluation input documents the staff's findings. As discussed between Roger Pedersen of my staff and your Project Manager, Rick Ennis, the impact of the EPU power level on control room habitability and post accident operator access to vital areas, was actually addressed and reviewed as part a separate licensee request to implement the Alternate Source Term (AST) at Vermont Yankee (TAC no. MC0253). Therefore, the enclosed safety evaluation input refers to this AST review, and contains a place holder (in bold lettering) for an ADAMS reference number once the AST approval is complete.

Docket No. 50-271

Attachment: Safety Evaluation Input

CONTACT: Roger Pedersen,
301)415-3162

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Adams Accession Number: ML043150224
DOCUMENT NAME:G:\DIPM\VY_EPU_SE

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SAFETY EVALUATION INPUT RELATED TO

AMENDMENT NO. 263

FACILITY OPERATING LICENSE NO. NPF-62

VERMONT YANKEE NUCLEAR POWER STATION

DOCKET NO. 50-271

2.10 Health Physics

2.10.1 Occupational and Public Radiation Doses

Regulatory Evaluation

The NRC staff conducted its review in this area to ascertain what overall effects the proposed extended power uprate (EPU) will have on both occupational and public radiation doses and to determine that the licensee has taken the necessary steps to ensure that any dose increases will be maintained within applicable regulatory limits and as low as is reasonably achievable (ALARA). The NRC staff's review included an evaluation of any increases in radiation sources and how this may affect plant area dose rates, plant radiation zones, and plant area accessibility. The NRC staff evaluated how personnel doses needed to access plant vital areas following an accident are affected. The NRC staff considered the effects of the proposed EPU on nitrogen-16 levels in the plant and any effects this increase may have on radiation doses outside the plant and at the site boundary from skyshine. The NRC staff also considered the effects of the proposed EPU on plant effluent levels and any effect this increase may have on radiation doses at the site boundary. The NRC's acceptance criteria for occupational and public radiation doses are based on 10 CFR Part 20, 10 CFR 50.67, 10 CFR Part 50 Appendix I, and draft GDC-11. Specific review criteria are contained in SRP Sections 12.2, 12.3,12.4, and 12.5, NUREG 0737, item II.B.2, and other guidance provided in Matrix 10 of RS-001.

Technical Evaluation

Source Terms:

In general, the production of radiation and radioactive material (either fission or activation products) in the reactor core are directly dependent on the neutron flux and power level of the reactor. Therefore, as a first order approximation, a 20% increase in power level is expected to result in a proportional increase in the direct (i.e., from the reactor fuel) and indirect (i.e., from the reactor coolant) radiation source terms. However, due to the physical and chemical properties of the different radioactive materials that reside in the reactor coolant, and the various processes that transport them to locations in the plant outside the reactor, several radiation sources encountered in the balance of plant are not expected to change in direct proportion to the increased reactor power. The most significant of these are:

1. The concentration of noble gas and other volatile fission products in the main steam line will not change. The increased production rate (20%) of these materials is offset by the

corresponding increase in steam flow (20%). Although the concentration of these materials in the steam line remains constant, the increased steam flow results in a 20% increase in the rate these materials are introduced into the Main Condenser and Off Gas systems.

2. For the very short lived activities, most significantly N-16, the decreased transit (and decay time) in the main steam line, and the increased mass flow of the steam results in a larger increase in these activities in the major turbine building components. For N-16, with its 7.13 second half-life, the licensee estimates a 26% increase in activity in the turbine building.

3. The concentrations of non-volatile fission products, actinides, and corrosion and wear products in the reactor coolant are expected to increase proportionally with the power increase. However, the increased steam flow is expected to result in an increased moisture carryover in the steam, resulting in an increased transport of these activities to the balance of the plant. The licensee has calculated that the 20% increase in steam flow will double the moisture carry over (from 0.04% to 0.08%) resulting in an overall increase in the condensate system by a factor of 2.4. The radiation from these non-volatile radioactive materials provides only a small contribution to the dose rates around balance of plant systems during normal power operations.

Radiation Protection Design Features:

1. Occupational and onsite radiation exposures.

The radiation sources in the core are expected to increase in proportion to the increase in power. This increase, however, is bounded by the existing safety margins of the plant design. Due to the design of the shielding and containment surrounding the reactor vessel, and since the reactor vessel is inaccessible to plant personnel during operation, a 20% increase in the radiation sources in the reactor core will have no affect on occupational worker personnel doses during power operations. Similarly, the radiation shielding provided in the balance of plant (i.e., around rad-waste systems, main steam lines, the main turbine, etc.) is conservatively sized such that the increased source terms discussed above are not expected to significantly increase the dose rates in the normally occupied areas of the plant. The existing radiation zoning design (e.g., the maximum designed dose rates for each area of the plant) will not change as a result of the increased dose rates associated with this EPU.

Operating at a 20% higher power level will result in an increased core inventory of radioactive material that is available for release during postulated accident conditions. The plant shielding design must be sufficient to provide control room habitability, per Draft GDC 11, and operator access to vital areas of the plant, per NUREG 0737 item II.B.2, during the accident. As part of a recent change to the Vermont Yankee design basis, the licensee recalculated the radiological consequences of the postulated design basis accidents using the Alternate Source Term (AST) in accordance with the provisions in 10 CFR 50.90 and 10 CFR 50.67. The AST provides more realistic assumptions, than the current design basis source term, on the timing and mechanisms of radioactive material release from the core during postulated accident conditions. The reevaluation of the design basis accidents included an evaluation of control room habitability, and the post accident vital areas access, at the proposed EPU power level of 1912 MWt. The staff has reviewed this design basis change and concluded that licensee continues to meet the applicable requirements **[REFERENCE NEEDED]**.

Therefore, following implementation of this EPU, Vermont Yankee will continue to meet its design basis in terms of radiation shielding, in accordance with the criteria in SRP section 12.4, Draft GDC 11, and NUREG 0737, item II.B.2.

2. Public and offsite radiation exposures.

There are two factors, associated with this EPU that may impact public and offsite radiation exposures during plant operations. These are the possible increase in gaseous and liquid effluents released from the site, and the increase in direct radiation exposure from radioactive plant components and solid wastes stored onsite. As described above, this EPU will result in a 20% increase in gaseous effluents released from the plant during operations. This increase is a minor contribution to the radiation exposure of the public. The nominal annual public dose from plant gaseous effluents for the Vermont Yankee station is about one mrem. A 20% increase in this nominal dose is still well within the design criteria of 10 CFR 20 Appendix I.

This EPU will also result in increased generation of liquid and solid radioactive waste. The increased condensate feed flow associated with this EPU results in faster loading of the condensate demineralizers. Similarly, the higher feed flow introduces more impurities into the reactor resulting in faster loading of the reactor water cleanup (RWCU) system demineralizers. Therefore, the deminerlizers in both of these systems will require more frequent back washing to maintain them. The licensee has estimated that these more frequent backwashes will increase the volume of liquid waste, that will need processing, by 1.2% and an increase in processed solid radioactive waste by 17.8%. These increases are well within the processing capacity of the Vermont Yankee Radwaste System and are not expected to noticeably increase the liquid effluents or solid radioactive waste released from the plant. Therefore, these increases will have a negligible impact on occupational or public radiation exposure.

The most significant increase in offsite-doses, from this EPU, will be due to increased N-16 skyshine and the direct exposure to radiation from miscellaneous radioactive waste stored on site. Based on measurements, the licensee has determined that the west boundary of the facility has the highest direct offsite radiation dose, nominally 15 mrem per year. The licensee has estimated that almost 90% of this dose, 13.4 mrem per year, is due to N-16 skyshine from the turbine building components. Skyshine is a physical phenomenon where gamma radiation that is released skyward during radioactive decay interacts with air molecules and, in this case, is scattered back down to the ground where it can expose members of the public. Since there is significantly less radiation shielding above the steam components in the turbine building, than there is to the sides of these components, skyshine from N-16 gammas is a significant contributor to offsite dose rates. As discussed above, the licensee has estimated that plant operations at this EPU will increase the N-16 activity in the turbine building by 26%. Therefore, the gamma dose rate from N-16 skyshine at west site boundary will likely increase to a nominal value of 16.9 mrem per year. Increases in the solid radioactive waste resulting from this EPU, which are stored on site, can also increase the direct radiation dose rate offsite. However, the licensee has committed to administratively control the contribution to offsite dose rates from these miscellaneous radioactive wastes. The maximum dose rate contribution, for the highest offsite location (west boundary), from radioactive waste stored onsite will be 1.74 mrem per year. Therefore, the projected maximum offsite dose rate from direct radiation exposure following this EPU is estimated to be about 18.6 mrem per year. This annual dose is within the applicable 40 CFR 190 annual limit of 25 mrem to an actual member of the public, as referenced by 10 CFR 20 paragraph 20.1301 (e).

Operational Radiation Protection Programs:

The increased production of non-volatile fission products, actinides and corrosion and wear products in the reactor coolant may result in proportionally higher plate-out of these materials on the surfaces of, and low flow areas in, reactor systems. The corresponding increase in dose rates associated with these deposited materials will be an additional source of occupational exposure during the repair and maintenance of these systems. However, the current ALARA program practices at Vermont Yankee (i.e., work planning, source term minimization, etc.), coupled with existing radiation exposure procedural controls, will be able to compensate for the anticipated increases in dose rates associated with this EPU. Therefore, the increased radiation sources resulting from this proposed EPU, as discussed above, will not adversely impact the licensees ability to maintain occupational and public radiation doses resulting from plant operation to with the applicable limits in 10 CFR 20 and as low as is reasonably achievable.

Conclusion

The NRC staff has reviewed the licensee's assessment of the effects of the proposed EPU on radiation source terms and plant radiation levels. The NRC staff concludes that the licensee has taken the necessary steps to ensure that any increases in radiation doses will be maintained as low as is reasonably achievable. The NRC staff further concludes that the proposed EPU meets the requirements of 10 CFR Part 20, 10 CFR Part 50, Appendix I, NUREG 0737, and draft GDC-11. Therefore, the NRC staff finds the licensee's proposed EPU acceptable with respect to radiation protection and ensuring that occupational radiation exposures will be maintained as low as is reasonably achievable.