Advanced Offgas Follow-up Report

On 4/3/96 the President of Vermont Yankee requested that the Advanced Offgas (AOG) Investigation Team reconvene to address the specific questions raised in letters dated 3/27/96 and 4/1/96 from the New England Coalition on Nuclear Pollution (NECNP).

The initial report by the AOG Investigation Team dated 1/17/96, specifically addressed each of the assertions contained in the original anonymous allegation. During interviews with approximately 30 Vermont Yankee and Yankee Atomic employees who were technically or operationally involved with the AOG system, the Investigation Team asked questions specially fashioned to elicit any indication that the AOG system was not operating properly or was not functioning as designed. Had the Investigation Team determined there was any evidence of a technical problem with the system, the Team would have recommended a full technical review of the design and operation of the AOG system. However, because: 1) there were no technical or operational problems existing with the AOG system , 2) the review of radiological data at the plant ventilation exhaust stack from the past operating cycle did not indicate any abnormal or "illegal releases," and 3) there were no other credible release paths, the Investigation Team concluded that Vermont Yankee was not releasing "illegal amounts of radiation" and that the AOG system was operational throughout the period of time under review.

Following the President's assignment on 4/3/96, the AOG Investigation Team reviewed the original report, supporting documentation, and the assertions and questions in the two recent NECNP letters. Radiation monitoring data reviewed by the Investigation Team encompassed potential pathways for release from the AOG system. The normal flowpath through the AOG system uses the recombiners, dryers, and adsorbers and was the primary focus of the review because it contains the critical monitoring equipment and components. The review also encompassed the potential AOG internal bypass flowpaths. These flowpaths include sufficient radiation monitoring equipment to monitor potential releases and were included in the initial review of radiological monitoring data. As a result of our review, the Team's original conclusions are unchanged.

March 27, 1996 NECNP Letter

Question 1 - *Time Frame: The letter gives no time frame for when the alleged releases took place. What period did you choose for review and why?*

Response:

The Investigation Team specifically reviewed data regarding releases over the past operating cycle (from May 2, 1995 to December 31, 1995). This was initially chosen as a review window because the allegations implied a chronic condition that was continuing and used the present tense: "is discharging illegal amounts of radioactivity." The plan of the Team was to review additional historical data if there were any indication in the data, or in the interviews with personnel that extraordinary releases had occurred. In fact, not only did the data show that no such release had occurred during the operating cycle, but the clear consensus of everyone interviewed was that the AOG system had historically been reliable and effective in meeting it's design. In addition, the Team was aware that the radiation monitors in question are designed to detect all releases through the stack. They are also subject to ongoing reviews and audits, by both internal and external reviewers, to ensure proper operation, and are reviewed for adverse trends on a daily basis. The Team, therefore, concluded that no wider review of historical release data was necessary. However, to eliminate any doubt as to the appropriateness of the original review window for this report, the Team has reviewed an additional period of stack release data (2/93 -1/95). This additional review looked at each start-up and shutdown and other random periods during this time frame. Again the Team found no evidence of any abnormal or "illegal" releases.

Question 2 - *100% Error Factor: The Vermont Yankee annual effluent reports state that the error involved in their method to determine isotopic releases "may be approximately" plus or minus one hundred percent (+/- 100%). Errors for Iodines and particulates are +/- 50%. Can such large error factors be exploited to mask illegal releases? If not why?*

Response:

No. Normal effluent releases from the plant stack are a few percent of the dose limits for noble gases and a few tenths of a percent of dose limits for iodine and particulate releases. At these very low levels of release, the relative uncertainty in distinguishing plant related releases above the natural variation in background radiation cause the relatively high estimate (+/- 100% factor) of accuracy. For the small effluent values that are typical, a doubling in the release value is still a small number both in terms of the total radioactivity being released and its percentage of the applicable release limits. As the magnitude of a release increases, the ability to distinguish it from the normal fluctuations in the detector background also increases, thereby tending to reduce the total error, even if other factors affecting overall error remain unchanged.

The requirement for the inclusion of the estimated error in the annual effluent report comes from the USNRC Regulatory Guide 1.21 (Revision 1, June 1974). The Regulatory Guide

requires that the total or maximum error associated with the effluent measurement include the potential cumulative errors resulting from the total operation of the sampling and laboratory measurement system. The Regulatory Guide recognizes that it may be very difficult to assign error terms for each parameter affecting the final measurement, and states that a detailed statistical evaluation of error is not suggested.

The annual effluent release reports typically list a total estimate of error for activation and fission product gases of plus or minus 100%, and plus or minus 50% for the quantification of iodine and particulates that make up total radioactivity releases. These determinations conservatively bound systematic errors associated with the sample collection and laboratory measurement program used to provide a retrospective quantification and isotopic breakdown of gaseous releases. In addition, on-line radiation monitors both in the plant stack and in the AOG system provide a direct, real time indication of any excessive level of the total radioactive gases being discharged. These monitors have an accuracy factor of +/- 25%. They provide part of the data record, along with sample collection and laboratory analyses, used in the determination of effluent discharges to the environment.

In addition to the cumulative dose limits intended to keep total impacts as low as reasonably achievable (ALARA), plant releases also have dose "rate" limits intended to minimize the amount of radioactivity that can be released at any moment. For noble gases this is equal to 500 mrem/year (0.057 mrem/hour). As a result, even if the indicated error band of +/- 100% did not decrease if releases were a significant fraction of the Technical Specification dose rate limit, the current method of reporting would not mask the range of the indicated release. As an example, if stack monitor readings indicated releases were equivalent to 50% of the effluent dose rate limit, the application of the +/- 100% error band would also indicate that the range could be from only 25% of the limit up to the limit itself. Such levels would be unusually high and would prompt additional plant evaluations and reporting since this magnitude of release rate could not be sustained but for a small fraction of the total hours in a quarter (about 4%) before the ALARA cumulative dose limits would be exceeded. Therefore, because of the procedural controls and the Technical Specification requirements in place to govern monitoring setpoints, it would be highly unlikely to mask an illegal release.

Question 3 - *Operational Records: Recent events at Seabrook suggests that very large releases can be missed by plant monitoring systems, especially when monitors are shut off at the time a release occurs. In news reports (Reformer, Jan 4,1996), Vermont State Engineer William Sherman said that Vermont Yankee had replaced stack monitors because "... the old ones required too much maintenance." Given the obvious importance of having a continuous record of radiation releases to the determination of the truth or falsity of the allegations, we would expect NRC's investigation to provide the operational records and data of the radiation monitors at Vermont Yankee.*

Response:

Vermont Yankee's radioactive monitoring program consists of many on-site radiation monitors that are designed and implemented to detect any abnormal levels of radioactivity. The on-site monitoring consists of building radiation monitors, process line radiation monitors, as well as the ventilation stack radiation monitors. The stack monitors are the final on-site check for radiation levels. In addition to the on-site monitors, Vermont Yankee has an off-site program that monitors the surrounding towns. This program is discussed further in the response to question 5.

Not withstanding the above, the Investigation Team reviewed Vermont Yankee operational data related to Stack Gas monitors 1 and 2 from start-up from the 1995 refueling outage (May 1995) through the end of 1995. A review of the Shift Supervisors log and the LER index found no indication of any abnormal or "illegal releases". In addition to the time frame discussed above, the Investigation Team reviewed one additional period of radiation data during the follow-up review. This additional review included all shutdowns and startups between 2/93 and 1/95, as well as other randomly selected time frames and found no evidence that Vermont Yankee released "illegal amounts" of radiation. In addition to the above, a second additional time frame was reviewed (1/18/84 - 1/22/84) during which time the AOG internal bypass line was used because of an increase in condenser air inleakage. The internal bypass utilized only bypasses the charcoal filters but still passes through the radiation monitors that provide automatic isolation of the stack as well as the stack monitors. Once the problem was identified, the plant was shutdown for repairs. The specific time that the internal bypass line was used was 1/19/84 @1410 thru 1/20/84 @1935. The review of radiological data during this period showed all releases were well within regulatory limits.

This review also looked at the maintenance history and the minimum number of radiation monitors operable during this period. The maintenance and surveillance records indicate that the equipment was always calibrated and functioning properly while in service but was replaced in 1995 to lower the frequency of maintenance. Licensee Event Report (LER) 95-012 documents a period of approximately 5.5 hours during the 1995 refueling outage when both Stack Gas 1 and 2 were out of service due to a power interruption. This event was analyzed for potential safety significance and reported to the NRC. Analysis revealed that no release occurred since the plant was in a shutdown condition and other monitoring equipment was in service. All data related to the recording of radiological information are kept on file at Vermont Yankee and are reviewed and subject to audit, inspection and assessment by both internal and external agencies. A review of the Shift Supervisors Log was also performed, back to 1984, to look for evidence of unreliable radiation monitor behavior. No evidence was identified.

Question 4 - *Bypass Mode: During startup and shutdown, Vermont Yankee must bypass the charcoal filter system. This should correlate with large increase in stack activity since filters result in nearly 1000 times reduction in gaseous activity levels. The Bypass Mode obviously represents a pathway for large releases. We would expect NRC's investigation to detail if the bypass valves were ever open during the reactor run mode. Also, it would be prudent to correlate any bypass mode operation with operational records requested above to determine if Vermont Yankee operated in bypass mode when stack monitors were not functioning.*

Response:

The above question states that Vermont Yankee "**must bypass the charcoal filter system**" during startups. There are 3 different bypasses of the AOG system, two of which bypass the charcoal filters and the third bypasses the hydrogen recombiners, dryers, and charcoal adsorbers; however, all effluent must pass through the stack radiation monitors.

It is the Investigation Team's belief that the NECNP is referring to the AOG "startup bypass" line. Although internal bypass capability is provided and permitted, this is not routinely done. Discussions with Operation Department personnel, and a review of past operations logs, indicate that the internal bypass has not been used since the mid 1980's.

In addition, if the internal bypass line were used, all effluent still passes by both the radiation monitors in the stack and other monitors both upstream and downstream of the charcoal filters. Thus, even if the internal bypass were employed, releases through the system would continue to be monitored for radioactivity. The following is a description of each mode of operation of the AOG system.

Normal Operation:

During normal plant operation, the AOG system is used to process gases prior to going to the stack. The normal flowpath through the AOG system utilizes hydrogen recombiners, dryers, and charcoal adsorbers. This flowpath is monitored by several radiation monitors and the system design has automatic isolation features based on increasing radiation levels.

Internal Bypass Line Operation:

There are two different internal bypasses associated with the charcoal filtering system of the AOG system. The first is what may be called the "Startup Bypass" and the other as the "AOG Bypass." Both internal bypass lines flow through the stack radiation monitors and both lines bypass the dryers and the charcoal adsorbers.

Vermont Yankee does not routinely use either of the internal bypass lines during startup or shutdown. Vermont Yankee procedures, Technical Specifications, and Final Safety Analysis Report (FSAR) provides guidance on the use of the AOG startup bypass during power operation. The only time in the last 12 years that the internal bypass line was used during power operation was for approximately 29 hours during January of 1984. Review of operating records indicates that all radiological limits and operating requirements were complied with during that period. The Team found no evidence of improper operation of the internal bypass line or indication of radiological releases above state or federal limits. It should also be noted that stack radiation monitors would indicate radiation levels with either internal bypass in use. Automatic isolation of the AOG system is provided for use with the start-up internal bypass that would terminate any release from the stack if radiation levels exceeded plant limits. This action would occur well before reaching any Technical Specification/NRC limits. The manually operated valves in the AOG bypass are closed (and verified closed on 4/15/96) and in a location that would prohibit inadvertent mispositioning of the valves. This flowpath was only established during the time that AOG was installed and put into operation in 1973 and is not currently used during any mode of operation. A review of operational logs was conducted and confirmed that neither of the internal bypass lines were used when any of the stack monitors were out of service for the past 12 years.

Mechanical Vacuum Pump:

The AOG dryers and adsorbers are primarily designed to process effluents from the Steam Jet Air Ejectors. Early in reactor startups, there is a need to begin to establish a vacuum in the main condenser. At this stage in the startup process there is insufficient steam pressure available to use the steam jet air ejectors and therefore, the AOG dryers and adsorbers (i.e. charcoal filters) are not in service. The Mechanical Vacuum pump is utilized to begin the condenser evacuation process. The effluent from the vacuum pump bypasses the AOG system but is discharged through the stack and monitored by the Stack Gas Monitors. The system will automatically isolate if high radiation levels are sensed in the main steam lines which is the path radioactive gasses would take to the condenser. Additional administrative controls are in place that prohibits vacuum pump operation at power levels >5% or with the reactor mode switch in Run.

Question 5 - *Monitoring Adequacy: The large unmonitored release at Seabrook was recorded by C-10, a citizen monitoring network under contract with the state of Massachusetts. It is our understanding that it was not recorded by plant monitoring systems. Vermont Yankee has no such extensive citizens monitoring. In refuting the allegations, officials at all levels have pointed to the lack of evidence from the plant monitoring systems. Can NRC demonstrate that even in the event of a large release the scope of the existing monitoring program would be sufficient to detect it? What assures us that plant monitors off-site were functioning, not miscalibrated, or in other ways compromised?*

Response:

There are systems in place at Vermont Yankee to detect any abnormal release. The Investigation Team has reviewed actual monitoring data, instrument calibration data, and discussed State monitoring results with state officials that substantiate the fact that there were no "illegal releases."

In addition to the above, the Vermont Yankee Radiological Environmental Monitoring Program (REMP) consists of environmental monitoring and sampling locations that provide monitoring information that would indicate changes in background radiation level. This monitoring program has been in existence since before Vermont Yankee began operation and includes 40 thermoluminescent dosimeters (TLDs) at offsite locations. TLDs are passive devices that record an integrated history of direct radiation exposure that they are subjected to. Each TLD is calibrated to National Institute of Standards and Testing (NIST) traceable sources. Included with each field batch of TLD's when read out, are Quality Control dosimeters (10% of the number of dosimeters in the batch) that have been given a known exposure as a check on the operation of the analysis system. Field TLD's are normally collected and read on a quarterly schedule, but would be evaluated more frequently if plant monitor indication showed an effluent release above administrative limits. In addition, the NRC independently manages its own set of 40 TLD locations in the Vermont Yankee plant vicinity. This provides a separate set of direct dose indications to complement and check the accuracy of the plant's own network. The state of Vermont also has its own monitoring programs similar to what was discussed above but completely independent of the Vermont Yankee monitoring program. In his comments made at the VSNAP meeting, Mr. Ray McCandless, of the Vermont Department of Health, reported that the state of Vermont had not seen any indication of higher than normal activity from their monitoring program.

In addition to direct exposure measurements using TLD's, the REMP has six offsite air sampling stations that continuously collect ambient air for analysis of radioiodine and airborne particulate radioactivity. Both the air sampling and analysis equipment are included in a Quality Assurance (QA) program that assures proper system maintenance, calibration, verification of the measurements' accuracy, and the historical records of the equipment. No abnormal releases have been identified by this program. The REMP also includes the collection of ingestion pathway media such as milk, water, and vegetation samples that could provide an indication of reconcentration of radioactive materials in food products.

The entire monitoring program is subject to the NRC's inspection program. All laboratory analyses are subject to a strict QA program to ensure the reliability and accuracy of each measurement. Again no indication of any abnormal releases has been detected

All of the above monitoring and testing programs are part of the Vermont Yankee Quality Assurance program that implement the requirements of 10CFR50 Appendix B, and all

are subject to NRC inspection and audit. The most recent NRC inspection of these programs in November of 1995, found no areas of noncompliance.

In addition to the above, for an abnormal release to occur, some abnormal plant operation or event would have to occur. These type of incidents are investigated individually and would be well documented. A review of operating records over the past cycle found no record of abnormal releases as a result of plant operations.

Question 6 - *Life Expectancy of the Charcoal Filters: What is the design life of the offgas filter system?*

Response:

The charcoal adsorber train in the AOG consists of a charcoal guard bed in each train (that is a 3 foot by 6 foot cylinder filled with charcoal that protects the adsorber beds from excessive moisture) containing 847 lbs. of charcoal, and seven adsorber vessels containing approximately 90,000 lbs of charcoal. The useful life of the charcoal in the adsorber train is expected to last for the life of the plant. The main potential threat to the performance characteristics of the charcoal adsorber is associated with excessive moisture carried over to the charcoal beds. To protect against this condition, the AOG includes moisture separator and dryer subsystems to remove water from the air stream flowing to the adsorber beds, including instrumentation to monitor the operational conditions in the AOG. Charcoal guard beds are included in the design to protect the downstream adsorber vessels from unexpected carry over of any moisture or other contaminants from the dryer subsystem. However, even if some moisture or other contaminant were to enter the adsorber train, the resulting impact would be only a partial reduction in the overall dynamic adsorption efficiency of the charcoal. Existence of any abnormal condition would be detected by the radiation monitors in both the inlet and outlet sides of the first two adsorber vessels and at the outlet of the AOG.

April 1, 1996 Letter:

The NECNP letter of April 1, 1996, accuses Vermont Yankee and the Investigation Team of either having engaged in a coverup or incompetence. This accusation supposedly arises out of the unawareness of the Chairman of the Investigation Team of the existence (and supposedly routine usage) of the AOG bypass line in a discussion that occurred during the VSNAP meeting of March 28, 1996.

There are many aspects of the Team's investigation that are not specifically called out in the report. The Team's scope included reviewing many aspects of the AOG system and specifically focused on the systems design, operation, and maintenance that could have lent credence to the allegation. This scope included a review of the FSAR, Technical Specifications, procedures, training modules, operational data, and maintenance records. Had the internal bypass been found to have potential relevance to the allegation it would have been discussed in more detail in the original report. The Investigation Team assessed the April 1, 1996 NECNP letter as it related to the Team's original review/assessment of the AOG allegations. The Team concluded that the AOG internal startup bypass line, which is the cause of the inquiry, was not germane to the anonymous allegation for the following reasons:

1. The internal bypass line in question does not bypass 5 of the critical radiation monitors in the system and that were reviewed for abnormal releases.

2. The Team discussed and was aware of all internal bypass capabilities of the system and specifically discussed their potential relevance to the allegation during the investigation, therefore the Team Leader had knowledge of the internal bypass.

3. The internal bypasses are normally isolated and there were no operational or system performance indications that they were compromised in any way. Again, there is no bypass that bypasses the entire system, and stack monitoring data demonstrated the performance of the AOG system and that no releases above regulatory requirements had occurred.

4. The Team did not feel the internal bypass line was germane to the allegation. Through the interview process, review of technical and operational data, and review of stack radiological data, the Team did not find it necessary to do an in depth review of the use of the bypass line.

5. The internal bypass lines do not have any radiation monitors specific to the bypass lines themselves but do reconnect to the original line and are monitored. The anonymous allegation spoke of critical monitoring equipment being miss-calibrated. The internal bypass lines have no critical monitoring equipment.

Therefore, based on the above, the internal bypass capabilities were not addressed in the original report or included in the simplified diagram presented at the VSNAP meeting because all effluent still passes through the radiation monitors previously discussed.

Respectfully submitted,

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Dated: May 7, 1996

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