

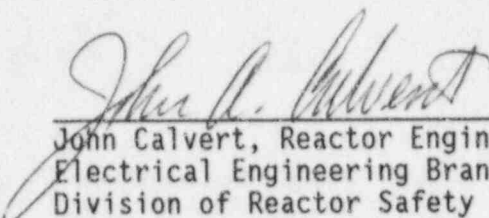
ENCLOSURE 3

U.S. NUCLEAR REGULATORY COMMISSION

REGION 1

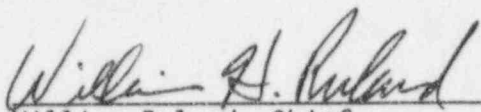
DOCKET/REPORT NO. 50-271/96-03  
LICENSEE: Vermont Yankee Nuclear Power Corporation  
FACILITY: Vermont Yankee  
DATES: March 3 - 8, 1996 thru April 10 - 11, 1996  
LOCATION: Vernon, VT

INSPECTOR:

  
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John Calvert, Reactor Engineer  
Electrical Engineering Branch  
Division of Reactor Safety

4/25/96  
Date

APPROVED:

  
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Electrical Engineering Branch  
Division of Reactor Safety

4/26/96  
Date

**REPORT DETAILS FOR VERMONT YANKEE  
INSPECTION REPORT NO. 96-03**

**1.0 ADVANCED OFFGAS SYSTEM MODIFICATION REVIEW**

This inspection was conducted on March 3 - 8, 1996, at the Vermont Yankee site, and April 10 - 11, 1996, by telecon from the NRC Region I offices.

**1.1 Scope and Background (IP37700)**

**a. Scope**

The inspector reviewed the current technical status of the advanced off-gas (AOG) system, as part of the verification process for the licensee's letter to the NRC (No. BVY 96-17), dated February 26, 1996. The inspector reviewed those issues dealing with system performance deterioration and a modification cancellation. The radiation aspects of the AOG system are covered, in part, in reports 50-271/95-25, Section 5.1, and 50-271/95-24. The hydrogen analyzer aspects of the AOG system are covered in inspection reports 50-271/96-02, Section 3.2 and 50-271/95-25, Section 3.2.4.

The inspector interviewed personnel associated with the AOG system and/or modification such as the design engineer, electrical engineer, I&C engineer, maintenance engineer, project engineering manager, and operations support engineer. The former project manager for the AOG modification declined to be interviewed by the inspector for this inspection.

The inspector reviewed pertinent licensee documents associated with the AOG system and modification such as the UFSAR, LERs, licensee safety evaluation, I&C work orders list, I&C procedures list, I&C system-analyzed maintenance (SAM), operator rounds procedures, reliability-based maintenance (RBM), system specifications/drawings, modification drawings, drawing modification job file, design engineering memorandums, and project engineering memorandums.

The inspector performed walkdowns of the control room AOG panel and accessible equipment in the AOG building.

**b. Background**

The AOG system was added to the Vermont Yankee plant in 1973. The purpose of the system is to process noncondensable gases removed from the main condenser to limit radioactive gaseous release to as low as reasonably achievable. The guard bed, adsorbers and associated system components are safety Class 3 (processes or houses radioactive waste) in the licensee's classification criteria. All other parts of the system are classified as non-nuclear safety.

The system performs six processes on the main condenser gases before release to the plant stack: hydrogen dilution; hydrogen recombination; preliminary delay for decay of radioactive gases; moisture removal; charcoal adsorption; and final delay for decay of radioactive gases. Except for the passive delay pipes and charcoal adsorbers, the AOG consists of two trains of equipment with cross connection capabilities for certain equipment.

A bypass line is installed downstream of the hydrogen dilution/recombiner trains and the preliminary delay pipe. The bypass does not include bypass of the hydrogen dilution/recombiner trains. The bypass permits continued reactor operation if portions of both trains of the moisture removal and the charcoal adsorbers were to become inoperable during normal operations. The bypass line is joined to the input of the final delay pipe for transport to the plant stack.

The radiation is redundantly monitored after the bypass line, just before the final delay pipe. If the radiation monitoring levels of the monitors exceed a preset level, automatic action occurs to shut off flow to the stack from the AOG system. The plant stack has additional radiation monitoring, but no automatic control function.

## 2.0 OBSERVATIONS AND FINDINGS

### 2.1 Review of 10 CFR 50.59 Safety Evaluation for the Planned Modification

The inspector reviewed the document, "EDCR 94-02 Enclosure (A) Safety Evaluation." The equipment involved in the modification was classified non-nuclear safety. The evaluation arrived at the appropriate conclusions and showed that neither the functions of any safety-related system would be degraded, nor would the margin of safety be degraded as defined in the Technical Specification for the AOG system.

### 2.2 Review of Modification Planning

The modification, EDCR 94-402, was designed by the licensee to improve the reliability operations and maintainability of the system. The modification was originally scheduled for the 1995 and 1996 refueling outages, but has since been planned to be separated into a set of smaller tasks that could be performed as minor modifications for the 1995 and 1996 outages.

An initial licensee engineering evaluation was made at the beginning of the modification design in 1992 to identify problems in the areas of reliability, operation, and performance of maintenance activities. The major areas listed below were identified as needing improvement.

- (1) Provide a verified, unified set of drawings for operations, maintenance, and I&C activities. Perform field verification of the as-built wiring. Revise the AOG control panel drawings, especially the electrical independence and wiring areas.

The original 1973 contractor drawings were difficult to read because of layout, lettering, lack of detail, and reproduction quality. The drawings and the actual electrical installation did not incorporate VY engineering standards, for example, redundancy and instrument fusing. The revision control of the drawings was poor. In the case of the piping and instrumentation diagrams (P&ID), there were two identical sets of drawings done by two different contractors.

An example of the wiring problems was that some of the neutral wires were connected from different power supplies than the hot wires. This was viewed by the licensee as a condition that could cause erratic operation of the instruments. This is further discussed in the Section on "Status of the Modification."

The major weakness the licensee engineering identified was that, if a postulated failure of a single link in the instrument ac bus occurred, it could cause extensive failure of the AOG instrumentation. This is further discussed in Section on "Status of the Modification."

The licensee stated that the functionality of the system was not hampered by these discrepancies. Maintenance could be performed, but not efficiently. Over the years, as minor changes were made, the confidence in the accuracy and completeness of the electrical drawings was questioned by operations and maintenance personnel.

- (2) Change the level control and pumping system for the AOG condensate drain tank, TK-104-1. This is an interfacing system to the AOG that is used during normal operations.

The tank receives extracted moisture from the AOG process lines. The water is then pumped to the main condenser. The tank level provides a water barrier between the condenser vacuum and the AOG process lines.

During start-ups from extended outages or in cold weather, a large volume of condensate is produced and AOG system startup times are increased. During normal plant operation, a low level of condensate is produced. There were instances when the tank was pumped dry, which the licensee found the root cause to be regulating valve controller failure.

The licensee's focus of this item was availability, rather than functionality, of the system. The modification was to replace the level control system with a type that integrated pump control and protection.

- (3) Upgrade the pressure rating for the steam jet air ejector (SJAE) inter-condenser.

This system operating pressure upgrade would increase the design margin to absorb pressure transients associated with the isolation of the AOG recombiner inlet valves. An installed rupture disc downstream of the inter-condenser currently prevents AOG system damage due to inadvertent system isolation and/or hydrogen detonations. Over the past several years, this rupture disc has actuated due to over-pressure conditions approximately eight times, necessitating a unit shutdown to replace the disc. With the increased inter-condenser pressure rating, the setpoint of the rupture disc could likewise be increased. The inspector determined that system availability, rather than system functionality, was the focus of this item.

The inspector notes that the potential radiological release consequences of a rupture of the AOG rupture disc has been the subject of previous

NRC staff review and follow-up (reference inspection reports 92-01, 92-15, 93-25, and 94-27). As documented in these reports, the licensee modified the turbine building ventilation system to exhaust to the main stack to ensure proper filtering and monitoring of gaseous radiological releases. Until this modification was completed in the Fall of 1993, the licensee took appropriate interim measures to monitor potential releases via the turbine building ventilation system pathway. The inspector also reviewed the applicable off-normal operating procedure (No. ON-3151, Off Gas Explosion/Rupture Disc Failure) and verified that appropriate procedural guidance was in place to ensure prompt actions are taken should this event occur.

In addition to the above items, eight other areas addressed in the modification package similarly focused on system availability, maintainability and routine operations. Examples were the replacement of analog recorders with digital chartless type recorders, replacement of analog controllers with digital controllers, circuit changes to eliminate spurious AOG annunciator alarms, and re-configuration of the instrument air supply to valves to prevent unnecessary loss of recombiner heat exchangers due to loss of instrument air.

### **2.3 Review of Modification Design**

The design engineering coordination with the operations, I&C, and maintenance functions to identify concerns, analyze the concerns, evaluate the alternatives, and document the design bases was performed well. This was indicated by the depth of the design analyses and the active engineering participation in site walkdowns.

The consolidation and updating of the as-built drawings of the AOG control room panel 9-50 was performed well. The licensee performed a detailed point-to-point walkdown and verification of the 9-50 panel as-built drawings and found only one minor difference, which was corrected on the drawings.

The licensee review at the site identified wiring discrepancies with the planned modification drawings that could have potentially complicated the installation process. This indicated good performance of the overall drawing review process, but indicated weakness in the engineering drawing check procedures for the modification.

The licensee checked the electrical wiring in the AOG building to confirm conformance with the original system installation drawings. Several discrepancies were found and corrected. None of the discrepancies affected proper functioning of the system, according to the licensee.

### **2.4 Status of the Modification**

The licensee management made a decision to not include the modification in the April 1995 refueling outage. The inspector reviewed two internal VY documents, "AOG Mods Design Change," December 22, 1994, (VY Vice President, Engineering to VY Department Manager and Project Manager), and "AOG Design Changes," January 24, 1995, (VY Vice President, Engineering to VY Department Manager) for reasons why the decision was made. The inspector found from the

review, supplemented by personnel interviews, information to suggest that the main reason for the management decision was because all the documentation necessary for the modification package had slipped schedule milestones.

The modification design drawings were completed and put under drawing control, but the modification was cancelled and not implemented as part of the 1995 refueling outage. The inspector noted that the 9-50 panel wiring, where the neutral wires were from different power supplies than the hot wires, was changed as a task during the 1995 refueling outage.

The change of the postulated failure of a single link in the instrument AC electrical bus and the effect on the instrumentation was not implemented as a separate task during the 1995 outage. The licensee has this task under review for future implementation. The inspector noted that if this postulated failure of a single link were to occur and if all AOG instrumentation would consequently fail, it would be covered by the Limiting Condition for Operation (LCO) in the requirements for minimum number of channels operable of Technical Specification (TS) Table 3.9.2 (2a,b,c), Gaseous Effluent Monitoring Instrumentation, which covers radiation monitoring, flow rate, and hydrogen monitors. This TS would permit continued plant operation and release of off-gas effluents via this pathway for up to seven days provided one stack radiation monitoring system was operable and off-gas temperatures and pressures were continuously monitored.

## **2.5 Review of Maintenance Engineering**

### **a. Instrument and Controls (I&C)**

The I&C engineering group started a system-analyzed maintenance (SAM) project for the AOG system in 1992. The inspector reviewed the document "VY I&C Preventative Maintenance, System Analyzed Maintenance Project (SAM)," Revision 2, dated February 6, 1996, that described the purpose, objectives, and methodology of the project.

The document described the method for classifying the instruments of a system according to designed function, safety class, importance to function, vendor recommendations, maintenance history, operating experience. An appropriate maintenance task with an associated interval is then assigned.

The AOG system has 370 instruments, 318 of which have been classified to date and are planned for final engineering review. Approximately 85% of the instruments were classified as functionally important. The inspector reviewed a sample of ten completed worksheets for the functionally important equipment and noted that the function was clearly described, and the general requirements for the maintenance task was delineated.

### **b. Mechanical**

The maintenance engineering group had a project similar to the I&C SAM project called reliability-based maintenance (RBM). The AOG mechanical components had all been classified and had been reviewed. The inspector selected a valve in the recombiner drain (HO-OG-587) and reviewed the basis of classification, and

noted that the functional importance basis and maintenance actions were appropriate for the valve service.

## 2.6 Review of Maintenance Status

The inspector reviewed a listing of work orders on the AOG system from 1991 to the present. The listing showed that the operators were alert to the identification of off-normal conditions, such as motor bearings making noise, pump cycling, air fitting leaking, and valve packing leaking that could lead to degraded conditions. The inspector determined that the listing showed no indication that functional problems occurred that were not addressed by corrective actions.

The inspector determined that there were I&C instrument calibration procedures for the system instrumentation. Additionally, there were functional/calibration procedures for the AOG hydrogen monitors, radiation monitors, trip system, moisture detectors. The work order status showed that instrument calibration and functional checks had been performed.

The inspector reviewed the document "Advanced Off-Gas Hydrogen Analyzer and Recombiner Catalyst," memo number VYI-2/96, dated January 5, 1996. The document stated that the licensee performed an analysis of temperature indications across a recombinder from actual plant data covering the period from 1980 to 1995. The trend of temperature showed that the recombinder was operable, but indicated a loss of catalyst efficiency. The outlet temperature data was lower than expected, which could indicate higher output hydrogen concentration. The licensee performed a grab sample check of the output that showed that the hydrogen concentration was well within the normal plant operating band. Engineering recommended that the inside and outside surfaces of the thermocouple wells be cleaned and the thermocouples be checked as the corrective action for the low outlet temperatures.

Engineering also found that the design specification for the catalyst life was for 18 months to 5 years, so they conservatively recommended replacement of the catalysts at the next refueling outage, even though the data showed that the recombiners are properly performing their function. This recommendation is being reviewed by licensee management. Further discussion of the catalyst life is found in Section 3.0.

## 2.7 System Walkdown

The AOG building was very well laid out and the inspector considered redundancy, physical separation, shielding, and maintainability. The material condition was generally very good.

The AOG control room panel CRP 9-50 arrangement provided the necessary readouts, recorders, system mimics, and controls to operate and determine system status. The inspector verified that the following indications were within normal operating ranges: radiation level at the SJAE; the recombinder inlet/outlet temperatures; recombinder outlet flow; hydrogen analyzer percent of combustible limit; guard bed inlet radiation; first section adsorber outlet radiation; and system outlet flow. The panel had an extensive temperature

monitoring panel for indication of system temperatures at heat exchangers, for example. Additionally, the panel had pressure indications for key points in the system.

### 3.0 REVIEW OF UFSAR AND COMMITMENTS

A recent discovery of a licensee operating their facility in a manner contrary to the Updated Final Safety Analysis Report (UFSAR) description highlighted the need for a special focused review that compares plant practices, procedures and/or parameters to the UFSAR descriptions.

While performing the inspections discussed in this report, the inspectors reviewed Section 9.4, "Gaseous Radwaste System," of the UFSAR that related to the areas inspected. The inspectors verified that the UFSAR wording for the AOG system was consistent with the observed plant practices, procedures and/or parameters. The modifications of EDCR 94-402 were not checked versus the UFSAR because the EDCR was cancelled and planned to be implemented at a later date.

As a result of their follow-up of the AOG system hydrogen monitor issues, the licensee noted that in their licensing change request to the NRC for the AOG system of June 16, 1972, Attachment A, Appendix A, "Description of Offgas Processing System Components," page A-3, that the recombiner catalyst lifetime was estimated to be equivalent to plant lifetime when operating in the steam/offgas environment. They also noted inconsistent lifetime catalyst information in the proprietary Appendix C, page C-3 of Attachment A to the licensing change request, which described the catalyst expected life as less than plant lifetime. The licensee's resolution of the inconsistent recombiner catalyst lifetime in the AOG license change request documents and any impact on catalyst maintenance is an unresolved item (URI 50-271/96-03-07).

### 4.0 MANAGEMENT OVERSIGHT

Project engineering management initiated an independent engineering review of the design implementation process. Inspection information suggested that plant and engineering management made the decision to not include the modification in the 1995 shutdown because all the documentation necessary for the modification package had slipped schedule milestones. The inspector inferred from these actions that management was actively involved in the oversight of the modification.

The inspector found no indication that the cancellation of the modification was driven by cost considerations other than the inherent cost risk associated with implementing a modification with possible incomplete documentation.

### 5.0 CONCLUSIONS

The licensee's resolution of the inconsistent recombiner catalyst lifetime in the AOG license change request documents and any impact on catalyst maintenance is an unresolved item (URI 50-271/96-03-07).



The inspector found no engineering or maintenance indications in the last 5 years that AOG system functionality was impaired in such a manner that led to degraded conditions that exceeded the Technical Specification requirements either for minimum channel availability, or AOG system instrumentation, or AOG system operability.

The inspector found no indication that the cancellation of the modification was driven by cost considerations other than the inherent cost risk associated with implementing a modification with possible incomplete documentation, such as installation and test instructions.

The engineering coordination with the plant staff, the quality of the consolidated as-built panel 9-50 electrical drawings, and the delineation and resolution of design issues for the planned AOG modification were generally very good.

The I&C and maintenance engineering initiatives regarding AOG system analyzed I&C maintenance and reliability-based mechanical maintenance for components were good.

#### 6.0 EXIT MEETING

The findings of the inspection were presented and discussed with Mr. D. Reid, Vice President of Operations and members of the licensee's staff on March 8, 1996, as listed in Section 7.0. The licensee acknowledged the findings presented.

The inspector telephoned the licensee on April 10 and 11, 1996, for additional information on the maintenance for the hydrogen recombiner catalyst.

The inspector received and reviewed proprietary material during the inspection and used the material for technical reference. No proprietary information was knowingly included in the report.

#### 7.0 LIST OF PEOPLE CONTACTED

##### Vermont Yankee Nuclear Power Corporation

J. Bolvin	Manager, Technical Support
E. Bowman	Operations Engineer
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L. Casey**	Design Engineer, YNSD
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*W. Cook	Senior Resident Inspector

\* Present at exit meeting on March 8, 1996

\*\* Contacted by telephone April 10 - 11, 1996