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U.S. ATOMIC ENERGY COMM.  
MAIL & RECORDS SECTION

EBS-73-44

March 16, 1973

Mr. Angelo Giambusso  
Deputy Director for Reactor Projects  
Directorate of Licensing  
U. S. Atomic Energy Commission  
Washington, D. C. 20545

Reference: Quad-Cities Nuclear Power Station, Unit 2  
Docket No. 50-265; License DPR-30  
Appendix A, Section 1.0.A.3 and 1.0.A.5

Dear Mr. Giambusso:

The purpose of this letter is to inform you of a hydrogen explosion which occurred in the Unit 2 off gas hold up volume on March 6, 1973 at about 9:25 PM. The pressurization of the off gas pipe broke the rupture disc in the 2B Air Ejector Room and resulted in an unplanned release of radioactivity through the turbine building ventilation system. The release was determined to be well within the Technical Specification limits for gaseous and particulate effluents. This abnormal occurrence was reported to Region III Compliance on March 7, 1973.

Description of Incident

At 9:24 PM on March 6, 1973 OCB 2-6 in the 345 KV switchyard tripped. The cause of the trip was not immediately apparent, however, it was believed to be the result of lightning from a storm in the area. At approximately the same time the Unit 2 Control Room Operator noticed that the air ejector discharge flow recorder was oscillating in an erratic manner. A power reduction was initiated and then stopped when the flow indication stabilized after one minute.

At approximately 9:26 PM several Area Radiation Monitors in the turbine building began alarming in the control room

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and the Standby Gas Treatment System started automatically when its 2 mr/hr setpoint was exceeded. The highest radiation appeared to be in the area of the air ejector rooms and ventilation exhaust fans. The radiation protection man on shift checked the Continuous Air Monitor which samples the Turbine Building exhaust air and saw that it was increasing. At 9:40 PM the Shift Engineer received this report and ordered the evacuation of all personnel from the Turbine Building and the Radwaste Building. As control room alarms were being investigated during this period, the operator observed that the off gas radiation monitors were decreasing. These monitors are located adjacent to the hold up pipe just outside the building. Combined with the other indications the shift engineer was relatively certain that the off gas rupture disc had blown.

At approximately 9:50 PM the shift foreman and several operators entered the Turbine Building dressed in protective clothing and full face masks. An inspection of the 2B air ejector room confirmed that the rupture disc had in fact blown and at 10:00 PM the operators began placing the 2A air ejector in service and isolating the 2B ejector. The change over was completed by about 10:05 PM and the turbine building radiation monitors began decreasing. During the incident the chimney sample system monitor had increased by a factor of six and then returned to its original reading within ten minutes after the 2B air ejector was isolated. The area outside the building was surveyed and no abnormal radiation levels or evidence of damage were detected that would indicate a failure of the hold up pipe.

#### Investigation

On March 7, 1973 samples were obtained before and after the off gas high efficiency filters and analyzed for particulate filtration and a DOP test was then conducted for confirmation of the filter efficiency. These tests indicated 100% penetration or zero efficiency on both filters. Chimney particulate samples pulled on the 7th were also counted at this time before the normal 48 hour and 7 day decay periods had elapsed. From these samples it was determined that the concentration of particulate isotopes with half lives greater than 8 days would continue to be a small fraction of the Technical Specification limit.

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Although each filter is designed for 100% capacity, station valve lineups allowed either one or two filter operation due to previous problems with the air ejectors. At the time of the incident both filters were in service. When the filters were removed, they were found to be charred and the upper support beams were deformed indicating that there definitely had been an explosive recombination of hydrogen and oxygen in the off gas line.

Some of the filter media had melted and was removed from the bottom of the filter vessel. In order to verify that the filter material had been retained in the vessel, one of the damaged filters was weighed and found to be essentially the same (less than one pound difference) as that of a new filter. The weight of the material removed from the bottom of the vessel could not be determined since it was a mixture of the filter material and other substances such as dust, rust, etc. It was therefore concluded that very little, if any, of the filter media had escaped the vessel. It also is very unlikely that if some material did escape that it could have been carried over to and up the 310 foot chimney.

As a result of this incident it was discovered that the failed filter element retainers had not been installed in the Quad-Cities off gas filters during construction. After both filters had been replaced and DOP tested satisfactorily, the filter retainer baskets were found in the site warehouse along with spare parts from the construction period and other supplies. Only two filters designed to hold the retainer were available at the site. One of the new Unit 2 filters was removed along with one on Unit 1 and the modified filter retainer assemblies installed. Each unit will operate with that filter in service and the other filter valved out as a spare until more of the new design filters can be obtained. At that time the retainers will be installed in the remaining two filters.

The off gas system design incorporates temperature and pressure switches to detect an explosion in the hold up pipe. These switches alarm and automatically close the air ejector suction valves to stop the flow of combustible gas into the pipe. During the incident the operator noticed the high temperature alarm, but could

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not positively recall seeing the high pressure alarm. He also did not observe any isolation of the off gas line. In the course of the investigation, all switches were tested by instrument mechanics and found to be functioning properly. Since this isolation is designed only to prevent feeding any combustion taking place in the pipe, it does not seal-in. Therefore, it can only be concluded that an isolation did start and the valves returned to their full open position immediately following the explosion and that this was not detected by the operator.

The contamination and radiation levels throughout the turbine building were caused by the direct discharge of off gas from the air ejectors into the building. The rapid rate at which the contamination was spread throughout the building was not due to a failure of the ventilation system design which vents the air from the air ejector rooms directly to the building exhaust fans. At the time of the occurrence the 2A fan had been removed for maintenance and an opening existed on the discharge side allowing some of the flow from the operating fans to return directly to the building. This was considered to be the major source of radiation inside the building. In addition some gases probably entered the radwaste building basement from the off gas line drains. These lines have loop seals which were more than likely blown clear by the explosion, however, the water formed by the recombination would have refilled the seals.

#### Additional Conclusions and Corrective Action

Although the exact cause of the detonation has not yet been positively identified, it is believed to have been the result of lightning in the vicinity of the station. The Commonwealth Edison Company Station Electrical Engineering Department is still investigating the incident in order to determine the specific cause. They are also reviewing the adequacy of the station grounding and lightning protection systems.

The off gas pipe and filter vessel are designed to withstand the force of an explosion of this nature. No physical evidence or signs of leakage have been detected; therefore, it can be concluded that the system satisfactorily meets this design requirement.



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The Station Review Board has reviewed all aspects of this incident including the immediate actions taken by operating personnel. We have concluded that their actions were prudent and that should a similar situation occur in the future, the reactor should be maintained at a steady power level once the integrity of the off gas pipe has been verified. In our opinion to immediately scram the reactor would disturb the equilibrium release rate and result in releasing long lived fission products unnecessarily. We are in the process of writing an operating procedure which will provide guidance along these lines to operating personnel.

During the period following the incident and prior to the filter replacement, Unit 2 operated with essentially no filtration of off gas particulates. This condition was reviewed and based on the extremely low particulate activity of the March 7th sample no power reduction was deemed necessary. Although particulate levels increased, the margin between the actual release rate and the maximum allowable release rate for iodine-131 and particulates with half lives longer than 8 days was not significantly affected since iodine-131 was still the controlling factor. This decision was further justified by the sample removed on March 8, 1973. This sample represented 24 hours of operation without the Unit 2 filters and was found to be less than 1% of the Technical Specification limit.

Proper radiation protection procedures were observed by the operating personnel who entered the turbine building. This resulted in no one being contaminated to any significant extent. The personnel involved were also subjected to a whole body count following the incident; the results of which were negative.

A review of the chimney sample system noble gas recorder revealed a spike at the time of the incident from approximately 24,000 uc/sec to about 175,000 uc/sec. The duration of this spike was about 1 to 2 minutes and the magnitude less than one half the Technical Specification limit. The cause of the spike is attributed to the rapid expulsion of the noble gases and relatively short lived gases such as N<sup>13</sup> from the hold up pipe by the pressurization. After the spike the release rate gradually

Mr. A. Giambusso

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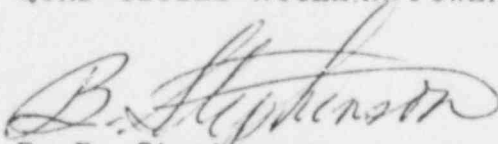
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returned to about the same level due to the direct path via the ventilation system instead of the holdup volume. After about 30 minutes the release rate returned to normal when the air ejector was isolated.

Although the probability of any significant release of radioactivity is extremely remote, samples from the environs monitoring stations were collected on March 13, 1973. These airborne particulate and iodine-131 samples are now being counted and the results should be available to the station by March 22, 1973. We do not expect these samples to indicate any increase above normal levels, however, we shall keep you advised of any significant results.

Very truly yours,

COMMONWEALTH EDISON COMPANY  
QUAD-CITIES NUCLEAR POWER STATION



B. B. Stephenson  
Superintendent

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cc: Director of Compliance, Region III  
Directorate of Regulatory Operations