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Docket No. 50-213
B10104

Director of Nuclear Reactor Regulation
Attn: Mr. Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

References: (1) W. G. Counsil letter to D. G. Eisenhut dated October 18, 1979.
(2) W. G. Counsil letter to H. R. Denton dated December 31, 1979.
(3) W. G. Counsil letter to D. L. Ziemann dated October 31, 1979.

Gentlemen:

Haddam Neck Plant
SEP Topic VI-5 - Combustible Gas Control

In response to questions informally received from the NRC Staff regarding SEP Topic VI-5, Combustible Gas Control, Attachment 1 is provided.

The responses in Attachment 1 are based on the current method of Combustible Gas Control and reflect a satisfactory method for mitigating the effects of combustible gas in the containment. It is noted that the responses associated with hydrogen monitoring reflect currently available systems and procedures. These are anticipated to be improved in accordance with TMI Lessons-Learned requirements.

We remain available to answer any further questions.

Very truly yours,

CONNECTICUT YANKEE ATOMIC POWER COMPANY

W. G. Counsil
W. G. Counsil
Senior Vice President

Attachment

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DOCKET NO. 50-213

ATTACHMENT 1

HADDAM NECK PLANT

SEP TOPIC VI-5 - COMBUSTIBLE GAS CONTROL

OCTOBER, 1980

Question (1)

The three (3) systems needed for combustible gas control are: (1) systems to mix the containment atmosphere; (2) systems to monitor combustible gas concentrations within the containment; and (3) systems to reduce combustible gas concentrations within the containment. For each of these three systems, provide the following information:

(a) A discussion of the redundancy and capability of the system to remain operable, assuming a single failure.

Response

The system that mixes the containment atmosphere at the Haddam Neck Plant is the Containment Air Recirculation System. Four (4) containment recirculation fans perform this function. The electrical supply for the CAR fans is arranged so that two (2) fans are fed from one (1) power train and the other two (2) are from the other train. Provisions are made so that in the event of a power failure in one train, a fan can be switched over manually to the operable train to have three (3) CAR fans operable at all times. A description of the electrical system is enclosed in the NRC's Safety Evaluation supporting Amendment No. 17 to DPR-61.

A description of the capabilities, single failure analysis, and operation of this system are discussed further in Section 3.6 of the FDSA. The service water system which provides cooling to the air recirculation fans is discussed in Section 8.9 of the FDSA.

The system to monitor combustible gas concentration within the containment is carried out by taking samples of the containment atmosphere and analyzing it with a gas chromatograph. The sampling point normally used is the radiation monitor's (R-11, R-12) sampling point. Sampling is done manually by the plant Chemistry Department and a graph is prepared to show the buildup of hydrogen against time. The graph is extrapolated so that when the hydrogen is expected to buildup to about three percent (3%) by volume within twenty-four (24) hours, containment purging is initiated.

There are two (2) systems to reduce combustible gas concentrations within the containment. The primary means of purging is the containment air particulate monitoring system and the backup system is the containment purging system. In both instances, the hydrogen is purged with outside air and vented through charcoal and HEPA filters in the Primary Auxiliary Building before it is released to the atmosphere through the stack.

The containment air particulate monitoring system is further discussed in Section 7.4 of the FDSA. Hydrogen production and accumulation in the Haddam Neck Plant containment is analyzed in Section 1.5 of the December, 1969 submittal entitled "Supporting Information for Connecticut Yankee Full-Term Operating License Application".

A review of the operating modes and procedures necessary to deal with significant amounts of hydrogen gas that may be generated during a transient is discussed in our recent response to the NRC I&E Bulletin No. 79-06A. This response was dated April 24, 1979 to Mr. Boyce H. Grier of the Office of Inspection and Enforcement in King of Prussia, Pennsylvania, on Page 14, Question No. 12.

Question (1)

(b) A discussion of the capability to withstand dynamic effects, to withstand the safe shutdown earthquake without loss of function, and to remain operable in the accident environment.

Response

Evaluation of the seismic capability of the required Haddam Neck Plant systems is being undertaken under two (2) SEP topics:

III-1, "Classification of Structures, Systems, and Components" and

the various "Seismic" topics, such as II-4, II-7B, and III-11.

Question (1)

(c) The codes, standards, and guides applied in the design of the systems and system components. Also specify the design requirements for each component and system.

Response

See previous response for system codes and standards. The design requirements are being evaluated under SEP Topic III-1. The design of the electrical system is discussed in Section 9.4 of the FDSA.

Question (1)

(d) The piping and instrumentation diagrams of the systems.

Response

The following P&ID's are shown in the FDSA.

Figure 8.11-4, Air Recirculating Fans, Purge, and Ducts

Figure 8.10-1, Containment Air Particulate Monitoring System

Figure 8.9-1, Service Water

Question (1)

(e) Specify the plant protection system signals that actuate the systems and components. Include a discussion of which system or systems are to be manually operated from the main control room or from another point outside the containment that is accessible following an accident. Identify the plant conditions and system operating parameters and setpoints for system actuation.

Response

During plant operation, there are three or four containment air recirculation fans normally operating. These fans are manually operated from the main control room. In the event they were not normally operating, two fans (one per safety train) would automatically start on a high containment pressure signal. A safety injection signal automatically sequences a CAR fan into a running diesel generator.

The Haddam Neck Plant currently does not have an automatic continuous hydrogen monitor. The method for monitoring hydrogen after a LOCA is discussed in Question (3). Efforts are in progress to respond to the TMI Lessons-Learned requirement in this regard.

The system used for reducing H_2 concentration is by purging. See Technical Specification 3.11(f) and Basis on Page 3-20.

See response to Question (4)(b) for plant conditions and setpoints for system actuation.

Question (1)

(f) Describe the environmental qualification tests that have been performed on systems and system components that may be exposed to the accident environment. Demonstrate that these tests are representative of temperature, pressure, humidity, and radiation that would be expected to prevail inside the containment following an accident and are applicable to the system design.

Response

Environmental Qualification is being reviewed as part of SEP Topic III-12, "Environmental Qualification of Safety-Related Equipment".

Question (2)

With regard to the systems that are relied on to mix the containment atmosphere, identify the ductwork that must remain intact to mix the containment atmosphere. Include a discussion of the design provisions that will ensure the ductwork will remain intact.

Response

The design of the containment ventilation system assures that all ductwork will remain intact. The ductwork is located outside the missile shield, and is designed to withstand post-accident conditions. The design of the system is described in [illegible] Section 3.6.

Question (3)

For the system provided to continuously monitor the combustible gas concentrations within the containment following an accident, provide the following information:

(a) A discussion of the operating principle and accuracy of the combustible gas analyzers.

(b) The locations of the multiple sampling points within the containment.

(c) A discussion of the capability to monitor combustible gas concentration within the containment independent of the operation of the other combustible gas control system.

Response

The Haddam Neck Plant's method of monitoring hydrogen buildup inside the containment is by manual sampling. The sample point taken as representative of the containment atmosphere is the same as used to normally sample for containment radiation levels prior to containment entry.

The basic operation of the gas partitioner begins with the introduction of a gas mixture into the instrument. The mixture is swept through two chromatographic columns by a continuous flow of carrier gas. The columns contain packings which selectively retard the passage of various components of the sample. Therefore, the components are separated and eluded from the system at different times. As each component is eluted, a detector senses and indicates its presence by producing an electrical signal. This signal is then sent to a recorder, where it appears as a measurable peak.

Given a particular set of chromatographic conditions, the time elapsed from the point of injection to the emergency peak is usually characteristic of a particular component and can be used to identify it. This time period is always the same, regardless of the concentration of the component or the presence or absence of other components. The height of the area of a peak is always proportional to the concentration of the gas, and after proper calibration is made, the percentage of that component in a mixture can be determined.

The Haddam Neck Plant uses hydrogen (8.5%) in helium as a carrier gas. This technique has been reported by Purcell and Ettre, Journal of Gas Chromatography, February, 1965, pp. 69 - 71. It was found that linear response for the hydrogen peak can be obtained up to the 60 volume percent level, and slightly curved calibration curve can be obtained at higher levels.

The sample component is quantitatively determined by comparing its peak height or area with that of a standard. Since peak height and peak area are proportional to both concentration and thermal conductivity of a gas, and since thermal conductivity varies for each gas, comparisons are made for each component of both the standard and the sample gas.

The standard gas mixtures used have quantitative analysis accompanying them that show the exact composition of the mixture (53% H_2, 47% N_2).

Under normal operating conditions, sample volume is the most critical variable, therefore, sampling techniques must be carried out with a high degree of precision and accuracy. Normally, hydrogen concentrations down to two percent can be detected.

In the event of a problem in containment, it is possible to obtain an air sample from the containment remote air sampler.

<u>Question (4)</u>

In order to perform an analysis of the production and accumulation of combustible gases within the containment following an accident, provide the following information:

(a) The surface area and thickness of aluminum, aluminum base paint, zinc, galvanized steel, and zinc base paints.

<u>Response</u>

The concern for aluminum (and other reactive metals) in containment arises from the fact that chemical reactions could contribute to the generation of hydrogen gas in the post-LOCA environment. The assumptions for evaluating the production of hydrogen following a LOCA are presented in Regulatory Guide 1.7.

Regulatory Guide 1.7 requires the consideration of "aluminum exposed to alkaline solutions" when post-LOCA hydrogen sources are assessed. The post-LOCA environment, however, is acidic and not alkaline at the Haddam Neck Plant. The boric acid content of the RCS and RWST makes the post-LOCA condition clearly acidic. This is not the case in all PWR's, as others add alkaline materials to containment spray (to wash out iodines) or the sump (to control sump pH).

A brief review of literature confirmed the fact that aluminum is not attacked by boric acid. Metals Handbook (Taylor Lyman, Editor), 1969, Page 930, stated, "Boric acid has little action on aluminum. Aluminum drying kilns, trays, bucket conveyors, and hoods for bottom closings for centrifuges are in service in boric acid plants". Other references also indicate a similar resistance to boric acid attack.

As far as zinc is concerned, we found that its only location within containment is that on the vessel flange as zinc chromate paint. This would not be enough material to increase the hydrogen within containment.

The ductwork for the containment ventilation system, the majority of which is located in the outer annulus is made out of galvanized steel as shown on Figure 8.11-4. Also, all the grating (1-1/4") in containment is galvanized steel. However, we conclude that there is not enough of a corroding medium with galvanized steel that could produce a significant reaction, plus the fact that the ratio of the containment building volume to the reactor power for the Haddam Neck Plant is one of the largest of existing large power reactor stations. Further information on this question can be found in Reference (3).

Question (4)

(b) The basis (time or hydrogen concentration) for activation of the combustible gas reduction system. Specify the design flow rates and the flow rates for the analyses.

Response

Following a LOCA, periodic samples are taken of the containment atmosphere and analyzed for hydrogen at a flow rate of 20-30 liters/minute. The sample results must be plotted versus time and extrapolated out to 3% by volume of hydrogen. When it has been determined that the hydrogen concentration will reach 3% by volume within the next twenty-four (24) hours, the plant Chemistry Department will calculate the required volume of air that must be released to obtain a reduction in hydrogen concentration.

The normal hydrogen purge flow rate is approximately 6 cfm to a maximum of 13 cfm. If the sample results indicate unsatisfactory decreases in hydrogen concentration, additional flow can be obtained by opening the bypass valve on the main containment purge line. This procedure must be completed upon reaching a 3% by volume of hydrogen in the containment in order to prevent the formation of an explosive mixture at 4% by volume of hydrogen.

Question (5)

Describe the program for periodic operability testing of the combustible gas control systems and system components. Discuss the scope and limitations of these tests.

Response

The purge system containment isolation valves and the air monitoring sample containment isolation valves undergo periodic leak-rate testing in accordance with the Haddam Neck Plant Appendix J requirements.

The air filtration portion of the containment air recirculation system is periodically tested per Technical Specification 4.4-IV.

The containment air recirculation fans are tes   once per month as far as amperage on motors, ΔP across the filters,   cooler integrity.