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RECEIVED JUN 3 1971 U.S. ATOMIC ENERGY COMMISSION Regulatory Mail Section

June 1, 1971

Dr. Peter A. Morris, Director
Division of Reactor Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Subject: Additional Information for Provisional Operating License DPR-19 (Dresden Unit 2) and Operating License DPR-25 (Dresden Unit 3) concerning Off-Gas Control Equipment

Dear Dr. Morris:

In a letter dated December 4, 1970, you indicated that, based on the operating experience at Dresden Unit 2, you had come to the conclusion, along with Commonwealth Edison Company, that additional equipment should be installed on Dresden Units 2 and 3 to reduce the emission of radioactive and gaseous effluents.

The purpose of this letter is to transmit to you Report No. 4 entitled "Dresden Units 2 and 3 Modifications to the Off-Gas System" which discusses the design and installation of off-gas control equipment. This report also fulfills a commitment made in the Bases of Specification 3.8 of the Dresden Unit 2 and Unit 3 Technical Specifications.

The attached report is part of a series of reports numbered 1 through 9, which were submitted to you on April 24, 1971.

In addition to three signed originals, 19 copies of this report are also submitted.

Very truly yours,

Wayne L. Stiede

Byron Lee, Jr.
Assistant to the President

SUBSCRIBED and SWORN to before me this 1st day of June, 1971.

Patricia A. Nelson
Notary Public

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REPORT NO. 4

DRESDEN UNITS 2 AND 3

MODIFICATIONS TO OFF-GAS SYSTEM

June 1, 1971

Commonwealth Edison Company

1.0 INTRODUCTION

The purpose of this report is to describe modifications being made to the Dresden Units 2 and 3 off-gas systems to ensure that radioactive gaseous emissions are kept as low as practicable. Our intent to make such modifications was indicated in a meeting with Dr. Peter A. Morris on December 3, 1970. The desirability of making these modifications was indicated in a letter to Commonwealth Edison from Dr. Morris dated December 4, 1970.

The modifications consists of a catalytic recombiner-8 charcoal bed system (plus necessary auxiliaries) and provides a curie reduction factor of approximately 40 relative to the existing off-gas system.

2.0 OBJECTIVE

The objective of the gaseous radwaste system is to process and control the release of gaseous radioactive wastes to the site environs so that the total radiation exposure to persons outside the controlled area is normally low and does not in any case exceed applicable regulations. The modifications described in this report provide further assurance that such exposure will be as low as practicable.

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3.0 MODIFICATION DESIGN BASES

The gaseous radwaste system modification shall be designed to limit off-site doses from routine station releases to as low as practicable and to stay within the limits established in the Station operating licenses. The design bases for the modification will be a curie reduction factor of forty assuming an input to the system equivalent to that input to the present system which would result in 200,000 μc/sec being released from the chimney. In addition, the modification shall be based on the assumption that each of the condenser shells leaks at the rate of 7 ft^3/min (at 130^oF, 1 atm). Shielding shall be provided as necessary for process piping and equipment.

4.0 OFF-GAS COMPOSITION

Noncondensible radioactive off-gas is continuously removed from the main condenser by the air ejector. The air ejector off-gas will normally contain activation gases, principally N-16, O-19, and N-13 which have short half-lives and are essentially decayed prior to leaving the holduppipe. The air ejector off-gas will also contain radioactive isotopes of krypton and xenon. The concentration of these noble gases depends on the amount of tramp uranium in the coolant

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and on the cladding surfaces (usually extremely small) and the number and size of fuel cladding leaks.

5.0 DESCRIPTION OF MODIFICATIONS

The off-gas treatment system, including the modifications, is shown in Figure 1. The modified system takes the fission gases, activation gases, and radiolytic hydrogen and oxygen removed from the main condenser by the air ejectors. This mixture is diluted with steam to maintain the hydrogen concentration below the flammability limit. The mixture is then routed through a preheater to the catalytic recombiner. Preheating the mixture is necessary to ensure optimum recombiner performance.

In the recombiner, the radiolytic hydrogen and oxygen are catalytically converted back to water (in the form of superheated steam). The formed steam, along with the steam used for dilution, trace quantities of unreacted hydrogen and oxygen, air, and radioactive gases, exits the recombiner to a condenser where the steam is condensed to liquid and returned to the reactor condensate system. The non-condensable effluent is then routed to the existing holdup piping where the shorter-lived radioactive isotopes (principally N-13, N-16, O-19, and certain isotopes of xenon and krypton) decay either to non-radioactive isotopes or radioactive particulate daughter products. With the present holdup piping, the mixture traverse time is increased to approximately four hours due to removal of the radiolytic hydrogen and oxygen.

Upon leaving the holdup pipe, the effluent is cooled again for removal of water vapor, passed through a moisture separator for further drying, and then heated in a reheater for humidity control. Before entering the charcoal absorbers, theeffluent is filtered to remove the above mentioned particulate daughter products. The charcoal absorption beds permit selective adsorption and delay of the xenons and kryptons from the carrier gas (principally air). Following the charcoal adsorbers, the effluent is filtered again to remove particulate daughter products and then discharged through the existing 310 foot concrete chimney.

The activity of the effluent entering and leaving the off-gas treatment system is continuously monitored; thus, system performance is known to the operator at all times.

This system results in a reduction of the off-gas activity (curies) released by a factor of approximately 40 relative to a 30-minute holdup system without a recombiner and based on a diffusion mixture. Table 1 shows the estimated release rates of various isotopes of krypton and xenon for two systems having the same input. One system has a 30-minute decay pipe and results in a release rate of 200,000 μc/sec. The second system has a recombiner-charcoal installation and results in a release rate of 7,000 μc/sec.

6.0 EQUIPMENT DESCRIPTION

The equipment containing process off-gas is designed per Section III, Sub-section ND, Class 3, Nuclear Power Plant Components, and shall be Seismic Class II. Redundancy of the preheater, recombiner, cooler-condenser system, moisture separator, particulate filters, and charcoal vault air conditioning units is provided.

7.0 INSTRUMENTATION AND CONTROL

The radiation levels at the air-ejector off-gas discharge line and after the off-gas treatment system are continuously monitored by pairs of detectors. This system is also monitored by flow and temperature instrumentation and hydrogen analyzers to ensure correct operation and control and to ensure that hydrogen concentration is maintained below the flammable limit. Process radiation instrumentation is described in the FSAR Sub-section 7.6. Table 2 lists process instruments that cause

TABLE 1

ESTIMATED KRYPTON AND XENON RELEASE RATES PER UNIT

Release rates are given in μCi/sec, based on diffusion mixture and same input

Isotope	30-Minute Holdup System	Recombiner-Charcoal System
Kr-83m	5,700	10
Kr-85m	10,000	800
Kr-85	20	20
Kr-87	29,600	4
Kr-88	32,000	600
Kr-89	500	-
Xe-131m	20	10
Xe-133m	400	20
Xe-133	10,000	3,000
Xe-135m	16,000	-
Xe-135	35,000	-
Xe-137	2,000	-
Xe-138	57,000	-

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TABLE 2

PROCESS INSTRUMENT ALARMS

Parameter	Main Control Room Indicated	Main Control Room Recorded
Preheater discharge temperature - low	X	
Recombiner catalyst temperature - high/low		X
Off-gas condenser drain well (dual) level - high/low		
Off-gas condenser gas discharge temperature - high		
H_2 analyzer (condenser discharged) (dual) - high		X
Gas flow (off-gas condenser discharge) - high/low		X
Cooler - condenser discharge temperature - high/low		X
Glycol solution temperature - high/low	X	X
Gas reheater discharge humidity high		X
Prefilter ΔP - high	X	
Carbon bed temperature - high		X
Carbon vault temperature - high/low	X	X
Post filter ΔP - high	X	

Instrumentation elements:

- Temperature - thermocouple
- Level - differential pressure diaphram
- Hydrogen - thermal conductivity
- Gas flow - flow orifice
- Differential pressure - differential pressure diaphram

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alarms and whether the parameters are indicated or recorded in the control room. The off-gas system provides adequate time for corrective action to limit the activity release rates should they approach established limits.

8.0 SAFETY CONSIDERATIONS

The decay time provided by the four hour holdup pipe and the long delay charcoal adsorbers is established to provide for radioactive decay of the major activation gases and fission gases in the main condenser off-gas. The adsorbers provide a 9.7-day xenon and a 12.9-hour krypton holdup. The daughter products that are solids are removed by filtration following the four hour holdup and/or are retained on the charcoal. Final filtration of the charcoal adsorber effluent precludes escape of charcoal fines that would contain radioactive materials. Particulate activity release is thus virtually zero.

Although iodine input into the off-gas system is small by virtue of its retention in reactor water and condensate, the charcoal will effectively remove it by adsorption and prevent its release. A radiation monitor at the recombiner outlet (same one as at beginning of existing 30-minute holdup pipe) continuously monitors gaseous radioactivity release from the

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reactor and, therefore, continuously monitors the degree of fuel leakage and input to the charcoal adsorbers. This radiation monitor is used to provide an alarm on high radiation in the off-gas.

A radiation monitor is also provided at the outlet of the charcoal adsorbers to continuously monitor the release rate from the adsorber beds. This radiation monitor is used to isolate the off-gas system on high radioactivity to prevent treated gas of unacceptably high activity from entering the plant vent chimney. The vent radiation monitor is described in the FSAR, Sub-section 7.6.

Shielding is provided for off-gas system equipment to maintain safe radiation exposure levels for plant personnel. The equipment is principally operated from the control room.

The charcoal adsorbers operate at essentially room temperature so that, on system shutdown, radioactive gases in the adsorbers will be subject to the same holdup time as during normal operation, even in the presence of continued air flow. Thus the radioactive materials are not subject to an accidental release. The charcoal adsorbers are designed to limit the temperature of the charcoal to well below the

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charcoal ignition temperature, thus precluding overheating or fire and consequent escape of radioactive materials. In addition, a radiation monitor is provided to monitor the radiation level in the charcoal bed vault. High radiation will cause an alarm in the control room.

The hydrogen concentration of gases from the air ejector is kept below the flammable limit by maintaining adequate steam flow for dilution at all times. This steam flow rate is monitored and alarmed. The preheaters are heated with steam rather than electrically to eliminate presence of potential ignition sources and to limit the temperature of the gases in event of cessation of gas flow. The recombiner temperatures are monitored and alarmed to indicate any deterioration of performance. A hydrogen analyzer downstream of the recombiners performs an additional check.

The air-ejector off-gas system operates at a pressure of approximately 5 psig or less so the differential pressure that could cause leakage issmall. To preclude leakage of radioactive gases the system is welded wherever possible, and bellows seal valve stems or equivalent are used. The entire system is designed to a minimum of 350 psig.

Operational control is maintained by the use of radiation monitors to keep the release rate within the established limits. Environmental monitoring is used to check on station performance. Provision is also made for sampling and periodic analysis of the influent and effluent gases for purposes of determining their composition. This information is used in calibrating the monitors and in relating the release to environs dose. The operator is thus in full control of the system at all times.

9.0 INSPECTION AND TESTING

The gaseous waste disposal systems are used on a routine basis and do not require specific testing to assure operability. Monitoring equipment will be calibrated and maintained on a specific schedule and on indication of malfunction.

The particulate filters will be tested after installation, using a dioctyl phthalate (DOP) smoke test or equivalent. During operation they will be periodically tested by laboratory analyses of inlet and outlet Millipore filter samples.

Experience with boiling water reactors has shown that the calibration of the off-gas and effluent monitors changes with isotopic content. Isotopic content can change depending on the presence or absence of fuel cladding leaks in the reactor and the nature of the leaks. Because of this, the monitors are

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calibrated against grab samples periodically and any time there appears to be a significant change.

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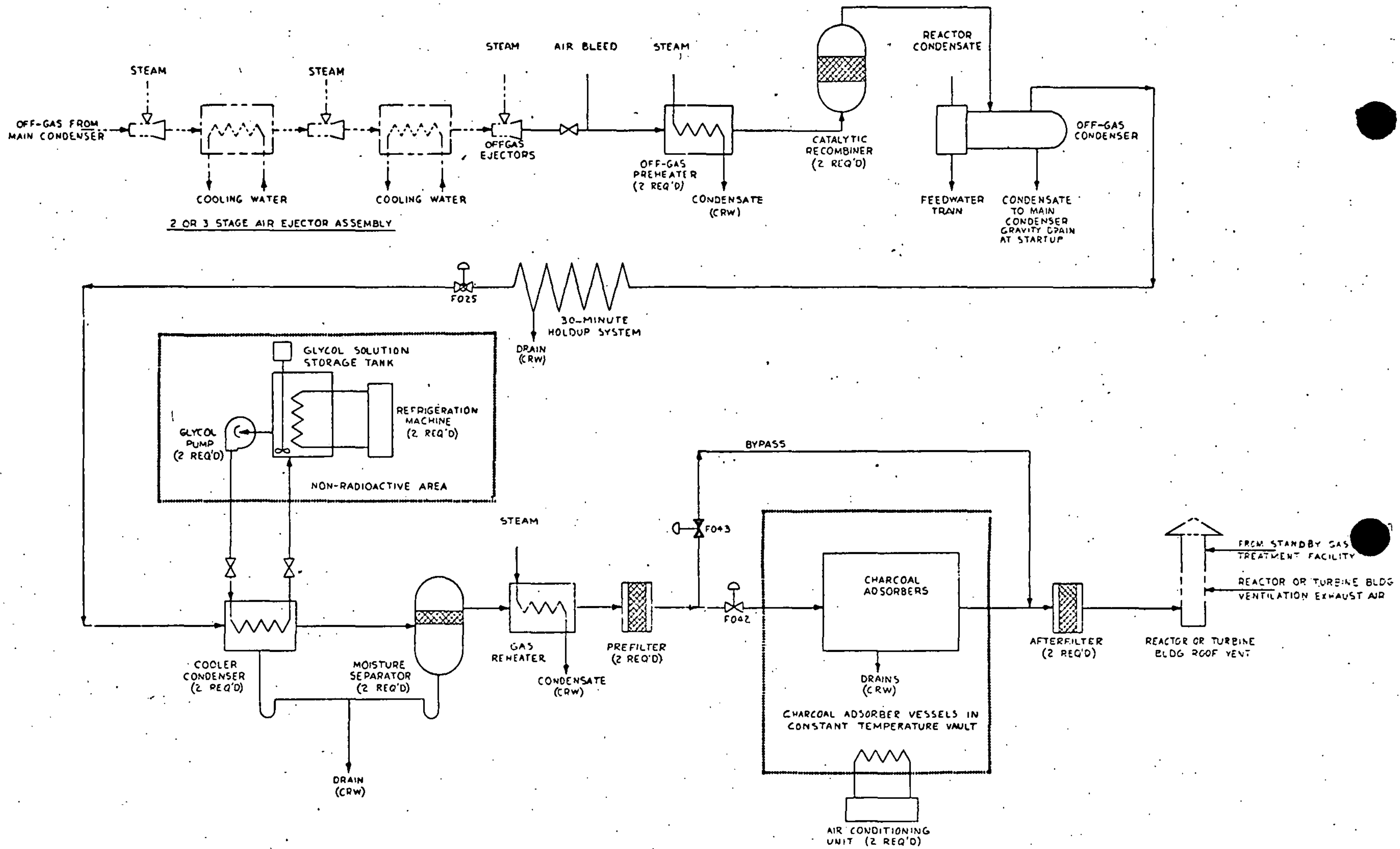

Figure 1. Off-Gas System Flow Diagram

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