SAFETY RELATED

System Diagram D-302-861
D-912-103

FINAL
SYSTEM DESIGN DESCRIPTION

POST ACCIDENT HYDROGEN REMOVAL SYSTEM

SOUTH CAROLINA ELECTRIC & GAS
VIRGIL C. SUMMER NUCLEAR STATION
UNIT 1

David T. Klinksiek - System Engineer
D. T. Klinksiek

Roman Patynowski - I&C Engineer
R. Patynowski

Issued
9-6-77

Reissued
4-3-81
7-24-81

Prepared By:

Gilbert Associates Inc.
P.O. Box 1498
Reading, Pennsylvania

System Designation HR

DGF

Gilbert/Commonwealth

TABLE OF CONTENTS

1.0 INTRODUCTION

This document provides a design description of the Post Accident Hydrogen Removal System for V. C. Summer Nuclear Station, Unit 1. This system includes the hydrogen purge and Reactor Building pressure equalization piping as a combined system.

The System is shown schematically on GAI System Diagram D-302-861.

1.1 SYSTEM FUNCTION

Following a loss of coolant accident, hydrogen gas may be generated inside the Reactor Building by reactions such as zirconium metal with water, corrosion of metals, and radiolysis of aqueous solution in the Reactor core and sumps. Redundant H_2 analyzers and atmosphere sampling devices are provided to measure the hydrogen gas, iodine, and particulate matter concentrations of the Reactor Building atmosphere at any time. A properly sized combustible gas control system is required to ensure that hydrogen concentration is maintained at a safe level.

A backup Reactor Building purge system is provided to act as a standby system for mechanically reducing hydrogen concentrations in the unlikely event that both recombiners have failed. The backup purge system is also used for Reactor Building pressure equalization during normal plant operation.

1.2 DESIGN CRITERIA

1.2.1 Electric Hydrogen Recombiners

Design bases which apply to the electric hydrogen recombiners:

a. The recombiners are designed to sustain all normal loads as well as accident loads including safe shutdown, earthquake, and

pressure transients from a design basis loss of coolant accident.

b. The recombiners are designed for a lifetime of 40 years consistent with that of the plant.

c. All materials used in the recombiners are selected to be compatible with the environmental conditions inside the Reactor Building during normal operation or during accident conditions.

d. Process capacity is such that the Reactor Building hydrogen concentration does not exceed 4 volume percent based on the NRC TID-14844 release model as indicated in Regulatory Guide 1.7, "Control of Combustible Concentrations in Containment Following a Loss of Coolant Accident."

e. Each recombiner is provided with a separate power panel and control panel. Each is powered from a separate Engineered Safety Features (ESF) bus.

1.2.2 Hydrogen Analyzers and Sampling Equipments

Monitoring of Reactor Building atmosphere by direct reading redundant H_2 analyzers or by use of a direct sample method is provided. One of the H_2 analyzers and the heating of its connection lines to the Reactor Building should be energized and in the "standby" mode at all times. This is to ensure availability when required.

1.2.3 Backup Purge/Reactor Building Pressure Equalization System

A backup purge system is required to reduce to safe levels the concentration of hydrogen inside the Reactor Building in the unlikely event of a failure of both electric hydrogen recombiners. This system is also used to keep Reactor Building pressure within specific limits during normal operation.

Design criteria:

a. Dilution of hydrogen in the Reactor Building atmosphere by pressurization to at least 3 psig, following a LOCA.

b. Controlled release flow rate to preclude exceeding offsite dose limits.

c. Backup purge flow to be passed through the Reactor Building purge exhaust system plenum for cleanup before release to the environment.

d. Remote manual control of all System valves and components during all modes of plant operation.

e. Maintain Reactor Building narrow range pressure requirements during normal plant operation.

1.2.4 Piping and Components

Tubing to the hydrogen analyzers is ANS Safety Class 3. Portions of piping and tubing which penetrate the Reactor Building, including Containment isolation valves, are ANS Safety Class 2a. Safety Class piping, tubing, and valves are designed to ASME Code, Section III, Classes 2 and 3.

It is required that Containment isolation valves and System piping up to the outer isolation valve be leak checked to conform to AEC Regulation 10CFR50, Appendix J, "Reactor Containment Leakage Testing for Water Cooled Power Reactors."

The hydrogen analyzers, sampling devices, backup purge fan, and other valves and piping are Non-nuclear Safety Class.

1.3 SUMMARY DESCRIPTION OF THE SYSTEM

The System is designed for control of combustible hydrogen concentrations in the Reactor Building following a loss of coolant accident. This system consists of a sampling system that provides Reactor Building atmosphere samples, electric hydrogen recombiners that are the primary means of reducing Reactor Building hydrogen concentrations, and a purge system which is used as a backup system to the recombiners. The purge system utilizes a pressure blower to reduce hydrogen concentration in Containment atmosphere. This purge system also serves as a method for controlling Reactor Building pressure during normal operation.

In conjunction with the redundant hydrogen analyzers, provisions have been made to obtain Reactor Building atmosphere samples for laboratory analysis. Particulate paper is analyzed for particulate matter, silver zeolite cartridges are analyzed to give iodine concentration, and a quick release section of tubing between two three-way ball valves is analyzed for noble gas contamination.

Hydrogen inside the Reactor Building is uniformly mixed by initial blowdown, subsequent Spray System operation, and Reactor Building cooling unit circulation.

2.0 DETAILED DESCRIPTION OF THE SYSTEM

2.1 COMPONENTS

2.1.1 Piping

Tubing for the hydrogen analyzers and sampling components is Type 304 stainless steel with 0.065 inch wall thickness. Piping for the alternate purge line Reactor Building pressure equalization system is Schedule 40S Type 304 stainless steel.

Safety Class Piping conforms to GAI Specification SP-545-044461-000, "Pipe Line Specification for Nuclear Safety Class Piping" and Specification DSP-544L-044461-000, "Building Penetration Piping in Non-safety Class Systems". Non-nuclear Safety Class piping conforms to GAI Specification SP-337-044461-000, "Pipe Line Specification for Conventional Piping."

2.1.2 Electric Hydrogen Recombiners

The recombiner units are located in the Reactor Building on the operating floor such that they process a flow of air containing hydrogen at a concentration which is generally typical of the average concentration throughout the Building.

To meet requirements for redundancy and independence, two recombiners are provided. Each recombiner has a separate power panel and control panel, and each is powered from a Class 1E bus.

Reactor Building atmosphere is circulated by natural convection through the recombiner where the hydrogen is heated to a temperature sufficient to cause recombination with Reactor Building oxygen, forming water.

The recombiner is a thermally insulated vertical metal duct with electric resistance metal sheathed heaters which heat a continuous flow of Reactor Building air (containing hydrogen) to a temperature which is sufficient to cause a reaction between hydrogen and oxygen. The recombiner has an outer enclosure to keep out Reactor Building Spray water.

The recombiners consist of an inlet preheat section, a heater-recombination section, and a discharge mixing chamber that lowers the exit temperature of the air.

The unit is manufactured from corrosion resistant, high temperature material except for the base which is carbon steel. The electric hydrogen recombiner uses commercial type electric resistance heaters sheathed with Incoloy-800 which is an excellent corrosion resistant material for the expected service.

Air is drawn into the recombiner by natural convection and passes first through the preheater section. This section consits of a shroud placed around the central heater section to take advantage of heat conduction through the walls to preheat the incoming air. This arrangement accomplishes the dual functions of reducing heat losses from the recombiner and of preheating the air.

The warmed air passes through a flow orifice and then enters the electric heater section where it is heated to approximately 1150 F to 1400 F, causing recombination to occur. Tests have verified that the recombination is not a catalytic surface effect associated with the heaters but occurs due to the increased temperature of the process gases. Since the phenomenon is not a catalytic effect, saturation of the unit by fission products does not occur. The heater section consists of five assemblies of electric heaters stacked vertically. Each assembly contains individual heating elements.

The materials of construction for the electric recombiner are selected for their compatibility with the post LOCA environment.

Major structural components are manufactured from 300-Series stainless steel except for the base which is carbon steel. Incoloy-800 is used for the heater sheaths and Inconel-600 for other parts, such as the heat duct, which operate at high temperature. There are no radiolytic or pryolytic decomposition products from these materials. The carbon steel base of the recombiner unit is coated with a paint that satisfies the requirements of ANSI 101.2 (1972), "Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities."

Design Data (per unit)	
Power (maximum), kw	75
Capacity (minimum), scfm	100
Heaters (per unit)	
Number	5
Heater Surface Area/Heater, ft^2	35
Maximum Heat Flux, Btu/hr ft^2	2850
Maximum Sheath Temp., F	1550
Gas Temperature	
Inlet, F	80-155
In heater Section, F	1150-1400
Materials	
Outer Structure	300-Series Stainless Steel
Inner Structure	Inconel - 600
Heater Element Sheath	Incoloy - 800
Dimensions (per unit)	
Height, ft.	9
Width, ft.	4.5
Depth, ft.	5.5
Weight, lb	6000
Manufacturer Specification	Westinghouse Dwg. 7070-2 (1MS-46-005)
Equipment Nos.	XHR-4A-HR XHR-4B-HR
Bill of Material Number	RJb

2.1.3 Redundant H_2 Analyzers and Sampling Equipment

Commercially available, redundant hydrogen analyzers that operate on a thermal conductivity principle are used.

The analyzers have 0-10% and 0-20% hydrogen range (by volume) and an accuracy within ±2% of range which provides adequate confirmation of recombiner operation.

The capability to obtain samples near each electric hydrogen recombiner and near the Reactor Building Cooling Units at approximately elevation 530' is provided. Whenever analysing is desired, the Control Room operator can select which of the sample points are to be monitored by opening the appropriate connection valves in the line of the operating analyzer. Trouble conditions are alarmed in the main control room and can be investigated at the (two) panels provided for each channel. Also, local sampling control panels can be used to carry out the Reactor Building ambient air sampling operations from the close proximity of the analyzing equipment in the Auxiliary Building at 463' elevation.

Design Data:

Quantity	2
Manufacture/Model	Comsip/K-111
Scale range	0-10% and 0-20% of H_2
Accuracy	±2%
Safety Class	2a
Equipment Number -	
Local Analyzer Panels	XPN-7215A & B - HR
Remote Control Panels	XPN-7258A & B - HR
Sampling Control Panel	XPN-7268A & B - HR
Bill of Material Number	RKa-9 (Analyzers)
Specification Number	SP-636

2.1.4 Collection Flasks

Two 1000cc, non-nuclear safety class collection flasks are mounted vertically near the Hydrogen Analyzers for the purpose of collecting (and diluting with nitrogen) samples from the Reactor Building atmosphere.

Design Data:

Quantity	2

Manufacture/Model	Whitey/304-HDF4-1000
Operating Pressure Range	0 to 100 psig
Operating Temperature	90°F
Volume	1000 cm^3
Safety Class	NNS
Material	304 SS
Equipment Number	XTK-135A & B - HR
Bill of Material Number	

2.1.5 Containment Pressure Control Blowers

Two purge lines each with a pressure blower are provided as a method to control Reactor Building pressure during normal operation.

For Containment pressure control the blowers are operated as corrections are needed to maintain normal Reactor Building pressure between a lower limit set by operating technical specifications and +1.5 psig. This operation of the system in this manner also provides for moderate purging of the containment atmosphere.

This system may also be used for purging of the reactor building of hydrogen provided site boundary radiation exposure limits are not exceeded. The purging can be accomplished by alternate pressurization/ depressurization of the reactor building. Another method can be the operation of both blowers to maintain a constant reactor building pressure.

Design Data:

Type	Centrifugal Blower
Fluid	Outside Air
Capacity, scfm	600 @ 3 psig outlet
Inlet flange, in. O.D.	4.0
Outlet flange, in O.D.	3.5
Motor Horsepower	20
Manufacturer Specification	Paxton CB-90

Equipment Nos.	XFN-95-HR
	XFN-96-HR
GAI Bill of Material No.	SM-32

2.1.6 Air Ejectors

There are two air ejectors, one for each collection flask, that are used to draw a vacuum on the collection flask and associated tubing before taking a sample of the Reactor Building atmosphere.

Design Data:

Quantity	2
Manufacture/Model	Air-Vac/AVR-093
Vacuum, in. Hg	27 max.
Air consumption, scfm	1.5
Vacuum Flow, scfm	1.1
Air Supply Pressure, psi	80
Safety Class	NNS
Equipment Number	XPS-150A & B - HR
Bill of Material	

2.1.7 Particulate Paper and Silver Zeolite Cartridge

In line with the collection flasks are removable cartridges containing particulate paper and silver zeolite. The particulate paper is used to collect samples of air borne particules in the Reactor Building atmosphere, and the silver zeolite is used to collect samples of radioactive iodine without retaining radioactive noble gas samples.

Design Data:

Quantity	2
Manufacture/Model	Richmond Laboratories/RLF-2
Particulate Paper	47mm filter paper

Safety Class	NNS
Equipment Number	XFL-89A & B - HR
Bill of Material	

2.1.8 Containment Isolation Valves (solenoid operated)

Redundant isolation valves are provided in each sampling line to the hydrogen analyzers and sampling equipments. The valves are normally closed; however, they can be manually opened at the main control board to permit collection of Reactor Building air samples or for measurement of hydrogen gas concentration.

Design Data:

Type	Valve, solenoid 3/8"-nuclear service
Fluid	Air, Hydrogen
Pressure, psig	70 maximum
Temperature, F	300 maximum
Flow, scfm	0.5 normal
Solenoid operator	Latching type
Position indication	Magnetic reed switch
Voltage	125, dc
Manufacturer/Model No.	Valcor Eng. Co. V52600-5292-15
ANS Safety Class	2a
GAI Bill of Material No.	RNt

Equipment Numbers:

XVX-6050A-HR	XVX-6052A-HR
XVX-6050B-HR	XVX-6052B-HR
XVX-6051A-HR	XVX-6053A-HR
XVX-6051B-HR	XVX-6053B-HR
XVX-6051C-HR	XVX-6054-HR

2.1.9 Reactor Building Pressurization System and Alternate Purge System Penetration Isolation Valves

The valves are 6-inch, stainless steel, electric motor operated gate type.

Design Data:

GAI Specification	SP-515-04461-000 Large Nuclear Power Plant Valves	
ANS Safety Class	2a	
Manufacturer	Anchor/Darling Valve Co.	
Bill of Materials No.	RNM-42	RNM-53
	RNM-43	RNM-54
Equipment Nos.	XVG-6056-HR	XVG-6066-HR
	XVG-6057-HR	XVG-6067-HR

2.1.10 Throttling Valves

The alternate purge line throttling valve is a 6-inch, stainless steel, motor operated, butterfly valve.

Design Data:

Quantity	1
Manufacturer/Model	Valve - FMC MOD12
	Operator - Romcon Mod. 100Br4
Safety Class	NNS
Equipment Number	XVB-6063-HR
Bill of Material Number	RNa-45

To control the flow of high pressure nitrogen to the collection flask, and high pressure gas from the collection flask to the particulate paper and silver zeolite cartridge, there are 1/2-inch hand adjusted needle throttle valves.

Design Data:

Quantity	4
Manufacture/Model	
Safety Class	NNS
Equipment Number	XVN-6074A & B - HR
	XVN-6085A & B - HR
Bill of Material	

To control the flow from the Purge Pressure Blowers, there are 6 inch, hand operated, butterfly valves.

Design Data:

Quantity	2
Manufacture/Model	NUPRO/SS-4SG-6
Safety Class	NNS
Equipment Number	XVB-6068
	XVB-6092
Bill of Material	

2.1.11 Check Valves

On the outlet lines from the purge-pressure blowers are 6-inch stainless steel, water type, check valves.

Design Data:

Quantity	2
Manufacture	F.W.I. Co.
Material	304 or 316 Stainless Steel
Safety Class	NNS
Equipment Number	XVC-6062-HR
	XVC-6065-HR
Bill of Material	ROc-64

On the outlet of the 10 psig nitrogen bottles and the air ejectors there are in-line stainless steel NUPRO 3/8-inch check valves.

Design Data:

Quantity	4
Manufacture/Model	NUPRO/SS-6C-1/3
Cracking Pressure	1/3 psi
Working Pressure Rating @ 70°F	1000 psi
Flow coefficient	1.47
Material	Stainless Steel
Safety Class	NNS
Equipment Number	XVC-6073A & B - HR
	XVC-6088A & B - HR

Bill of Material

2.1.12 Ball Valves

Throughout the sampling portion of the system there are bellows seal, 2-way, 3-way and 4-way 3/8" Whitey ball valves with pneumatic operators.

Design Data:

Quantity -	
2-way	22
3-way	9
4-way	2
Manufacture/Model	Whitey/
2-way	/SS-44S6-133NC or NO
3-way	/SS-43YHF2
4-way	/SS-42XS4-151SR
Operators	Pneumatic
Material	316 Stainless Steel
Safety Class	NNS
Equipment Number	
2-way	XVA-6091A & B - HR
	XVA-6077A & B - HR
	XVA-6076A & B - HR
	XVA-6078A & B - HR

	XVA-6079A & B - HR
	XVA-6075A & B - HR
	XVA-6082A & B - HR
	XVA-6059A & B - HR
	XVA-6090A & B - HR
	XVA-6089A & B - HR
	XVA-6084A & B - HR
3-way	XVA-6080A & B - HR (pair)
	XVA-6086A & B - HR (pair)
	XVA-6087A & B - HR (pair)
4-way	XVA-6081A & B - HR

Bill of Material Numbers

2.2 INSTRUMENTS, CONTROLS, ALARMS AND PROTECTIVE DEVICES

Post Accident Hydrogen Removal and Pressure Equalization System instrumentation provides the necessary inputs for control, operation, and performance/status monitoring of the System.

Those devices (indicators, switches, alarms, computer monitoring, etc.) available to the operator in the Control Room are shown on GAI Flow Diagram D-302-861. In addition, indicators and/or controls are also located on local panels and/or near the component.

The Instrument List provides information pertaining to device location, safety classifications, separation channel, and identification of reference drawings and documents. Instrument numbers assigned to this system are 8250 to 8299.

Further information is available from 1MS-94B-898, H_2 Analyzer Instruction Manual, and 1MS-94B-451, Recombiner Instruction Manual.

2.2.1 Instruments

The specific locations of local indicators are represented on the System flow diagram.

a. Pressure Transmitters

A pressure transmitter located in the East Penetration Access Area provides RB working pressure (narrow range) signals for the computer, Control Room indication, and high and low pressure alarms. The transmitter is isolated on Containment Isolation Phase A signal. A group of four impulse lines are provided connecting to six pressure transmitters to monitor containment pressure. The transmitter outputs provide indication, recording, alarm and computer input as shown in the flow diagram. Four of the above pressure transmitters are used to initiate containment high pressure signals for the Engineering Safeguard Features (ESF) Actuation System.

b. Temperature Elements

Three temperature elements are provided in each electric hydrogen recombiner for monitoring the performance of the recombiners at the local control panel.

c. Flow Transmitters

The flow transmitters on the continuous and backup purge lines provide signals for Control Room indication at the HVAC control board and also to the computer.

d. Test Connections

Test connections are provided on the purge lines and on the Reactor Building. One set of connections in the Fuel Handling Building and one set in the Auxiliary Building are provided for taking Containment air samples.

e. Padiation Detectors

A radiation detector is located close to each A&B analyzer sample line.

f. Radiation Monitors

A radiation monitoring indicator is located within each A&B analyzer panel to monitor each analyzer sample line for the presence of radiation.

g. Pressure Indicators

A pressure indicator is provided to monitor the sample collection flask A pressure. Associated with it is a pressure switch that closes the valve XVA 6084A when the flask pressure falls to atmospheric. This is to protect the integrity of particulate paper filter cartridge.

A similar indication and switching feature is provided in the B flask line, except it operates in conjunction with a pressure transmitter on account of an extended distance from the impulse line.

h. Limit Switches

Limit switches are provided on valves to monitor their open or closed position as shown in the flow diagram.

i. Hydrogen Indicators

Hydrogen % indication is provided for each A&B channel on the Main Control Board and also on the local analyzer panels.

2.2.2 Controls

The System functional diagram D-802-034 outlines the control functions for the containment isolation valves and fan associated with this system.

2.2.2.1 Electric Hydrogen Recombiner

Each recombiner is controlled from its local control panel, located in the Auxiliary Building on the operating floor. The recombiner is started manually at the local control panel 24 hours after the LOCA and the controls are adjusted, following Westinghouse instructions, until the proper temperature is achieved.

2.2.2.2 Isolation Valves - H_2 Analyzer Connections (XVX-6051A-HR, XVX-6051B-HR, XVX-6051C-HR, XVX-6050A-HR, XVX-6050B-HR, XVX-6052A-HR, XVX-6052B-HR, XVX-6053A-HR, XVX-6053B-HR)

a. These redundant isolation valves are normally closed.

b. The solenoid-operated valves can be manually actuated by selector switches on the main control board whenever H_2 sampling is desired. Valve status is indicated by lights on the Main Control Board.

c. Valves are "active", fail close on loss of electric power or air, and perform a safety related function.

2.2.2.3 Isolation Valve - Containment working Pressure (narrow range) transmitter (XVX-6054-HR)

a. This solenoid isolation valve is closed for normal operation, as indicated on the flow diagram. It automatically closes on receipt of a Containment Isolation Phase A signal.

b. This solenoid operated valve can be manually actuated by a selector switch on the main control board. Valve status is indicated on the Main Control Board.

c. This valve is "active", fail closed on loss of electrical power or air, and performs a safety related function.

2.2.2.4 Isolation Valves - Continuous Purge Line (XVG-6066-HR, XVG-6067-HR) and Backup Purge Line (XVG-6056-HR, XVG-6057-HR)

a. These redundant isolation solenoid valves are normally closed. They are manually opened during pressure equalization or purge modes. The valves automatically close on receipt of the isolation signals as explained on the flow diagram.

b. The solenoid operated valves can be manually actuated by selector switches on the control board in the Control Room. Valve status is indicated by lights on the HVAC Control Board.

c. Valves are "active", fail closed on loss of air or electrical power, and perform a safety related function.

2.2.2.5 Hydrogen Removal System Purge Throttling Valve (XVB-6063-HR)

a. This motor operated butterfly valve can be manually actuated by a selector switch on the HVAC control board.

b. The valve can be modulated to any position between full open and full closed by use of the momentary contact selector switch. Valve status is indicated by lights on the HVAC Control Board.

c. Valve is "inactive" and fails "as is" on loss of electrical power.

2.2.2.6 Backup Purge Line Exhaust Fan (XFN-95-HR)

The fan is controlled from the HVAC control board in the Control Room. The fan is started manually when required for Reactor Building pressure equalization or if required for post-accident purging. Fan status lights are provided on the HVAC Control Board.

2.2.2.7 Continuous Purge Exhaust Fan (XFN-96-HR)

The fan is controlled from the HVAC control board in the Control Room. The fan is started manually and runs continuously during normal plant operation. Fan status lights are provided on the HVAC control board.

2.2.2.8 ANALYZERS (XPN-7215A&B, XPN7258A&B-HR)

There are two (redundant) analyzer systems, each consisting of "local" and "remote" panels, and each capable of operation from the main control board after opening of the appropriate sample line isolation valves. One analyzer is always in the "standby" mode with its sample line heating switched on. This is to ensure that the equipment is always calibrated and ready for use. The main control board includes the indication of the plant status, percentage (by volume) of H_2 present (also available in the TSC room) and one plant alarm per channel. More detailed plant performance information can be established from the respective local or remote panels in the Auxiliary Building at 463' elevation. Sample line heating control facilities are also provided near these panels.

2.2.2.9 SAMPLING (XPN-7268A&B-HR)

There are two (redundant) sampling systems, each capable of operation from a local panel in the Auxiliary Building at 463' elevation. The corresponding analyzer must be in operation before the sampling operation is started.

2.2.3 Alarms

The annunciator and computer input list identify the alarms associated with this system. The alarms are also shown on the system flow diagram.

2.2.4 Special Instrumentation

In addition to the normal status lights, ESF monitor lights provide an easily recognizable indication of the status of essential components and equipment. Included among the monitor lights are status indication for the containment isolation valves in this system.

3.0 MODES OF OPERATION

The hydrogen recombiners, sampling equipment, analyzers, and backup purge system are available 24 hours after a loss of coolant accident; however, each unit shall be demonstrated operable during normal plant operation.

3.1 NORMAL OPERATIONS

The Reactor Building pressure equalization system function of the backup H_2 purge system is operable at all times during normal plant operation. A narrow range pressure transmitter provides indication and alarm signals to the Control Room. Control is remote manual by the control room operator.

One H_2 analyzer and its sample line heating are in operation at all times. This will allow taking samples of the containment atmosphere when required.

3.2 ACCIDENT OPERATIONS

One hydrogen recombiner is turned on 24 hours after a loss of coolant accident. The minimum process flow rate of 100 scfm per recombiner is sufficient to continuously reduce the hydrogen volume to a level approaching zero percent.

If both recombiners fail to operate, or operate and fail to recombine the hydrogen as indicated by the H_2 analyzers, the alternate purge system pressure blower is operated when 3 volume percent H_2 approached. The Reactor Building is purged by the alternate purge fan when the H_2 concentration again approaches 3 volume percent. The second H_2 analyzer and its sample line heating are switched on and calibrated as soon as possible after an accident to serve as a standby.

Note: The sample lines are heated to 175°F. Analysis may start when the Reactor Building ambient temperature is 175°F or below. Otherwise condensation in the sample lines would result in erroneously high H_2 indications.

4.0 SAFETY PRECAUTIONS

The hydrogen recombiners are not considered hazardous except that inadvertent operation involves generation of large quantities of heat inside the Reactor Building. Care must be taken so that these units are not inadvertently activated during any mode of normal plant operation or during the first 24 hours of a loss of coolant accident. In addition, the diesel loading sequence is not designed to handle the electrical load of the recombiners until 24 hours after the accident.

The backup purge/Reactor Building pressure equalization system is not considered hazardous except that its operation affects offsite radiation levels. Care must be taken so that offsite dose limits are not exceeded.

5.0 MAINTENANCE

5.1 PREVENTIVE MAINTENANCE

Service and preventive maintenance as specified by the component manufacturer are sufficient to insure operability when needed. The entire System should be kept clean and attention should be given to abnormal vibrations from the fan or motor of the alternate purge fan. Usual plant maintenance for valve packing and fan service is required.

5.2 SPECIAL DESIGN CONSIDERATIONS

The hydrogen recombiners are physically independent of any other Engineered Safety Feature; however, total System operation involves the Reactor Building Spray System or the Reactor Building cooling unit operation to insure mixing of evolved hydrogen to a uniform concentration in the Containment atmosphere.

Sufficient time exists (13 days) following a LOCA, even assuming that the electric hydrogen recombiners were not operated and both H_2 analyzers failed to operate, to obtain additional analyzers from commercial sources not at the plant site.

During post-accident conditions, sufficiently high radiation levels may exist to constitute a potential safety hazard. Preventive safety precautions should be taken.

6.0 REFERENCES

1. ASME Code, Section III and ANSI B16.15

2. ANSI 101.2

3. ASME Boiler and Pressure Vessel Code Section III, Code Class 2

4. AEC Regulation 10 CFR 50, Appendix J

5. GAI Specification SP-337-4461-000

6. GAI Specification SP-545-4461-000

7. NRC TID-14844 Release Model

SEE

APERTURE

CARDS