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CONTAINMENT SYSTEMS

3/4.6.6 PRIMARY CONTAINMENT ATMOSPHERE CONTROL

DRYWELL AND SUPPRESSION CHAMBER HYDROGEN RECOMBINER SYSTEMS

LIMITING CONDITION FOR OPERATION

3.6.6.1 Two independent drywell and suppression chamber hydrogen recombiner systems shall be OPERABLE.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

ACTION: With one drywell and suppression chamber hydrogen recombiner system inoperable, restore the inoperable system to OPERABLE status within 30 days or be in at least HOT SHUTDOWN within the next 12 hours.

SURVEILLANCE REQUIREMENTS

4.6.6.1 Each drywell and suppression chamber hydrogen recombiner system shall be demonstrated OPERABLE:

a. At least once per 6 months by verifying during a recombiner system warmup test that the minimum recombiner heater outlet temperature increases to greater than or equal to 500°F within 90 minutes.

b. At least once per 18 months by:

   1. Performing a CHANNEL CALIBRATION of all recombiner operating instrumentation and control circuits.

   2. Verifying the integrity of all heater electrical circuits by performing a resistance to ground test within 30 minutes following the above required functional test. The resistance to ground for any heater phase shall be greater than or equal to 10,000 ohms.

SEE NEW 3. ON INSERT

   ~~3. Verifying during a recombiner system functional test that, upon introduction of 1% by volume hydrogen in a 140-180 scfm stream containing at least 1% by volume oxygen, that the catalyst bed temperature rises in excess of 120°F within 20 minutes.~~

   4. Verifying through a visual examination that there is no evidence of abnormal conditions within the recombiner enclosure; i.e., loose wiring or structural connections, deposits of foreign materials, etc.

c. By measuring the system leakage rate:

   1. As a part of the overall integrated leakage rate test required by Specification 3.6.1.2, or

   2. By measuring the leakage rate of the system outside of the containment isolation valves at P_a, 34.7 psig, on the schedule required by Specifiation 4.6.1.2, and including the measured leakage as a part of the leakage determined in accordance with Specification 4.6.1.2.

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Replace 4.6.6.1.b.3 with the following:

3. Verifying during a recombiner system functional test that upon introduction of at least 1% by volume hydrogen into the catalyst bed preheated to a temperature not to exceed 300°F that;

   a) the effluent stream has a hydrogen concentration of less than 25 ppm by volume, and;

   b) that at least 75% of the temperature increase occurs above the fourth temperature measuring device in the catalyst bed.

3/4.6.4 VACUUM RELIEF

Vacuum relief breakers are provided to equalize the pressure between the suppression chamber and drywell and between the reactor building and suppression chamber. This system will maintain the structural integrity of the primary containment under conditions of large differential pressures.

The vacuum breakers between the suppression chamber and the drywell must not be inoperable in the open position since this would allow bypassing of the suppression pool in case of an accident. There are nine pairs of valves to provide redundancy and capacity so that operation may continue indefinitely with no more than two pairs of vacuum breakers inoperable in the closed position.

3/4.6.5 SECONDARY CONTAINMENT

Secondary containment is designed to minimize any ground level release of radioactive material which may result from an accident. The reactor building and associated structures provide secondary containment during normal operation when the drywell is sealed and in service. At other times the drywell may be open and, when required, secondary containment integrity is specified.

Establishing and maintaining a vacuum in the reactor building with the standby gas treatment system once per 18 months, along with the surveillance of the doors, hatches, dampers, and valves, is adequate to ensure that there are no violations of the integrity of the secondary containment.

The OPERABILITY of the standby gas treatment systems ensures that sufficient iodine removal capability will be available in the event of a LOCA. The reduction in containment iodine inventory reduces the resulting SITE BOUNDARY radiation doses associated with containment leakage. The operation of this system and resultant iodine removal capacity are consistent with the assumptions used in the LOCA analyses. Continuous operation of the system with the heaters OPERABLE for 10 hours during each 31 day period is sufficient to reduce the buildup of moisture on the adsorbers and HEPA filters.

3/4.6.6 PRIMARY CONTAINMENT ATMOSPHERE CONTROL

The OPERABILITY of the systems required for the detection and control of oxygen /hydrogen gas ensures that these systems will be available to maintain the oxygen ~~hydrogen~~ concentration within the primary containment below the lower oxygen limit for oxygen/hydrogen mixture ~~its flammable limit~~ during post-LOCA conditions. Either drywell and suppression chamber oxygen/hydrogen recombiner system is capable of controlling the expected oxygen ~~hydrogen~~ generation associated with ~~(1) zirconium-water reactions, (2)~~ radiolytic decomposition of water ~~, and (3) corrosion of metals within containment.~~ The oxygen/hydrogen control system is consistent with the recommendations of Regulatory Guide 1.7, "Control of Combustible Gas Concentrations in Containment Following a LOCA," September 1976.

Add Insert

CHANGES FROM G02-92-064

Following an accident the inerted primary containment oxygen level is controlled to not exceed 4.8% volume with the catalytic recombiner system. By FSAR Figure 6.2-26 the containment will reach 4.8% oxygen approximately 60 hours after the accident if either recombiner system is operating.

To provide assurance that recombiners are capable of achieving the required oxygen removal, the feed and effluent streams will be sampled during surveillance testing to establish that the effluent hydrogen concentration is less than 25 ppm by volume for a feed of at least 1% hydrogen by volume. This will confirm a minimum efficiency of 99.75% for the expected range of post-accident conditions. This efficiency will be adequate to maintain the post-accident oxygen level below 4.8% by volume.

The CAC system employs a platinum on alumina catalyst to recombine the oxygen and hydrogen flow from the containment. During accident conditions, the gas mixture is preheated to approximately 450 to 550°F prior to entering the catalyst. This preheat increases the effectiveness of the hydrogen/oxygen recombination because it limits the potential for bed poisoning. In the test configuration, the blower is used as the only source of gas stream heating and the catalyst preheaters are not energized. The blowers are capable of heating the gas stream by compression. Temperatures at the blower exit are limited for test purposes to approximately 300°F due to the blower gas exit temperature trip setpoint.

The capacity of the catalyst bed can be reduced through mechanical, thermal, or chemical (poisoning) deactivation. Poison can be introduced through the environment or the process. To protect the catalyst, the CAC skid is maintained isolated with a pressurized nitrogen blanket. During the performance of the required surveillance testing, the catalyst is exposed to air (and the potential for poisoning from the environment). However, the process of testing establishes that the bed is operable and has not been damaged. The process stream, in a design bases event, may include iodine. Iodine can chemically poison the platinum catalyst; however, the CAC skid scrubs the process gas to remove iodine from the process stream and heats it to reduce effects on the catalyst.

It is important to note that a catalyst bed and its ability to recombine hydrogen and oxygen does not deplete simply from use. Any reduction in recombination capability is caused by poisoning or other damage to or loss of catalyst, or by insufficient activation energy (low inlet temperature). Given adequate inlet temperature, the presence of poisoning in the top few inches of the bed will simply move the peak reaction further down in the bed with very little effect on the percent completion of the reaction. Any such downward movement in the site of the majority of the recombination should be evaluated to determine any actions that may be necessary. Measuring the hydrogen concentration in the effluent stream provides the necessary information that in fact the catalyst is able to recombine hydrogen and oxygen at greater that the 99% efficiency assumed in the containment analysis. Verification that the maximum temperature rise occurs near the top of the bed (i.e., as seen on the first three RTDs) assures that no damage

to the bed is preventing proper operation. If the maximum temperature rise occurs near the bottom of the bed (i.e., on the lowest RTD), verification that at least 75% of the increase was achieved above that RTD indicates that the lower portion of the bed is still capable of providing the necessary catalytic function. However, the change of location of that recombination process provides indication of the potential degradation of the catalyst.

Degradation of the catalyst bed will also be indicated by the decreased ability to recombine hydrogen and oxygen. This indication can be determined through the evaluation of the hydrogen content of the influent and effluent. The catalyst bed should maintain a relatively constant capacity for recombination. If the comparison of the influent and effluent hydrogen concentrations begins to indicate a degradation of the catalyst bed, replacement of the bed will be evaluated.