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SUBJECT: LER 91-029-00:on 911031,inadequate primary containment hydrogen recombiner recycle flow control indentified.Caused by less than adequate design & change implementation.W/ 911127 ltr.

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WASHINGTON PUBLIC POWER SUPPLY SYSTEM

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December 2, 1991
GO2-91-219

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: NUCLEAR PLANT NO. 2
LICENSEE EVENT REPORT NO. 91-029

Dear Sir:

Transmitted herewith is Licensee Event Report No. 91-029 for the WNP-2 Plant. This report is submitted in response to the report requirements of 10CFR50.73 and discusses the items of reportability, corrective action taken, and action taken to preclude recurrence.

Very truly yours,

J. W. Baker
WNP-2 Plant Manager

JWB:ac

Enclosure:
Licensee Event Report No. 91-029

cc: Mr. John B. Martin, NRC - Region V
Mr. C. Sorensen, NRC Resident Inspector (M/D 901A)
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U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

ESTIMATED BURDEN PER RESPONSE TO COMPLY WTH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

# LICENSEE EVENT REPORT (LER)

| FACILITY NAME (1) | DOCKET NUMBER (2) | PAGE (3) |
|---|---|---|
| Washington Nuclear Plant - Unit 2 | 0 5 0 0 0 3 9 7 | 1 OF 0 8 |

TITLE (4)
Inadequate Primary Containment Hydrogen Recombiner Recycle Flow Control

| EVENT DATE (5) | | | LER NUMBER (6) | | | REPORT DATE (7) | | | OTHER FACILITIES INVOLVED (8) | |
|---|---|---|---|---|---|---|---|---|---|---|
| MONTH | DAY | YEAR | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | MONTH | DAY | YEAR | FACILITY NAMES | DOCKET NUMBER(S) |
| 1 0 | 3 1 | 9 1 | | 0 2 9 | 0 0 | 1 1 | 2 7 | 9 1 | | 0 5 0 0 0 |
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OPERATING MODE (9): 1

POWER LEVEL (10): 1 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check one or more of the following)* (11)

| | | | |
|---|---|---|---|
| 20.402(b) | 20.405(c) | 50.73(a)(2)(iv) | 73.71(b) |
| 20.405(a)(1)(i) | 50.36(c)(1) | X 50.73(a)(2)(v) | 73.71(c) |
| 20.405(a)(1)(ii) | 50.36(c)(2) | X 50.73(a)(2)(vii) | OTHER *(Specify in Abstract below and in Text, NRC Form 366A)* |
| 20.405(a)(1)(iii) | X 50.73(a)(2)(i) | 50.73(a)(2)(viii)(A) | |
| 20.405(a)(1)(iv) | 50.73(a)(2)(ii) | 50.73(a)(2)(viii)(B) | |
| 20.405(a)(1)(v) | 50.73(a)(2)(iii) | 50.73(a)(2)(x) | |

LICENSEE CONTACT FOR THIS LER (12)

| NAME | TELEPHONE NUMBER |
|---|---|
| Carl L. Fies, Compliance Engineer | AREA CODE 5 1 0 9 3 7 7 1 - 4 1 1 4 7 |

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

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SUPPLEMENTAL REPORT EXPECTED (14)

X YES *(If yes, complete EXPECTED SUBMISSION DATE)* ☐ NO

EXPECTED SUBMISSION DATE (15): MONTH 0 1 3 | DAY 0 1 1 | YEAR 9 1 2

ABSTRACT *(Limit to 1400 spaces, i.e., approximately fifteen single space typewritten lines)* (16)


On October 31, 1991, a reportability evaluation was completed that concluded that a problem associated with flow control of the Primary Containment Hydrogen Recombiners was reportable. A contract engineer performing a setpoint calculation review had discovered that incorrect Containment Atmospheric Control (CAC) Recycle Flow Control controllers (CAC-FC-67A/B) were installed for both divisions in the control room. The plant design and operating procedures required these instruments to be used in the auto mode of operations to control recombiner recycle flow. If these incorrect controllers had been used in the auto mode, they would not have controlled recycle flow which could have resulted in a reduced recombination rate or possible system shutdown due to excessive recombination.

Immediate corrective action was taken to change plant procedures requiring operation of these instruments in the manual mode. This allows plant operators to control recycle flow from the control room by manually positioning the Recycle Flow Control Valve (CAC-FCV-6A/B).

The root cause of this event was a less than adequate design and design change process during plant construction/startup. A contributing cause was less than adequate testing programs that should have identified the incorrect instruments.

Further corrective action will include a review of the design, testing, and operation of the CAC System by the Nuclear Safety Assurance Group Division.

The safety significance review shows that under postulated accident conditions, sufficient time would have been available for plant operators to discover and correct the prob- lem with operation of CAC-FC-67A/B in the auto position.

Plant Conditions

Power Level - 100%
Plant Mode - 1

Event Description

At approximately 1200 hours on October 31, 1991 a reportability evaluation was completed that concluded a problem associated with the Containment Atmosphere Control (CAC) System was reportable. The problem with the flow instrumentation had been under review since it was discovered on August 7, 1991. A contract engineer identified the issue while evaluating the instrumentation associated with the CAC system as part of the Supply System's setpoint evaluation program. This event was reported under 50.72 at approximately 1500 hours on October 31, 1991.

At WNP-2 the CAC System includes redundant catalytic hydrogen recombiners provided to combine the hydrogen and oxygen in the Primary Containment during degraded post-LOCA conditions. The recombiner subsystems (A and B) are located adjacent to the Primary Containment in the Reactor Building (Secondary Containment). Each redundant subsystem consists of a blower, wet scrubber, electric heater, catalyst vessel, gas cooler and associated instrumentation, valves and piping. A constant speed blower is used to draw the atmosphere from the Primary Containment, process it through the equipment and return it back to the Containment. The amount of recombination is controlled by the amount of recycle flow that is directed back through the unit (see the attached sketch). The amount of recycle flow is controlled by Recycle Flow Control Valve, CAC-FCV-6A/B. As the amount of recycle flow is increased, the rate of recombination decreases. If CAC-FCV-6A/B is fully closed, the system functions with single pass flow through the unit resulting in maximum recombinations but risking subsystem shutdown due to high recombiner outlet temperature if the recombination rate becomes too high. Part of the instrumentation for the recombiner subsystem is associated with the control of recycle flow. CAC-FCV-6A/B is controlled by a locally mounted Flow Indicating Controller, CAC-FIC-67A/B, which recieves a flow feedback signal from the Recycle Flow Transmitter CAC-FT-7A/B. CAC-FIC-67A/B, in turn, was designed to be controlled by remote Master Controller CAC-FC-67A/B located in the control room. The Remote Master Controller receives input on total flow from Flow Transmitter CAC-FT-6A/B. CAC-FC-67A/B should be, by design, ratio-type setpoint stations providing, in the AUTO mode, the setpoint signal to

CAC-FIC-67A/B. Plant Procedures PPM 2.3.3A/B, Containment Atmospheric Control, Revision 0, would have been used for post-LOCA operation of the system. These procedures called for CAC-FC-67A/B to be in automatic on system initiation.

The contract engineer discovered the fact that CAC-FC-67A/B are proportional-integral controllers rather than ratio type controllers. These proportional-integral controllers receive total flow as a process feedback signal. Their output, however, only controls recycle flow. Hence, they are acting in an open control loop and their output will integrate either up or down until the recycle valves are full open or full closed. If the recycle valve went full open this would limit the containment gas flow through the scrubber and dilute the hydrogen concentration at the recombiner. The recombiner would continue to run under this condition but with reduced efficiency. If the recycle valve went closed, this could cause a high temperature rise across the recombiner, resulting in automatic system shutdown. The system would then have to be manually restarted.

Immediate Corrective Action

Plant System Operating Procedures, PPM 2.3.3A/B, Containment Atmospheric Control, were deviated to require operation of CAC with CAC-FC-67A/B in the manual mode. The recycle flow (minimum recycle ratio) is to be set to the value given in the procedure. This ratio is provided as a function of containment pressure. The procedure calls for the control room operator (Section 5.3, CAC Operation Following LOCA) to periodically monitor recombiner catalyst temperature and Drywell pressure to maintain minimum recycle ratio (maximum recombination) by adjusting CAC-FC-67A/B.

Further Evaluation and Corrective Action

A. Further Evaluation

1. This event is being reported per the requirements of 10CFR50.73 under three different paragraphs. First, it is reportable under 50.73(a)(2)(i)(B) as a "condition prohibited by the Plant's Tech Specs" since the system did not meet the OPERABLE definition contained therein. Second, 50.73(a)(2)(v) is also applicable as, "Any event or condition that alone could have prevented the fulfillment of the safety function..." in controlling the release of radioactive material and mitigating the consequences of an accident. Finally, 50.73(a)(2)(vii) is impacted since the event caused, "...two independent trains...to become inoperable...." in a single system designed to mitigate the consequences of an accident.

2. Past records indicate that this discrepancy has existed since initial Plant Startup. Startup Problem Report SPR I-1145, dated June 2, 1981, documents the discovery that the Bailey controllers supplied for initial installation were not correct. The Bailey devices installed in the Control Room were Model 701 003ADAE1 proportional-type controllers.

3. Further review showed that Design Change PED 218-I-3923 was issued on February 11, 1982 to respond to this problem. The design change specified a Bailey Model 715 030AAE1 ratio setpoint controller for CAC-FC-67A/B. Further investigation revealed that this design change alone would not have been sufficient to correct the problem. The Recycle and Total Flow Transmitters (CAC-FT-7A/B and CAC-FT-6A/B) were calibrated to different ranges. Further, the feedback signal to the flow controller was a delta-P signal directly from the transmitter since square root converters had not been installed. Additional signal conditioning equipment would have been required to make the controllers (CAC-FC-67A/B and CAC-FIC-67A/B) function together correctly to control the Recycle Flow Control Valve CAC-FCV-6A/B.

4. For reasons that are indeterminate, the correct Bailey ratio-type setpoint stations were never installed. The root cause investigation was unable to determine or locate documentation that could explain why the correct ratio-type setpoint stations were not installed by PED 218-I-3923. The Startup Problem Report was closed out based on the issuance of the corrected design and the recommended System Lineup Test.

5. A System Lineup Test was referenced on the Startup Problem report as being a required retest after replacement of the instrument. This test was performed in April 1983 but it was limited to a functional check of the incorrectly installed Model 701 003ADAE1 proportional-type controller.

6. The Preoperational Test on the system was performed in December 1983. The Test Procedure has a step which states, "Set FC-67 to recycle 55% of the gas leaving the phase separator." The procedure did not specifically require placing CAC-FC-67A/B in the auto position. The preoperational test did not discover the fact that the incorrect device was installed.

7. Various surveillance tests are performed on equipment associated with the CAC system. This includes an 18-month surveillance (4.6.6.1.b.1) which requires, "Performing a CHANNEL CALIBRATION of all recombiner operating instrumentation and control circuits." Plant Procedure PPM 7.4.6.6.1.3C/D, H2 Recombiner 1A/B Flow Instrumentation Channel Calibration, performs this surveillance test. On November 21, 1991, during a further evaluation associated with this LER, it was discovered that this surveillance had not tested the operation of the Recycle Flow Control Valve, CAC-FCV-6A/B, from the Remote Master Flow Controller, CAC-FC-67A/B in the manual mode of operation. A trouble shooting plan was formulated and implemented that demonstrated movement of the CAC-FCV-6A/B from the control room.

8. A review was performed of the 50.59 that implemented the change to PPM 2.3.3A/B, System Operating Procedures for Containment Atmospheric Control (Division I/II). These procedures are referenced by the Emergency Operating Procedures and were changed previously (see Immediate Corrective Action above) to allow for manual operation of CAC-FC-67A/B. The review found a Safety Evaluation was not performed on the change and one was

completed on November 27, 1991. During the Safety Evaluation the discovery was made that operation of the system at 55 percent recycle flow could have resulted in automatic system shutdown due to high catalyst temperature caused by higher than expected flows through the system. This could occur since the flow measured by the preoperational test was higher than the flow assumed in the analysis. The analyzed flow was 65.7 scfm compared to the measured flow of 86 scfm at atmospheric pressure. Recombiner mass flow would be even higher at elevated containment pressures due to increased density. These high flows resulted in a recommendation for additional changes to PPM 2.3.3A/B. A deviation to these procedures was approved on November 27, 1991 (Procedure Deviations 91-1126 and 91-1127) that required an additional operator to be stationed at the recombiner panel in the control room as soon as possible, but no later than six hours following a LOCA (the design analysis assumes the recombiners are started six hours post accident). This dedicated operator would provide added assurance that CAC recycle flow is monitored in a manner that would maximize the hydrogen and oxygen removal rate while preventing a high temperature shutdown.

B. Root Cause

The root cause of this event was a less than adequate design and design change implementation. Design Change PED 218-I-3923 was not driven to completion by the change process during construction and plant startup testing. There are also contributing root causes that allowed this event to go undetected. The first contributor was a less than adequate Preoperational Test which failed to identify the wrong flow controller and an improper system setup. The second contributor was a less than adequate surveillance testing program that failed to adequately test the functionality of the recycle flow control subsystem.

C. Further Corrective Action

1. The design change process in place during construction depended on contractors to implement changes that were issued by the Architect-Engineer. It is concluded, based on the turnover process put in place at the end of construction, that the failure to implement Design Change PED 218-I-3923 is an isolated occurrence. The construction design change process in place when this event began was completely changed when the plant went into operation. Therefore, no further corrective action is warranted.

2. Plant Procedure PPM 7.4.6.6.1.3.C/D will be revised to incorporate a test of the CAC-FC-67A/B to CAC-FCV-6A/B instrument control loop.

3. Since events associated with this LER have some safety significance, Plant Management has requested a Technical Assessment be performed on the CAC System by the Nuclear Safety Assurance Division. This review will include an assessment of the design, testing, and operation of the system. The results of this effort will be reported in a revision to this LER.

## Safety Significance

Emergency Operating Procedure PPM 5.2.1, Primary Containment Control, provides the flowchart to be used by Plant Operators in the event of a LOCA combined with degraded ECCS Operation. This procedure states that CAC is to be initiated if drywell or wetwell hydrogen concentration reaches 0.5 percent. Primary containment hydrogen is monitored on Containment Monitoring Control Panels CM-CP-1301/1401 and recorded on Stripchart Recorders CM2-H2R-1/2. These instruments would be on scale at this low concentration. Thus, WNP-2 Emergency Operating Procedures are conservative requiring CAC to be operational early in an accident scenario if hydrogen is generated.

The FSAR analysis (6.2.5.2.2) for hydrogen control assumes that the initial levels of hydrogen and oxygen in the containment following the design basis LOCA are 2.5 percent and 3.5 percent, respectively. With these initial conditions and the predicted hydrogen and oxygen generation rates, the analysis demonstrates that even with a six hour delay in starting the recombiners the hydrogen and oxygen concentrations can be successfully maintained below the flammability limits.

The use of Emergency Operating Procedure PPM 5.2.1 would have provided WNP-2 Plant Operators with time (minimum of six hours) to detect problems with the recycle flow and take appropriate corrective action. Both total recombiner flow and recycle flow is recorded in the control room on recorder CAC-FR-67A/B. Operation with CAC-FC-67A/B in the auto position, as explained above, could have resulted in the recycle valve CAC-FCV-6A/B going to the full closed or full open position. The output indicated on the flow controller (CAC-FC-67A/B) would also have read either maximum or minimum. These controllers are similar to others in the control room and plant operators are familiar with their operation. Placing CAC-FC-67A/B in manual would have been a natural reaction and allowed plant operators to control recycle flow.

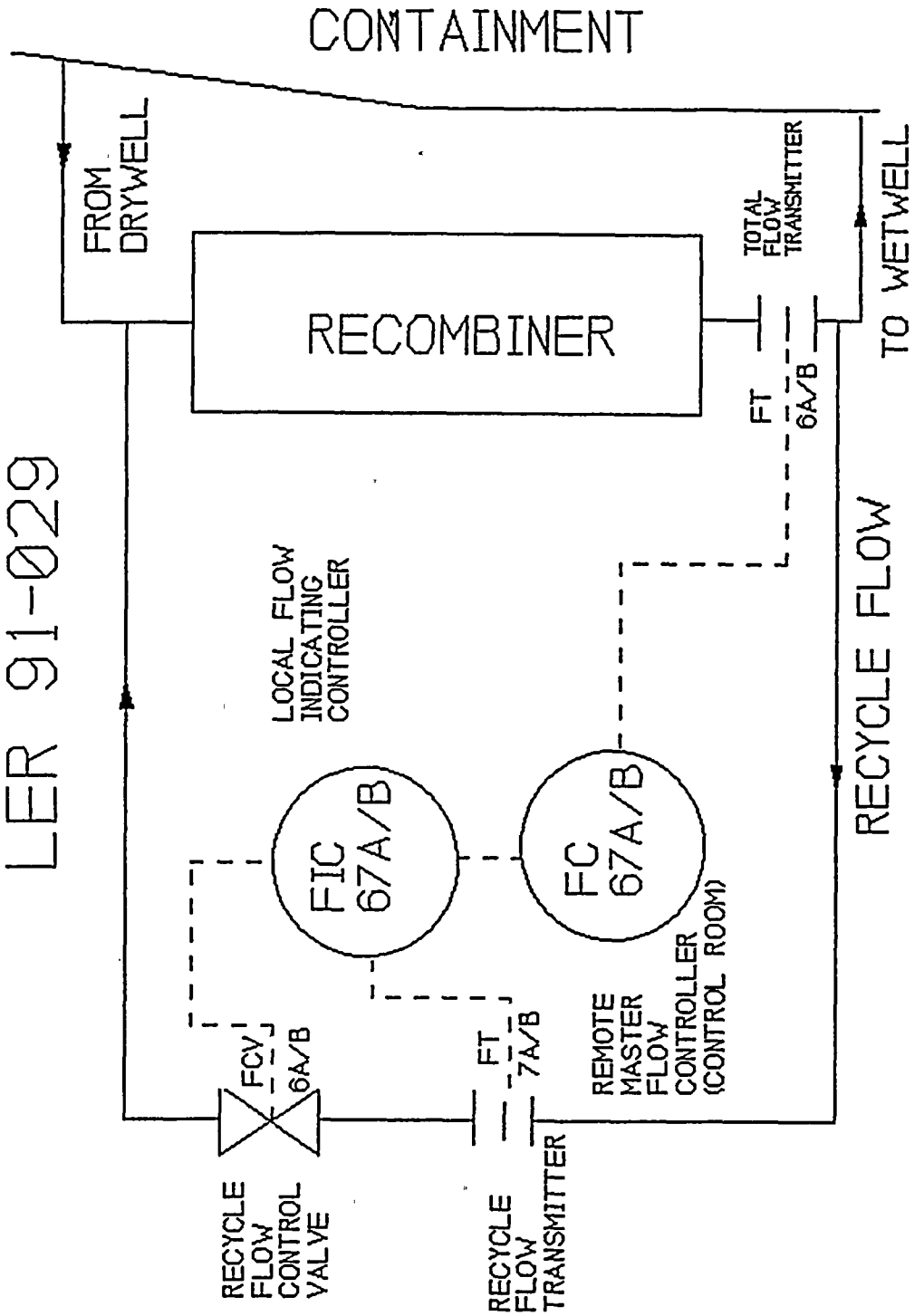
We believe this event has safety significance since the operability of both divisions of one of the WNP-2 Engineered Safety Features was impacted. However, this impact is decreased by the fact that sufficient time would have been available, along with information on system operation, to allow plant operators to take corrective action.

## Similar Events

LER 84-013 reported the event where both hydrogen recombiner fan (CAC-FN-1A/B) motors tripped on electrical overload during preoperational testing at 18 psig containment pressure. The fuses and overloads installed had not been sized for the higher pressure conditions. The portion of this event associated with surveillance testing is similar to those events reported in LER 91-013-02. It is also similar to several events referenced in LER 91-013-02 from the standpoint that inadequate surveillance procedures have been in place since plant startup. The long term corrective actions for this problem are being defined by a Quality Action Team (QAT).

## EIIS Information

| Test Reference | EIIS Reference | |
|---|---|---|
| | System | Component |
| Primary Containment Hydrogen Recombiner | BB | RCB |
| Containment Atmosphere Control (CAC) System | BB | -- |
| CAC Recycle Flow Controller (CAC-FC-67A/B) | BB | FC |
| CAC Recycle Flow Control Valve (CAC-FCV-6A/B | BB | FCV |
| CAC Recycle Flow Transmitter (CAC-FT-7A/B) | BB | FT |
| CAC Local Recycle Flow Indicating Controller (CAC-FIC-67A/B) | BB | FIC |
| CAC Total Flow Transmitter (CAC-FT-6A/B) | BB | FT |
| Containment Monitoring Control Panels (CMS-CP-1301/1401) | IK | PNL |
| Containment Monitoring System Hydrogen Recorders (CMS-H2R-1/2) | IK | R |
| CAC Recombiner Fan (CAC-FN-1A/B) | BB | FN |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FROM DRYWELL
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TOTAL FLOW TRANSMITTER
FT 6A/B
TO WETWELL
RECYCLE FLOW
LER 91-029
LOCAL FLOW INDICATING CONTROLLER
FIC 67A/B
FC 67A/B
REMOTE MASTER FLOW CONTROLLER (CONTROL ROOM)
FCV 6A/B
FT 7A/B
RECYCLE FLOW CONTROL VALVE
RECYCLE FLOW TRANSMITTER