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PROGRESS ENERGY
CRYSTAL RIVER UNIT 3
PLANT OPERATING MANUAL

EMERGENCY PLAN IMPLEMENTING PROCEDURE

EM-225A

POST ACCIDENT RB HYDROGEN CONTROL

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1.0 PURPOSE

This procedure provides guidance for the Accident Assessment Team (AAT) and other emergency response personnel in developing appropriate actions to monitor and control post-accident hydrogen concentration in the Reactor Building (RB) to protect the health and safety of the general public and Crystal River Energy Complex personnel during an emergency at CR-3.

2.0 REFERENCES

2.1 Developmental References

2.1.1 FSAR Chapter 14 Appendix B

2.1.2 MAR 91-05-03-01, "Hydrogen Purge Redundancy Restoration"

2.1.3 MAR 93-05-03-02, "Hydrogen Purge Redundancy Restoration, Elect. & I&C"

2.1.4 CALC M-99-0051, "Mission Dose Assessment"

2.1.5 CALC I-90-0013, "Post Accident Reactor Building Hydrogen Purge Flow Accuracy"

2.1.6 CALC M-90-0056, "Hydrogen Mini Purge Pressure Loss"

2.1.7 CALC M-99-0052, "Zone Environmental Radiation Dose for LOCA"

2.1.8 CALC N-00-0002, "Public And Control Room Dose From A LOCA Using The Alternative Source Term"

2.1.9 CALC M-85-1004, "H2 Generation Rate"

2.1.10 CALC I-90-0023, "RB Hydrogen Concentration Loop Accuracy"

3.0 PERSONNEL INDOCTRINATION

3.1 Definitions

3.1.1 Off-shore winds - winds originating from NNE to SE sectors (011.2° to 146.3°). The most common time for this to occur is midnight.

3.2 Responsibilities

3.2.1 Emergency Coordinator (EC) or designee

- Approves RB purge prior to initiation (Enclosure 6).
- Ensures coordination with off-site agencies prior to initiation of RB purges.

3.2.2 Accident Assessment Team

- Tracks RB conditions and predicts time for RB purge initiation.
- Monitors the effectiveness of purge methods in hydrogen removal.
- Informs the EC of RB conditions and the status of pre-planned releases
- Assign a Purge Release Authorization Form number (Enclosure 6).

3.2.3 Dose Assessment Team

- Monitors meteorological conditions and predicts when off-shore winds should exist.
- Projects off-site doses for proposed RB purges.

3.2.4 Procurement Representative

- Ensures required air compressors are delivered on-site within the required time.
- Ensures support materials (fuel, oil, etc.) are available to support portable compressor operations.

3.2.5 Emergency Repair Team

- Connects temporary air compressors when delivered.
- Installs LR-82-FE, LR-83-FE, LR-82-FI, and LR-83-FI in accordance with MP-815, Installation of Post Accident Hydrogen Purge Monitors.

3.2.6 Radiation Monitoring Team

- Evaluates actual plant radiological conditions and determine routes to be used (see Enclosure 9).

3.2.7 Operations

- Performs RB purge per Enclosure 7.

3.3 Limits and Precautions

- 3.3.1 All hydrogen concentration values referenced in this procedure are presented in % by volume as indicated on the hydrogen analyzers.
- 3.3.2 Maintain RB hydrogen concentration < 3.6% to provide adequate margin below the lower flammability limit of 4.1% for hydrogen in air.
- 3.3.3 Travel through radiation areas should be as shown in Enclosure 9 unless otherwise directed by the emergency RWP.
- 3.3.4 Purging should be performed under favorable meteorological conditions (off-shore winds) whenever possible.
- 3.3.5 RB pressure must be carefully controlled during purge evolutions to prevent ES actuations from high RB pressure.
- 3.3.6 The purging criteria established by this procedure is not valid during Severe Accidents.
- 3.3.7 Mission dose calculations credit 10 days of radioactive decay when determining the dose received for performance of local actions. Taking local actions prior to this time may result in excessive radiation exposure.
- 3.3.8 If a predictable pattern of off-shore winds is identified, consideration should be given to performing a series of intermittent releases during periods when off-shore winds are present.
- 3.3.9 The AAT is responsible for overall implementation of this procedure. TSC teams responsible for performing the specific actions listed in the enclosures of this procedure are denoted at the end of each step as applicable.

4.0 INSTRUCTIONS

NOTE

Enclosure 11, "Hydrogen Purge System Flow Diagram," depicts the hydrogen Purge flow paths established by this procedure. Enclosure 11 is provided for information only.

- 4.1 IF RCS LOCA conditions exist,
THEN MONITOR RB hydrogen concentration in accordance with Enclosure 1, Hydrogen Monitoring, of this procedure.
- 4.2 IF at any time RB hydrogen concentration $\geq 1\%$,
THEN PERFORM the following:
- Perform Enclosure 2, Initial Preparations For Purging, in this procedure.
 - Notify Procurement Representative to contact Hydrogen Recombiner vendor to coordinate preliminary transportation plan and schedule for delivery of recombinder. Refer to EM-104.
 - DAT/AAT evaluate plant conditions and equipment availability to determine if a Hydrogen Recombiner will be required. Notify Procurement Representative if recombinder is required.
- 4.3 WHEN at any time RB purge compressors arrive on site,
AND radiological conditions permit,
THEN PERFORM Enclosure 3, Portable Compressor Installation, of this procedure.
- 4.4 WHEN RB hydrogen concentration $\geq 3.3\%$,
AND radiological conditions permit,
THEN PERFORM Enclosure 4, Prerequisite Field Actions, of this procedure.
- 4.5 WHEN RB hydrogen concentration $\geq 3.4\%$,
THEN PERFORM Enclosure 5, RB Pressurization For Hydrogen Purge, of this procedure.
- 4.6 WHEN RB hydrogen concentration $\geq 3.5\%$,
THEN begin Enclosure 6, Purge Release Authorization Form, of this procedure.
- 4.7 WHEN any of the following conditions exist:
___ RB H₂ concentration $\geq 3.5\%$ for ≥ 24 hours
___ RB H₂ concentration $\geq 3.5\%$ and off shore winds exist
___ RB H₂ concentration $\geq 3.6\%$,
THEN PERFORM Enclosure 7, Purging RB, of this procedure.
- 4.8 WHEN RB purge is stopped,
THEN GO TO Step 4.6 or this procedure.

HYDROGEN MONITORING

STATUS

- LOCA Conditions Exist

ACTIONS

DETAILS

1.1 Ensure one H₂ analyzer is aligned and placed in service (Ops).

- Ensure applicable steps of EOP-14, Enclosure 2, PPO Post Event Actions, have been completed for H₂ analyzers.

1.2 Plot RB H₂ concentration on Enclosure 8 of this procedure (AAT).

- Obtain H₂ concentrations from either of the following:
 - EOP-14, Enclosure 21, RB Hydrogen Monitor Log.
 - RECALL

1.3 Project when RB H₂ concentration will exceed action levels of this procedure (AAT).

- Use H₂ concentration plotted on Enclosure 8 of this procedure.
- Extrapolate to estimate time when H₂ concentration will reach procedure action levels.

<u>Action Level</u>	<u>Date</u>	<u>Time</u>
H ₂ ≥ 1%	_____	_____
H ₂ ≥ 3.3%	_____	_____
H ₂ ≥ 3.4%	_____	_____
H ₂ ≥ 3.5%	_____	_____
H ₂ ≥ 3.6%	_____	_____

HYDROGEN MONITORING (Cont'd)

ACTIONS

DETAILS

1.4 — IF at anytime H₂ concentration is ≥ an action level of this procedure, THEN immediately notify the Accident Assessment Team Coordinator (AAT).

- Action levels based on RB H₂ concentrations.

Action Level Required Action

H₂ ≥ 1% See step 4.2

H₂ ≥ 3.3% See step 4.4

H₂ ≥ 3.4% See step 4.5

H₂ ≥ 3.5% See step 4.6

1.5 — Continue monitoring RB H₂ concentration (AAT).

— Plot RB H₂ concentration on Enclosure 8 of this procedure every 8 hours.

— Perform Step 1.3 of this Enclosure every 8 hours.

INITIAL PREPARATIONS FOR PURGING

STATUS

- RB H₂ Concentration ≥ 1%

ACTIONS

DETAILS

1.1 Notify the Procurement Representative, Radiation Controls Coordinator, Repairs Coordinator and Control Room to begin preparations for RB purge.

- Review this procedure for:
 - Procurement of tools and equipment.
 - Selection of emergency team personnel.
 - Assigning Operations support to the OSC.
 - Initiation of reentry process per EM-104.
 - Collection of radiological and meteorological data.
 - Review of dose projection process.

1.2 Evaluate plant radiological conditions and determine routes to be used to perform Enclosures 2, 3, 4, 5, and 7 (RMT).

- Refer to Enclosure 9 for locations of required actions/components and suggested routes.

1.3 Notify off-site sources to obtain portable air compressors (Procurement Representative).

- Obtain 3 or more air compressors from one of the following off-site sources:
 - Compressed Air Systems, Telephone (800) 626-8177 OR (813) 626-8177 (Tampa)
 - Air Components & Equipment, Inc., Telephone (813) 621-3087 (Tampa)
- Obtain air compressors capable of 225 scfm minimum each for continuous purge (rated exhaust flow) and rated discharge TEMP < 150°F.

1.4 Ensure all CCHE habitability breaches are sealed (ERT).

PREPARATIONS FOR RB HYDROGEN PURGE (Cont'd)

ACTIONS

DETAILS

- 1.5 ___ Monitor meteorological conditions to predict off-shore wind cycle (DAT).
- ___ Off-shore winds originate from NNE to SE sectors (011.2° to 146.3°).
 - ___ Most common time for off-shore winds is midnight.

-
- 1.6 ___ Ensure the purge flow instrumentation cart is properly staged and equipped (ERT).
- ___ Refer to MP-815 for location of equipment.
 - ___ DO NOT install purge instruments until Enclosure 4 is performed.

-
- 1.7 ___ Ensure power is available to LR-82-FI and LR-83-FI receptacle (OPS).
- ___ RX MCC 3B2 is energized.
 - ___ RX MCC 3B2, BKR 8AR closed.
 - ___ ACDP-20, BKR 12 closed. (143 ft AB near elevator)

-
- 1.8 ___ Notify the Accident Assessment Team Coordinator that Enclosure 2 is complete (AAT).

PORTABLE COMPRESSOR INSTALLATION

STATUS

- Purge Compressors Are On Site
- Hydrogen Concentration $\geq 1\%$

ACTIONS

DETAILS

1.1 Consult Radiation Monitoring Team to determine routes and precautions to be used during compressor installation (ERT).

- Refer to Enclosure 9 for locations of required actions/components and suggested routes.

1.2 Connect portable air compressors (ERT).

- DO NOT open LRVs at this time.
- Indicate LRVs to which portable air compressors are connected.
- Preferred - RB portable compressor connections (119 ft IB outside west wall):

<input type="checkbox"/> LRV-11	<input type="checkbox"/> LRV-16
<input type="checkbox"/> LRV-12	<input type="checkbox"/> LRV-17
<input type="checkbox"/> LRV-13	<input type="checkbox"/> LRV-18
<input type="checkbox"/> LRV-14	<input type="checkbox"/> LRV-19
<input type="checkbox"/> LRV-15	<input type="checkbox"/> LRV-20

- Alternate - H₂ recombiner connections (119 ft IB outside west wall):
(adapters in stores – CAT ID # 0001260356)

<input type="checkbox"/> LRV-92 (Pen 125)
<input type="checkbox"/> LRV-90 (Pen 121)
<input type="checkbox"/> LRV-94 (Pen 125)
<input type="checkbox"/> LRV-88 (Pen 122)

PORTABLE COMPRESSOR INSTALLATION (Cont'd)

	<u>ACTIONS</u>	<u>DETAILS</u>
1.3	___ Ensure plant personnel are familiar with the operation of the portable compressors (OPS/ERT).	
1.4	___ Obtain support materials for portable compressors (Procurement Representative).	<ul style="list-style-type: none">• ___ Determine portable compressor fuel and oil consumption rate from compressor vendor.• ___ Ensure sufficient fuel and oil supplies are available to support compressor operation.
1.5	___ Notify the Accident Assessment Team Coordinator that Enclosure 3 is complete (OPS/ERT).	

PREREQUISITE FIELD ACTIONS

STATUS

- RB H₂ Concentration ≥ 3.3%

ACTIONS

DETAILS

1.1 ___ Consult Radiation Monitoring Team to determine routes and precautions to be used while performing RB Purge Field Actions (ERT).

- Refer to Enclosure 9 for locations of required actions/components and suggested routes.

1.2 ___ Defeat all starting interlocks on AHF-7A and 7B (OPS).

1. ___ Obtain key 92 from the Control Room.
2. Select RB exhaust fan permissive bypass switches to the "Emergency" position . (119 ft IB East Door)
 - ___ AHF-7A, Ventilation MCC 3A-10C
 - ___ AHF-7B, Ventilation MCC 3B-9C

1.3 ___ Open RB exhaust dampers for emergency operation (OPS).

- ___ Select AHV-77 to the "EMERGENCY OPERATION OF AHD-95, AHD-96, AND AHD-94" position. (143 ft AB Ventilation Equipment Area, HVAC-13)
- ___ Select AHV-78 to the "EMERGENCY OPERATION OF AHD-97, AHD-98, AND AHD-94" position. (143 ft AB Ventilation Equipment Area, HVAC-13)

PREREQUISITE FIELD ACTIONS (Cont'd)

<u>ACTIONS</u>	<u>DETAILS</u>
1.4 ___ Ensure RM-A1 is in service (OPS/DAT).	<ul style="list-style-type: none">• ___ Ensure RM-A1 pump is running with path to and from pump (143 ft AB).• ___ Ensure RM-A1 monitors have power aligned.• ___ Ensure the following MCB annunciator links are closed:<ul style="list-style-type: none">___ 1712___ 1713___ 1714• ___ Adjust RM-A1 gas channel "HIGH" alarm setting potentiometer to maximum (clockwise).• ___ Ensure LMH controller associated with RM-A1 is in "AUTO".
<hr/>	
1.5 ___ Notify Repairs Coordinator to obtain and install flow instrumentation (ERT).	<ul style="list-style-type: none">• ___ CONCURRENTLY PERFORM MP-815, Installation of Post Accident H₂ Purge Flow Instruments.
<hr/>	
1.6 ___ <u>WHEN</u> H ₂ Purge Flow Instruments are installed <u>THEN</u> notify the Accident Assessment Team Coordinator that Enclosure 4 is complete (OPS/ERT).	

RB PRESSURIZATION FOR HYDROGEN PURGE

STATUS

- RB H₂ Concentration ≥ 3.4%
- Portage Air Compressors are installed.

ACTIONS

DETAILS

1.1 ___ Consult Radiation Monitoring Team to determine routes and precautions to be used while performing RB Pressurization (ERT).

- Refer to Enclosure 9 for locations of required actions/components and suggested routes.

1.2 ___ IF portable air compressors were connected to RB portable compressor connections, THEN start air supply to RB and establish and maintain RB PRESS at ≈ 2 psig (ERT/Ops).

- 1 ___ Start portable air compressors.
- 2 Open isolation valves for operating air compressors (119 ft IB west door):

___ LRV-11	___ LRV-16
___ LRV-12	___ LRV-17
___ LRV-13	___ LRV-18
___ LRV-14	___ LRV-19
___ LRV-15	___ LRV-20

- 3 ___ Open LRV-36
"AIR SUPPLY TO PENETRATION 121 ISO"
(119 ft IB south of A MSSVs).
- 4 ___ Unlock and open LRV-50
"PENETRATION 121 ISO"
(119 IB ft south of PZR Htr MCC 3B overhead).
- 5 ___ Adjust LRV-26
"LRV-24 BYPASS"
(119 ft IB south of A MSSVs) to maintain RB PRESS at ≈ 2 psig.

RB PRESSURIZATION FOR HYDROGEN PURGE (Cont'd)

ACTIONS

DETAILS

1.3 — IF portable air compressors were connected to H₂ recombiner connections, THEN start air supply to RB and establish and maintain RB PRESS at ≈ 2 psig (ERT/Ops).

- 1 — Start portable air compressors.
- 2 Open H₂ recombiner connection isolations for operating air compressors (119 ft IB):

___ LRV-87 (unlock)	___ LRV-88
___ LRV-89 (unlock)	___ LRV-90
___ LRV-91 (unlock)	___ LRV-92
___ LRV-93 (unlock)	___ LRV-94

- 3 — Adjust the compressor output to establish and maintain RB PRESS at ≈ 2 psig.

1.4 — WHEN RB PRESS is being maintained at ≈ 2 psig, THEN notify the Accident Assessment Team Coordinator that Enclosure 5 is complete (OPS/ERT).

PURGE RELEASE AUTHORIZATION FORM

PRAF # _____

COMPLETED BY THE ACCIDENT ASSESSMENT TEAM:

- 1) Date/Time accident started: _____ / _____
- 2) Projected Date/Time for purge start: _____ / _____
- 3) Time after accident for purge start: _____ (hrs) [1 minus 2]
- 4) Error Corrected Flowrate based on time after accident (see Enclosure 10) _____ (scfm)

Completed By: _____ Date: _____

COMPLETED BY THE DOSE ASSESSMENT TEAM:Containment Atmosphere Activity ($\mu\text{Ci/cc}$)

Meteorological Conditions used in projection:

Wind Direction _____ Wind Speed _____ Stability Class _____

Projected purge duration = 1440 minutes (1 day)

RADDPOSE-IV Projected Dose (REM) based on Error Corrected Flow rate:

Site Boundary _____ 2 miles _____ 5 miles _____ 10 miles _____

RADDPOSE-IV Projected Curies to be released: Noble Gas _____ Iodine _____

Completed By: _____ Date: _____

COMPLETED BY EMERGENCY COORDINATOR:

EOF Director notified: _____

EOF Director notified: Date/Time _____ / _____

Ensure the EOF Director has coordinated with the State and local government officials prior to initiating purge.

EMERGENCY COORDINATOR APPROVAL _____ / _____

Sign/Date

PURGING RB

STATUS	
• RB Purge Is Required	

ACTIONS

DETAILS

1.1 _____ Ensure Enclosure 2, 3, 4, and 5 of this procedure have been completed (AAT).

- ___ Enclosure 2 complete
- ___ Enclosure 3 complete
- ___ Enclosure 4 complete
- ___ Enclosure 5 complete

1.2 _____ Determine required purge flow rate (AAT/DAT).

- ___ IF H₂ purge has been previously performed, THEN use flows from previous purge.
- ___ IF H₂ purge has NOT been previously performed, THEN refer to Enclosure 10 to determine flows:

 ___ Required Purge Flow ___ scfm
 ___ Error Corrected Flow ___ scfm
- ___ Record Error Corrected Flow on Enclosure 6.

1.3 _____ Consult Radiation Monitoring Team to determine routes and precautions to be used while performing RB Pressurization (ERT).

- Refer to Enclosure 9 for locations of required actions/components and suggested routes.

1.4 _____ WHEN Enclosure 6, Purge Release Authorization Form is complete and approved by the EC, THEN continue with this enclosure.

PURGING RB (Cont'd)

STATUS

- EC has approved Purge Release Authorization Form, Enclosure 6

ACTIONS

DETAILS

1.5 ___ Notify the EC and the EOF Director that RB hydrogen purge is commencing (AAT).

1.6 ___ Start RB purge Exhaust fan (OPS).

- Start at least one RB Exhaust fan:

___ AHF-7A

___ AHF-7B

1.7 ___ IF RB purge has previously been performed, THEN open purge isolation valves associated with the previously adjusted throttle valve (OPS).

- IF LRV-121 was previously throttled THEN Open A Train isolation valves.

___ LRV-70

___ LRV-71

- IF LRV-123 was previously throttled THEN Open B Train isolation valves.

___ LRV-72

___ LRV-73

PURGING RB (Cont'd)

ACTIONS

DETAILS

1.8 ___ IF purge has NOT previously been performed, THEN establish required RB purge flow (OPS).

1 ___ Record "Required Purge Flow" from Step 1.2 of this enclosure.

- Required Purge Flow _____ scfm

2 ___ IF A Train purging is desired, THEN perform the following in order:

___ Open LRV-70

___ Open LRV-71

___ Throttle LRV-121 to obtain "Required Purge Flow" on flow indicator LR-82-FI (143 ft AB Ventilation Room).

___ Record reading from LR-82-FI
_____ scfm

3 ___ IF B Train purging is desired, THEN perform the following in order:

___ Open LRV-72

___ Open LRV-73

___ Throttle LRV-123 to obtain "Required Purge Flow" on flow indicator LR-83-FI (143 ft AB Ventilation Room).

___ Record reading from LR-83-FI
_____ scfm

PURGING RB (Cont'd)

ACTIONS

DETAILS

1.9 — Maintain RB PRESS constant at
≈ 2 psig (OPS).

- — IF portable air compressors were connected to RB portable compressor connections, THEN adjust LRV-26 "AIR SUPPLY TO PENETRATION 121 CONTROL BYPASS" (119 ft IB south of A MSSVs) to maintain RB PRESS at ≈ 2 psig.
- — IF portable air compressors were connected to H₂ recombiner connections, THEN adjust the compressor output to maintain RB PRESS at ≈ 2 psig.

PURGING RB (Cont'd)

ACTIONS

DETAILS

1.10 ___ WHEN all of the following exist:

- ___ RB H₂ Concentration is
 ≤ 3.5%
- ___ EC approves termination

THEN stop RB purge (OPS/ERT).

1 Ensure the following valves are closed:

A Train	B Train
___ LRV-70	___ LRV-72
___ LRV-71	___ LRV-73

2 Ensure RB exhaust fans are stopped:

- ___ AHF-7A
- ___ AHF-7B

3 ___ IF portable air compressors are connected to RB portable compressor connections, THEN close the following valves:

- ___ LRV-50
 "PENETRATION 121 ISO"
 (119 ft IB south of
 PZR Htr MCC 3B overhead)
- ___ LRV-36
 "AIR SUPPLY TO
 PENETRATION 121 ISO"
 (119 ft IB south of A MSSVs)

4 ___ IF portable air compressors are connected to H₂ recombiner connections, THEN close the following valves:

___ LRV-87	___ LRV-88
___ LRV-89	___ LRV-90
___ LRV-91	___ LRV-92
___ LRV-93	___ LRV-94

5 ___ Stop portable air compressors.

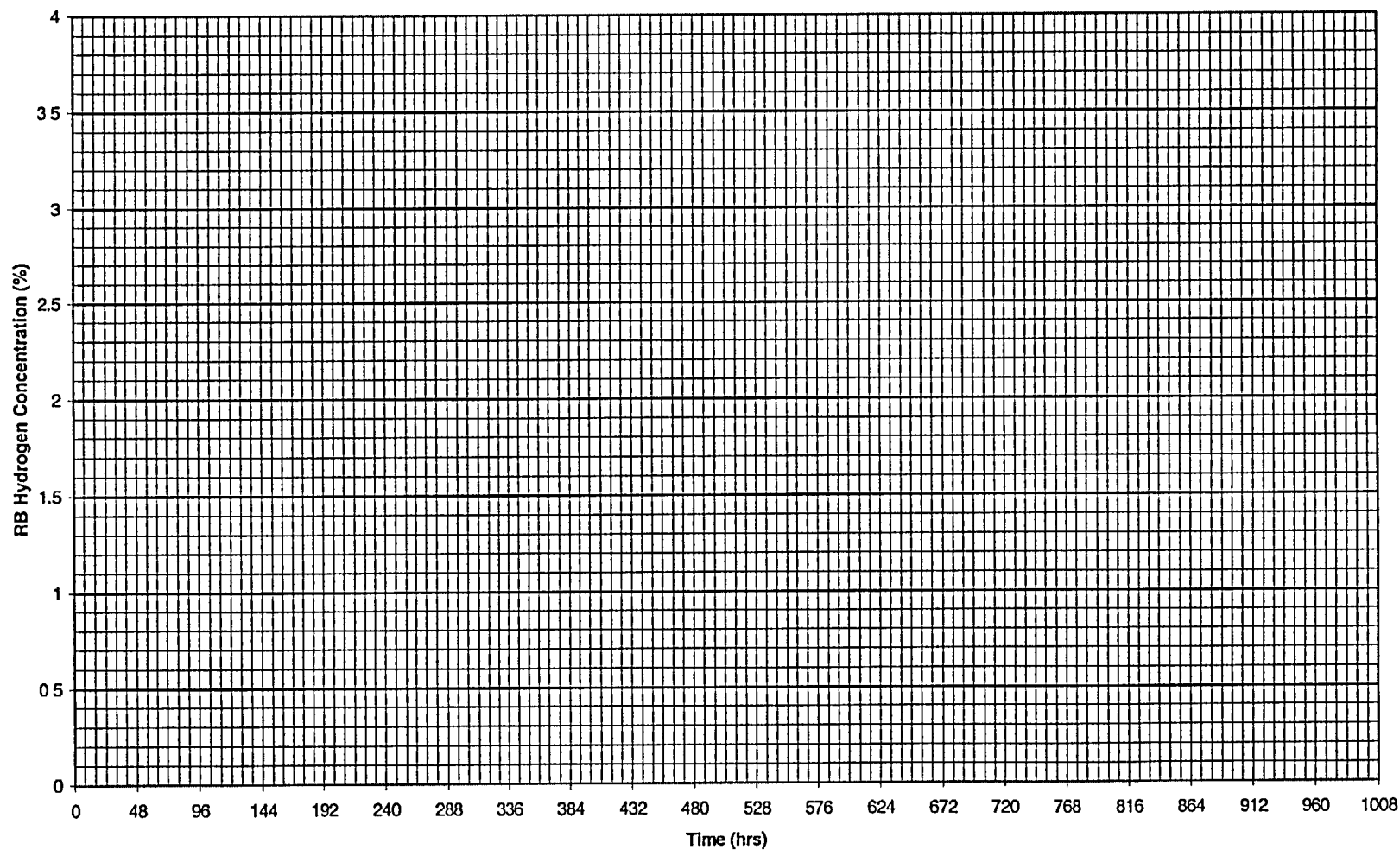
PURGING RB (Cont'd)

ACTIONS

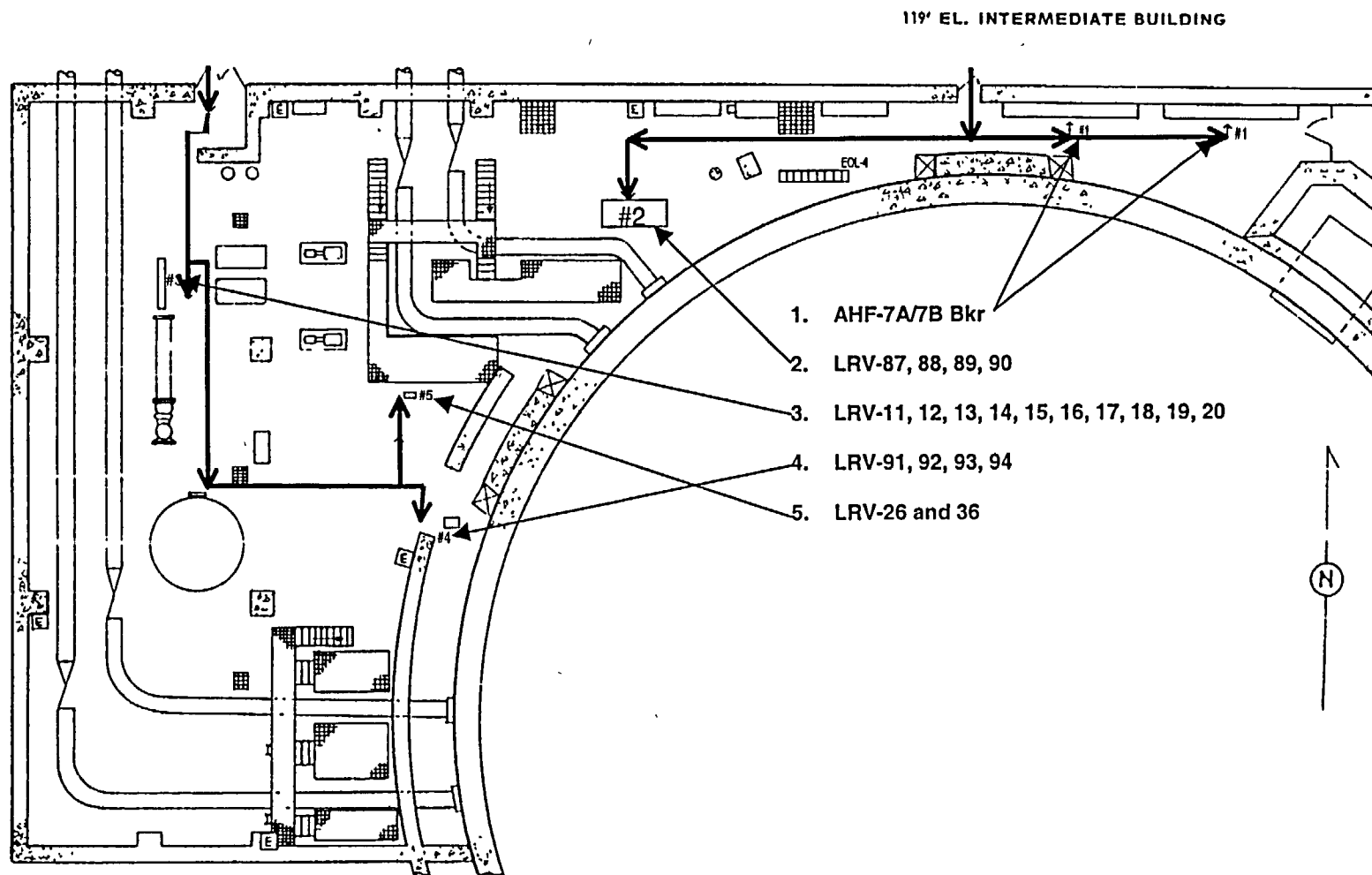
DETAILS

- 1.11 — Notify the Accident Assessment Team Coordinator that RB purge is secured.

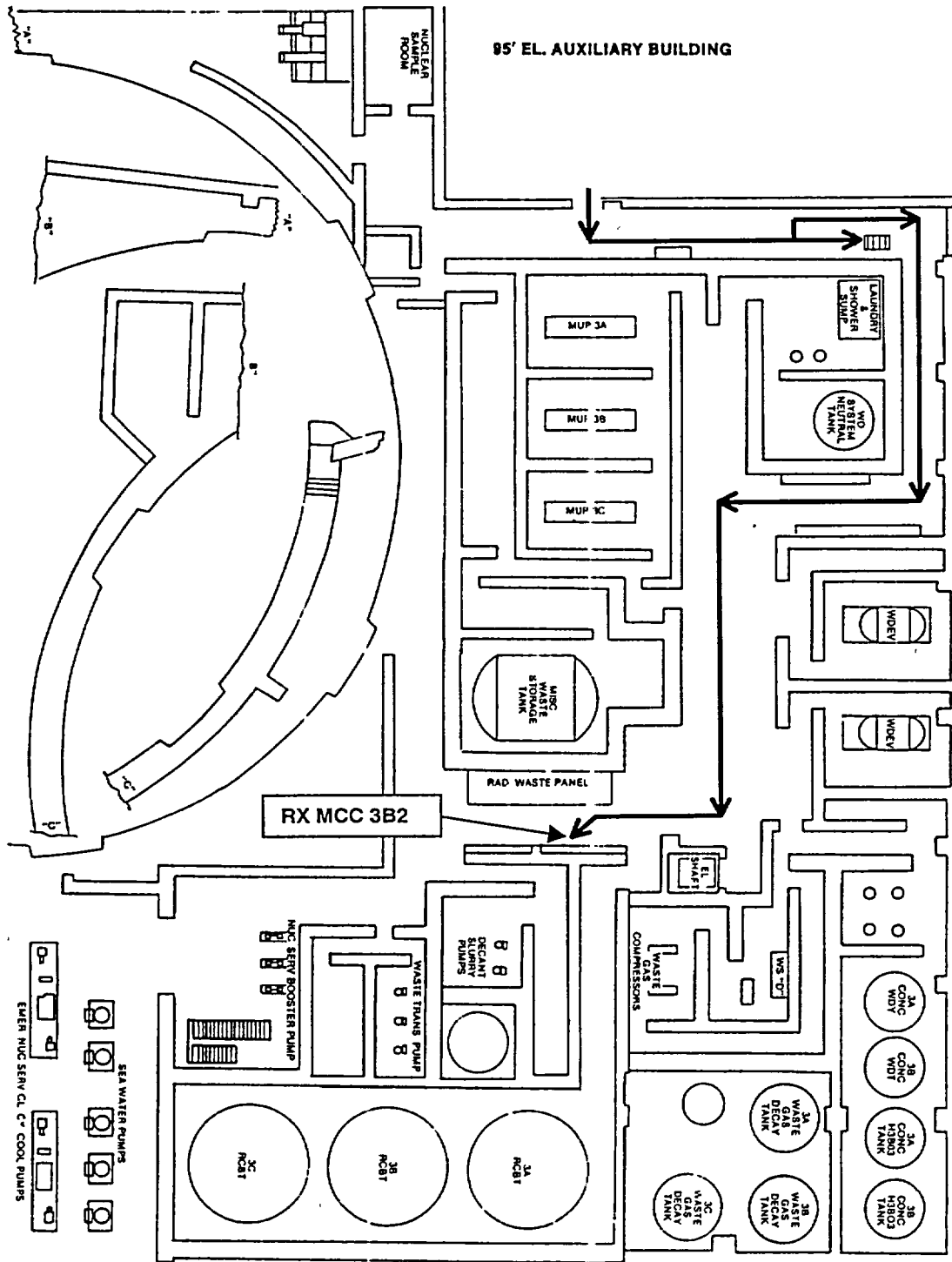
RB HYDROGEN CONCENTRATION TREND



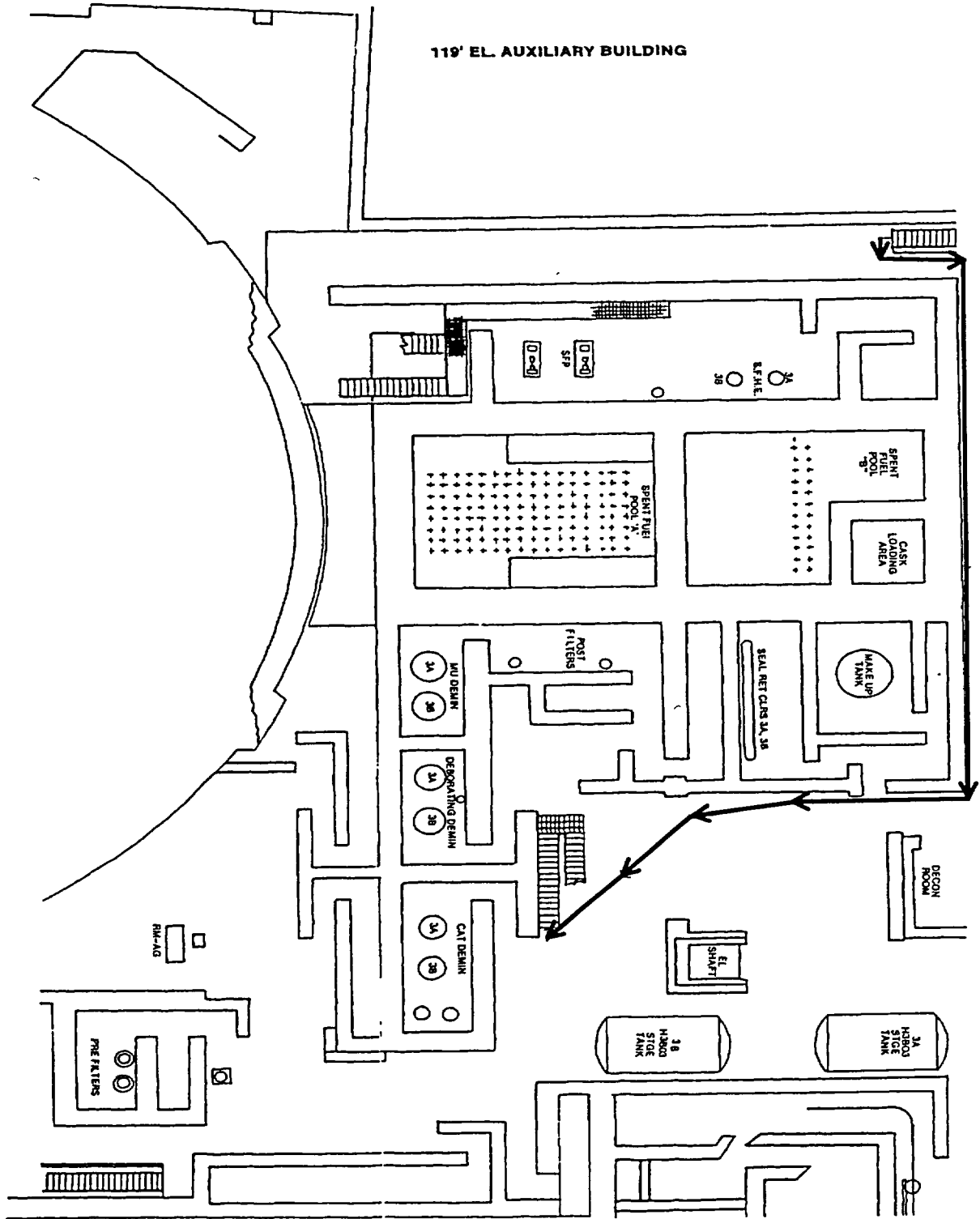
ACCESS ROUTES



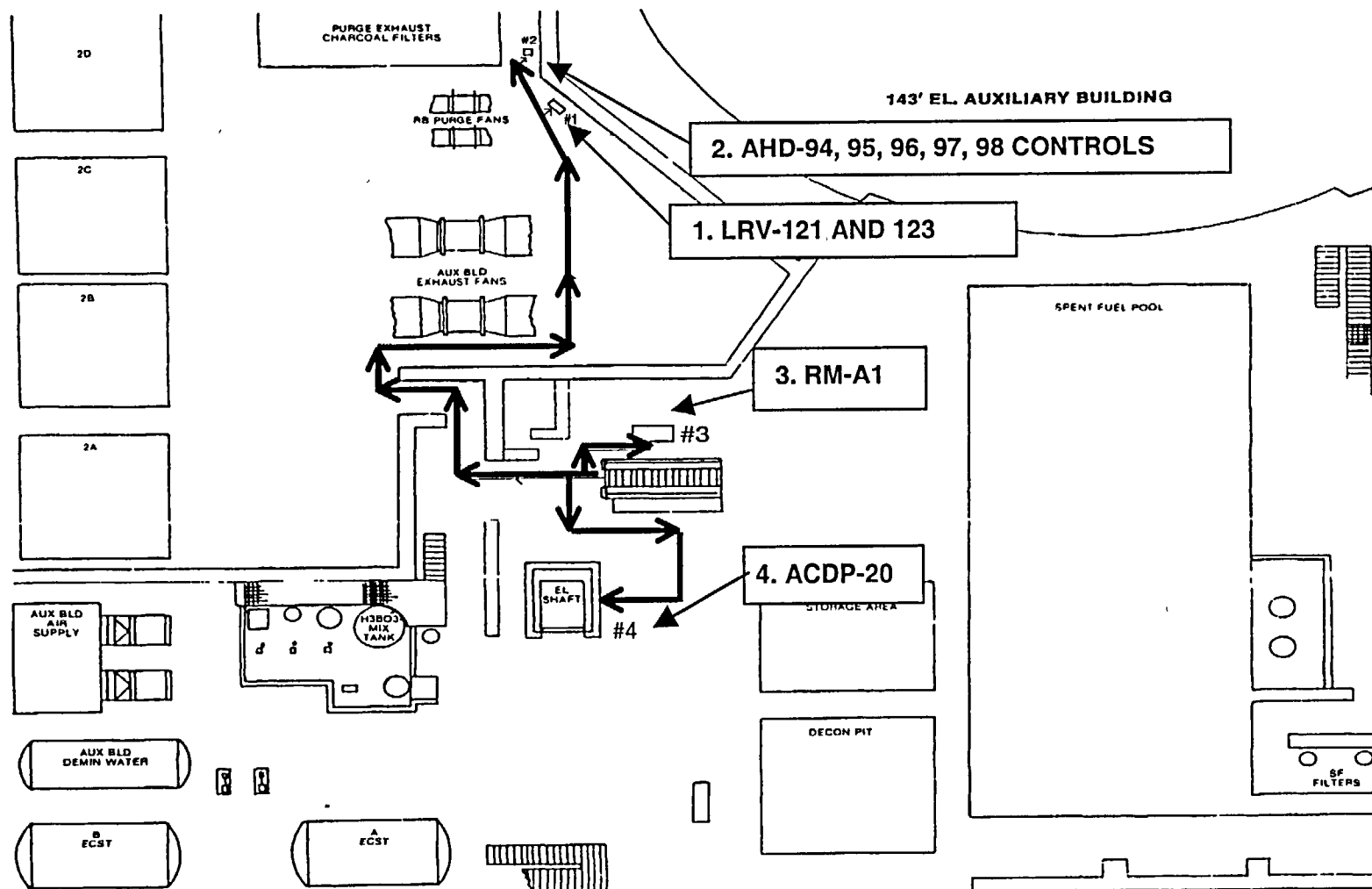
ACCESS ROUTES (Cont'd)



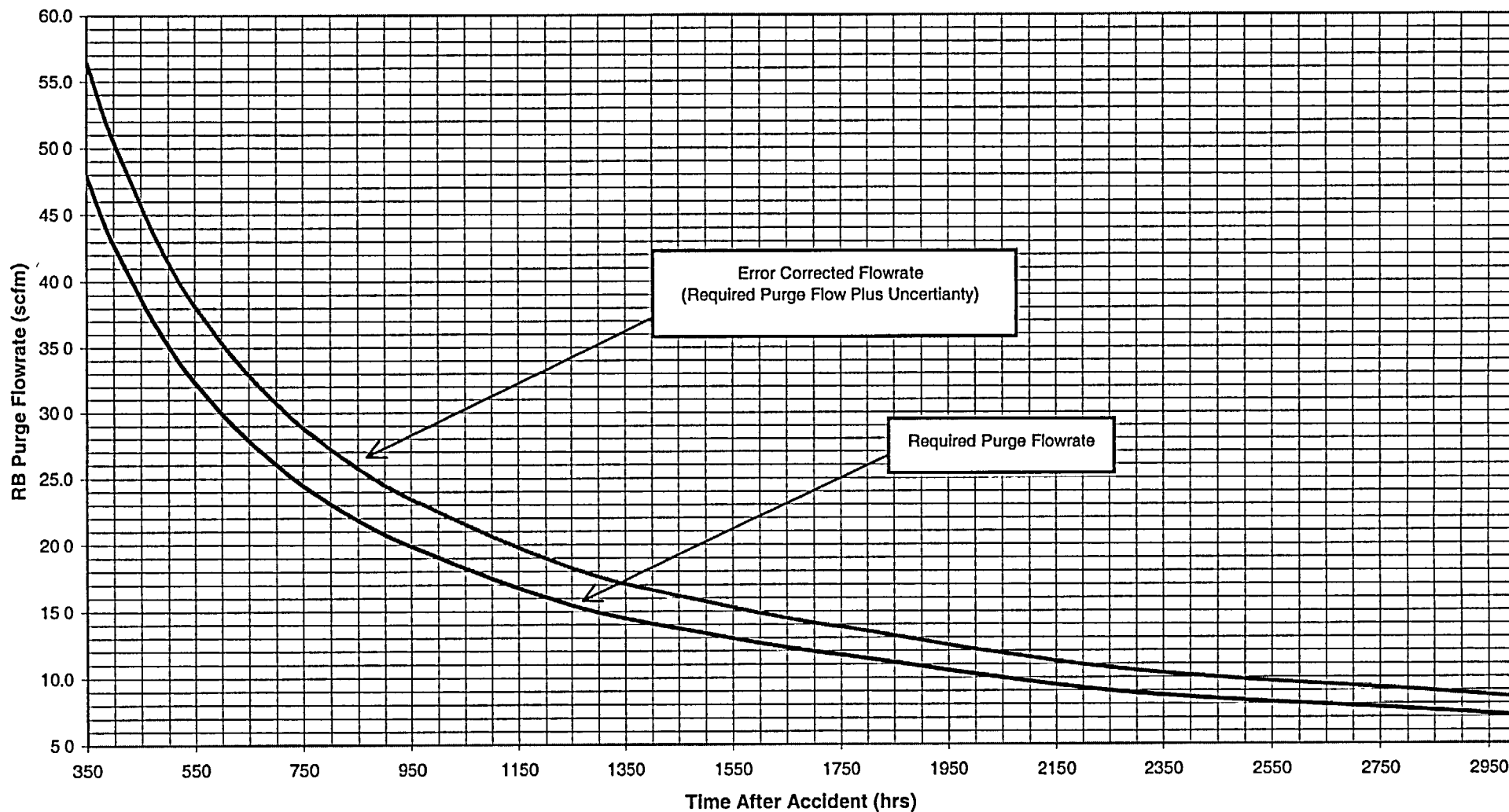
ACCESS ROUTES (Cont'd)



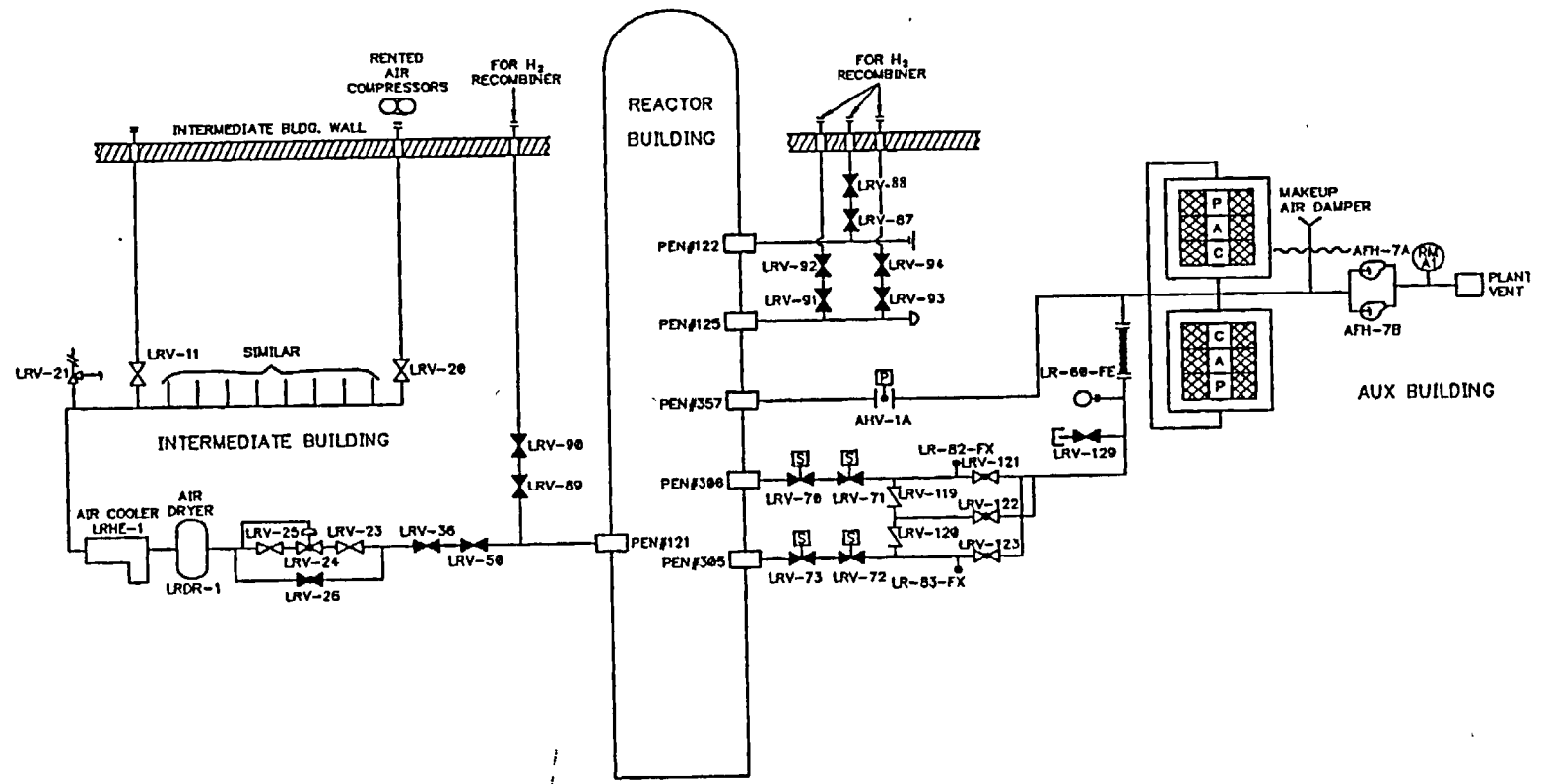
ACCESS ROUTES (Cont'd)



CONTINUOUS PURGE FLOW RATES AFTER A LOCA



HYDROGEN PURGE SYSTEM FLOW DIAGRAM



Summary of Changes

SECTION	CHANGE
1.0	Changed the coversheet to reflect the change to Progress Energy
4.0	Changed action words to all caps to conform to writer guide.
Enclosure 3 Step 1.2	Changed FIMIS # to CAT ID Number for PassPort implementation. (Ref NTM 53999/17)
Enclosure 4 step 1.3	Changed the details to reflect the labeling of HVAC-13, HVAC Control Cabinet 13. (Ref NCR 73431)
Enclosure 10	Revised required and error corrected purge flow rates to reflect changes in calc M-85-1004 revision due power upgrade from 2544 to 2568 MWth. (Ref. NTM 73800)