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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 before initiation (Enclosure 6).
- Ensures coordination with off-site agencies before 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 before 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.**

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.
 - RMT/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 MONITORINGSTATUS

- LOCA Conditions Exist

ACTIONSDETAILS

- | | | |
|-------|--|--|
| 1.1 | ____ Ensure one H ₂ analyzer is aligned and placed in service (Ops). | • ____ Ensure applicable steps of EOP-14, Enclosure 2, PPO Post Event Actions, have been completed for H ₂ analyzers. |
| <hr/> | | |
| 1.2 | ____ Plot RB H ₂ concentration on Enclosure 8 of this procedure (AAT). | • Obtain H ₂ concentrations from either of the following: ____ EOP-14, Enclosure 21, RB Hydrogen Monitor Log. ____ RECALL |
| <hr/> | | |
| 1.3 | ____ Project when RB H ₂ concentration will exceed action levels of this procedure (AAT). | • ____ Use H ₂ concentration plotted on Enclosure 8 of this procedure. • ____ Extrapolate to estimate time when H ₂ 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 H_2 concentration is \geq an action level of this procedure, THEN immediately notify the Accident Assessment Team Coordinator (AAT).

- Action levels based on RB H_2 concentrations.

Action Level Required Action

$H_2 \geq 1\%$ See step 4.2

$H_2 \geq 3.3\%$ See step 4.4

$H_2 \geq 3.4\%$ See step 4.5

$H_2 \geq 3.5\%$ See step 4.6

- 1.5 — Continue monitoring RB H_2 concentration (AAT).

- Plot RB H_2 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 $\geq 1\%$

ACTIONSDETAILS

- 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)

ACTIONS

DETAILS

- 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).

- ☐ 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 \geq 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". |
| 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. |
| 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 \geq 3.4%
- Portage Air Compressors are installed.

ACTIONS

- 1.1 ☐ Consult Radiation Monitoring Team to determine routes and precautions to be used while performing RB Pressurization (ERT).
- 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 \approx 2 psig (ERT/Ops).

DETAILS

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

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

| | |
|---------------------------------|---------------------------------|
| <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 |

- 3 ☐ Unlock and 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 ft IB 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 \approx 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):

| | |
|--|--|
| <input type="checkbox"/> LRV-87 (unlock) | <input type="checkbox"/> LRV-88 (unlock) |
| <input type="checkbox"/> LRV-89 (unlock) | <input type="checkbox"/> LRV-90 (unlock) |
| <input type="checkbox"/> LRV-91 (unlock) | <input type="checkbox"/> LRV-92 (unlock) |
| <input type="checkbox"/> LRV-93 (unlock) | <input type="checkbox"/> LRV-94 (unlock) |

- 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)

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

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

RADDose-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 before 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

- 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 |
|---------------|---------------|
| <u>LRV-70</u> | <u>LRV-72</u> |
| <u>LRV-71</u> | <u>LRV-73</u> |

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)

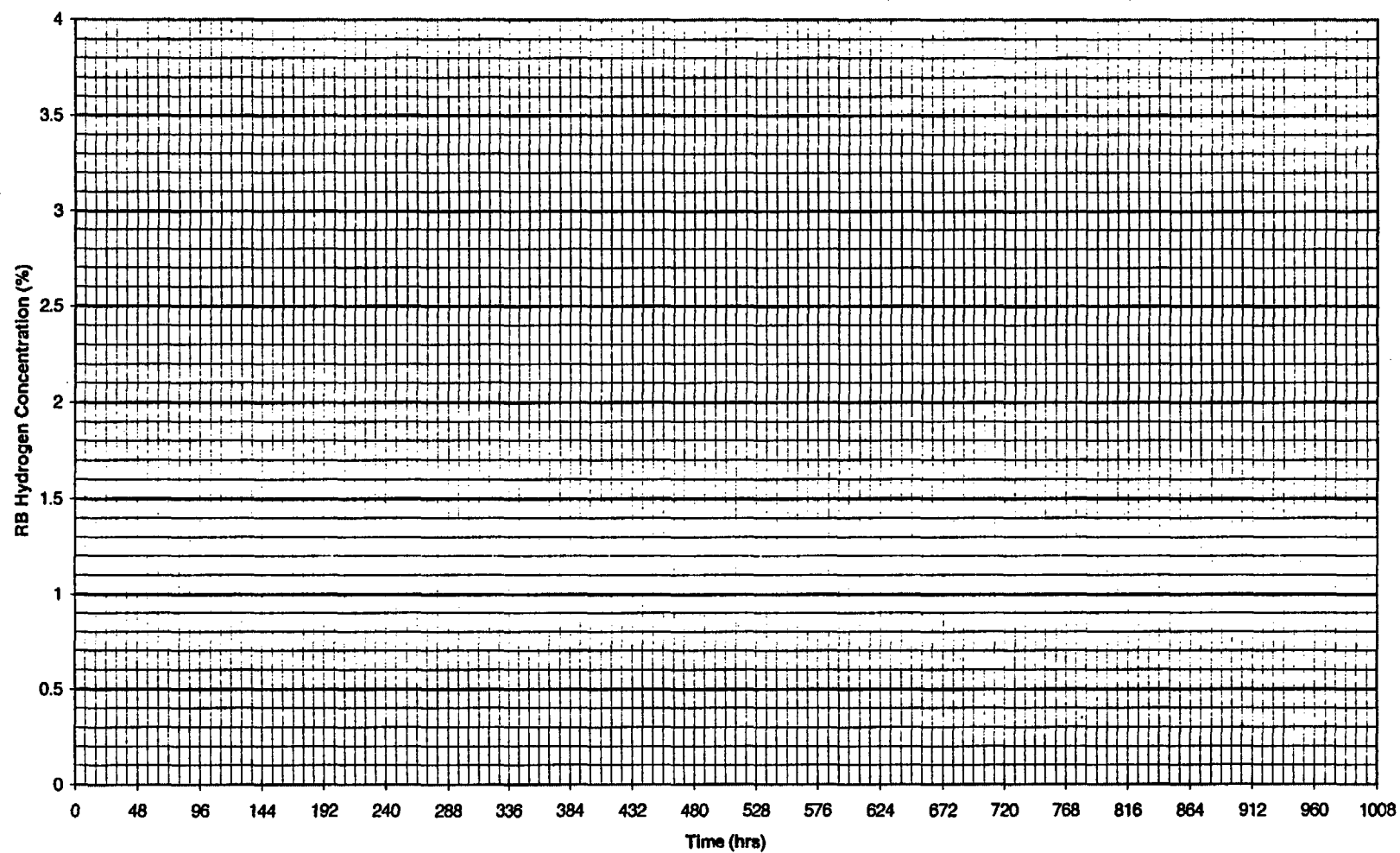
LRV-36
"AIR SUPPLY TO
PENETRATION 121 ISO"
(119 ft IB south of A MSSVs)

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

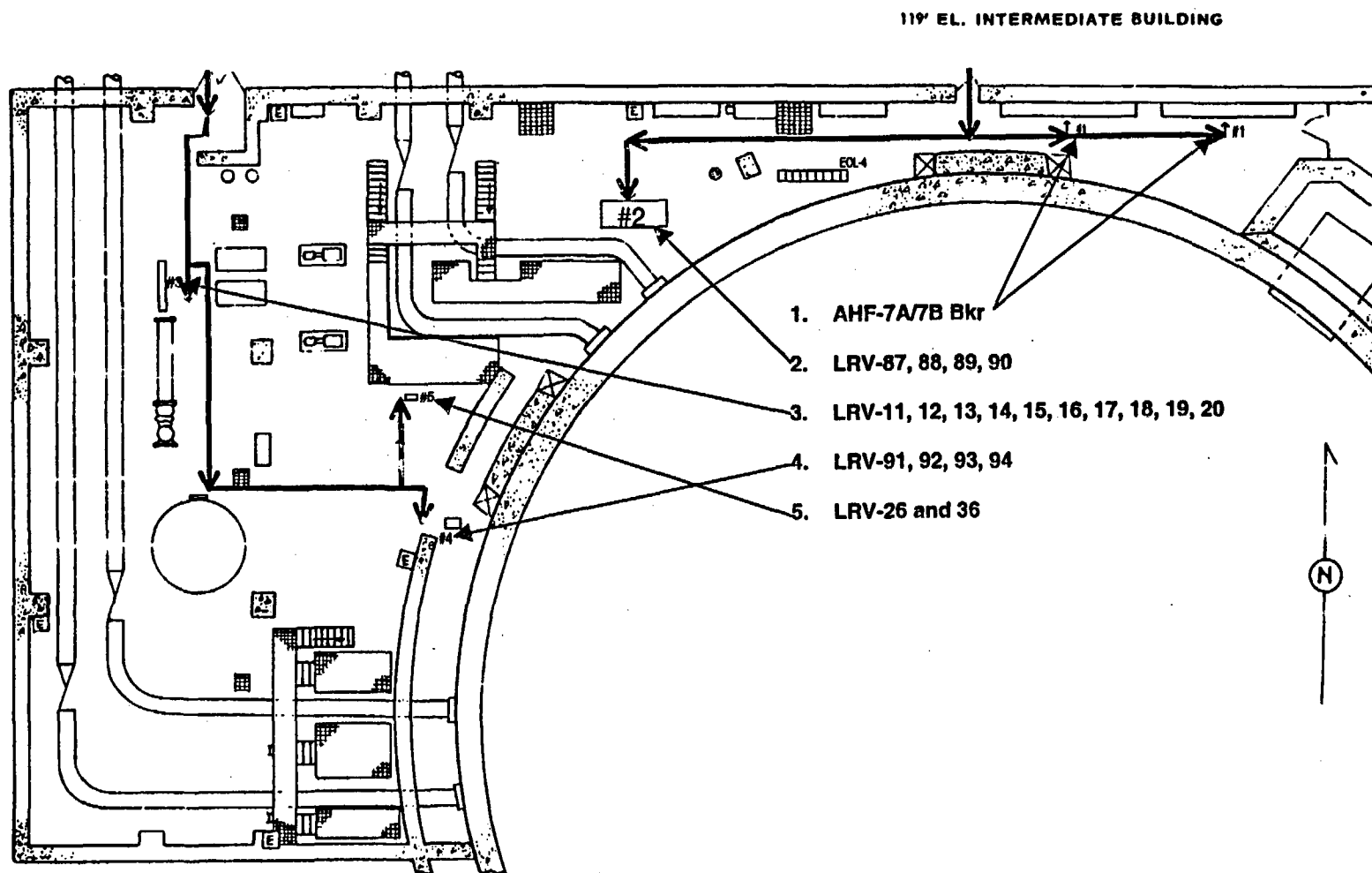
| | |
|---------------|---------------|
| <u>LRV-87</u> | <u>LRV-88</u> |
| <u>LRV-89</u> | <u>LRV-90</u> |
| <u>LRV-91</u> | <u>LRV-92</u> |
| <u>LRV-93</u> | <u>LRV-94</u> |

5 Stop portable air compressors.

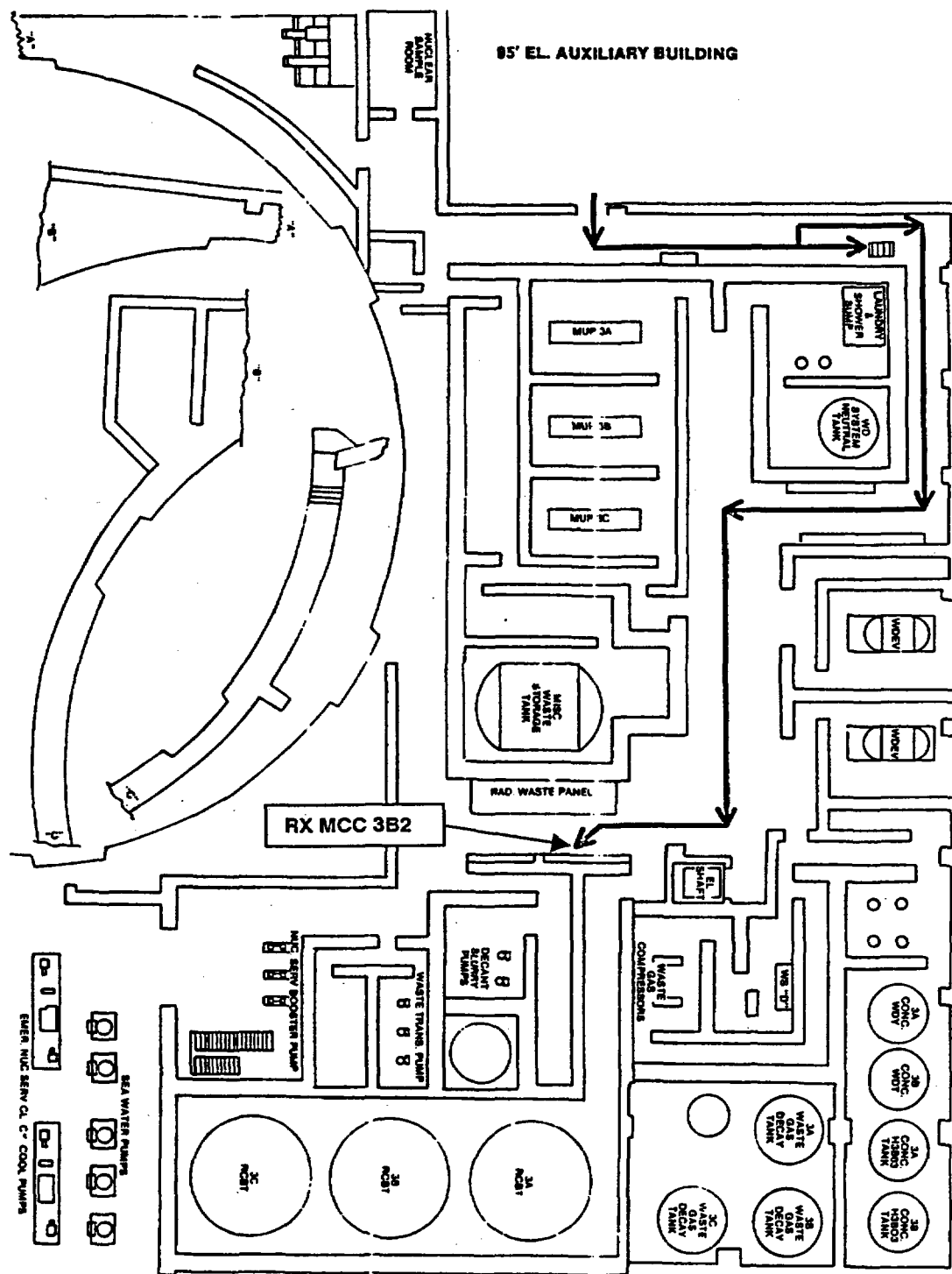
1.11 Notify the Accident Assessment Team Coordinator that RB purge is secured.

RB HYDROGEN CONCENTRATION TREND

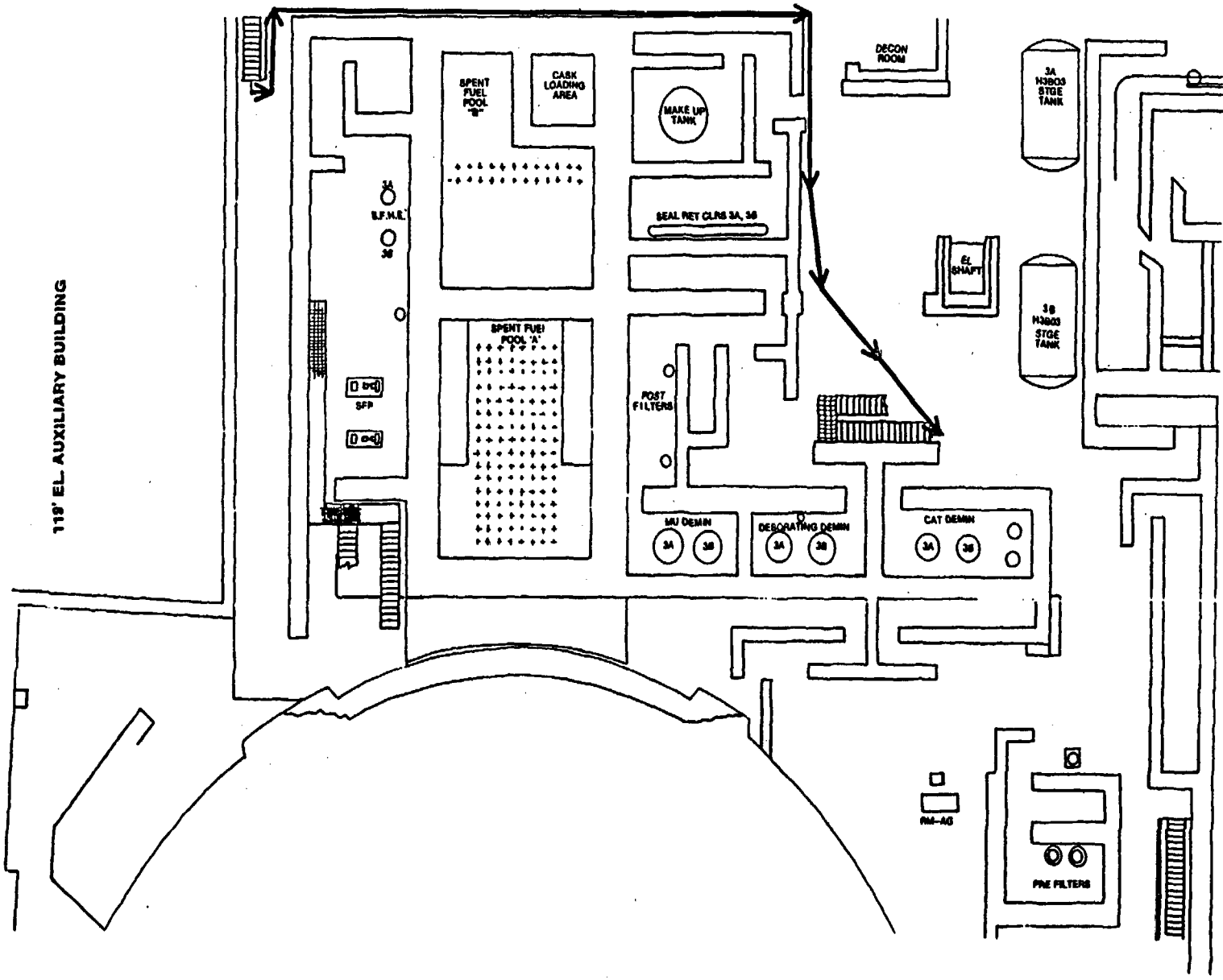
ACCESS ROUTES



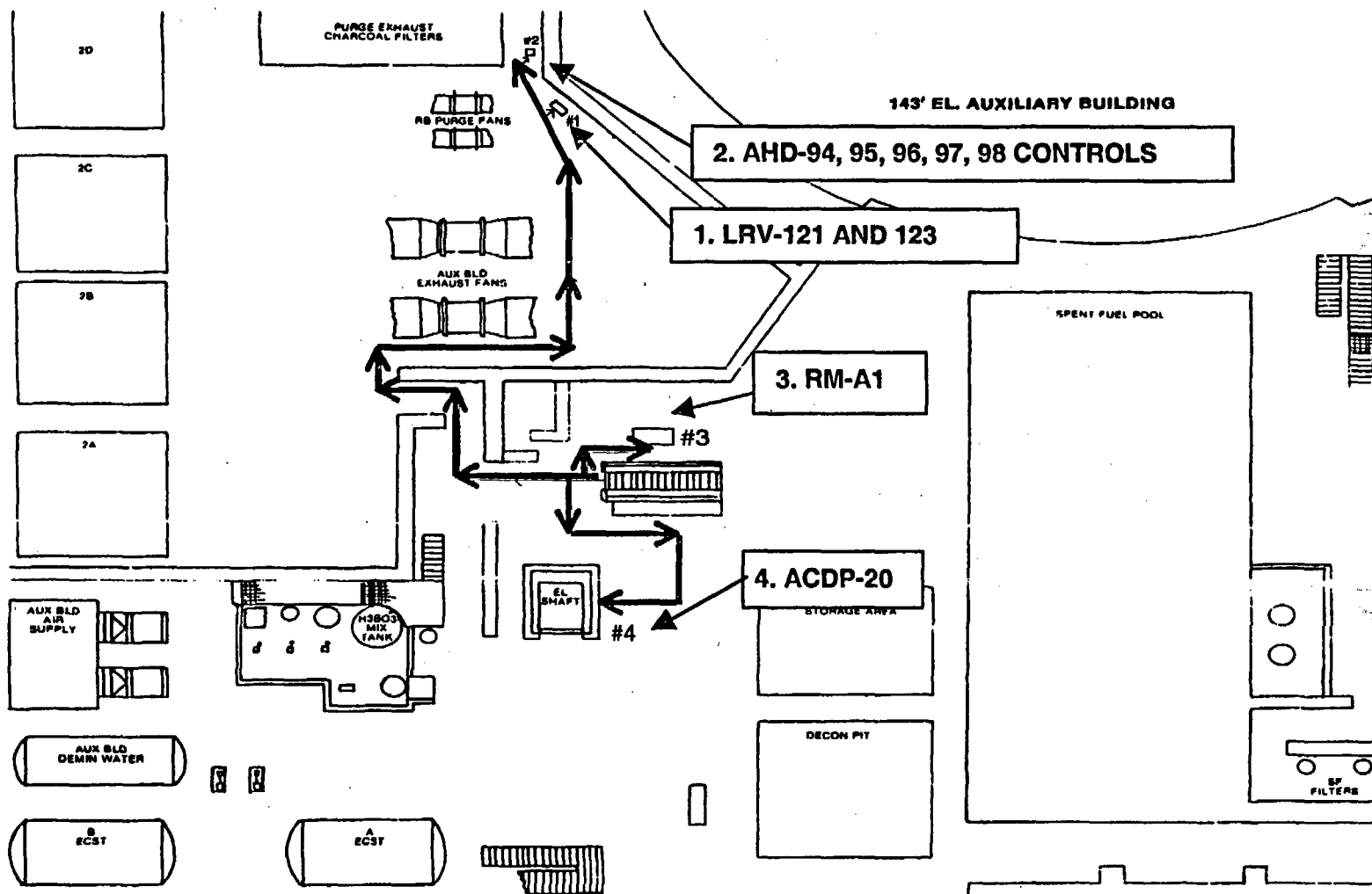
ACCESS ROUTES (Cont'd)

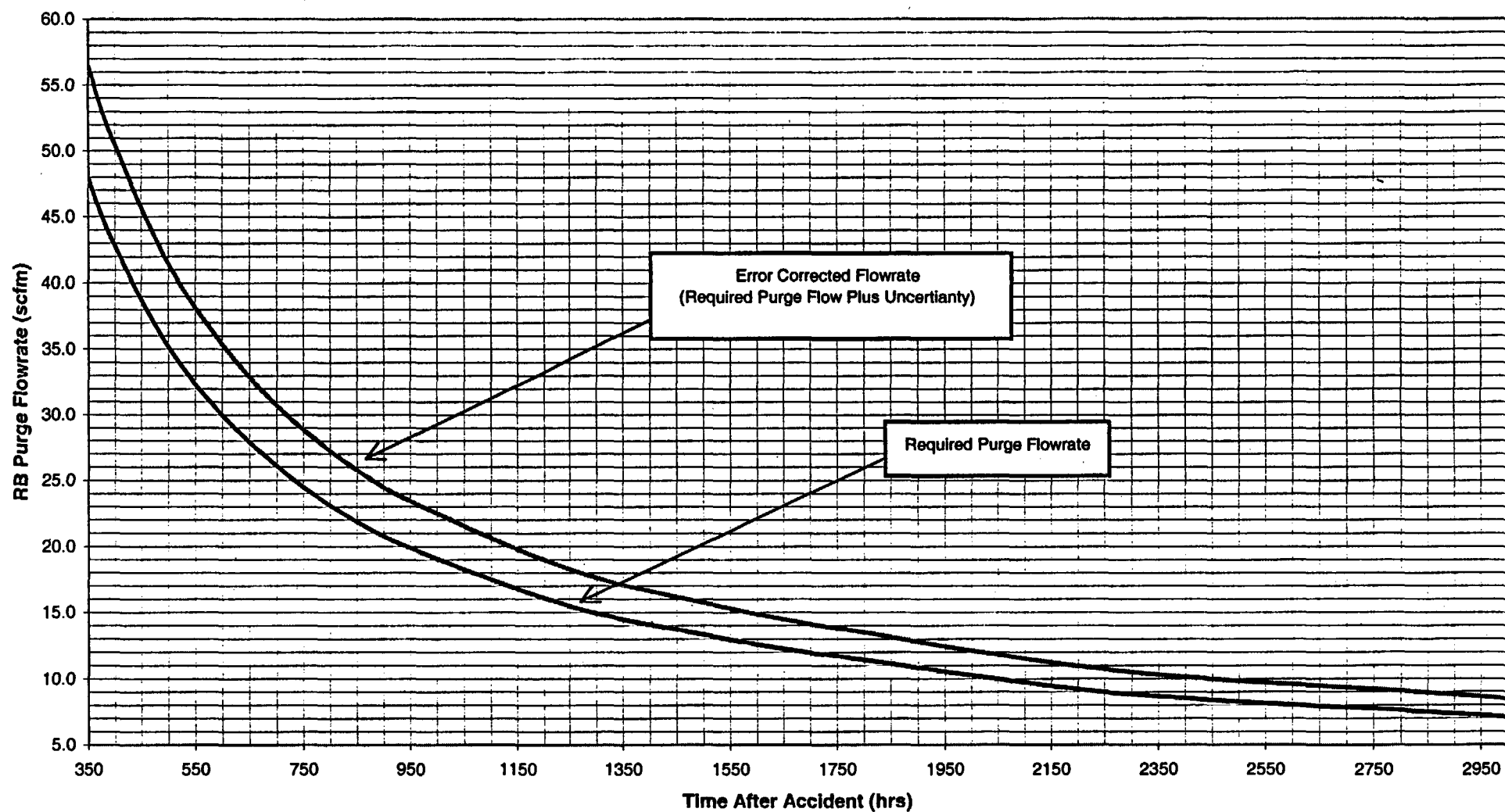


ACCESS ROUTES (Cont'd)

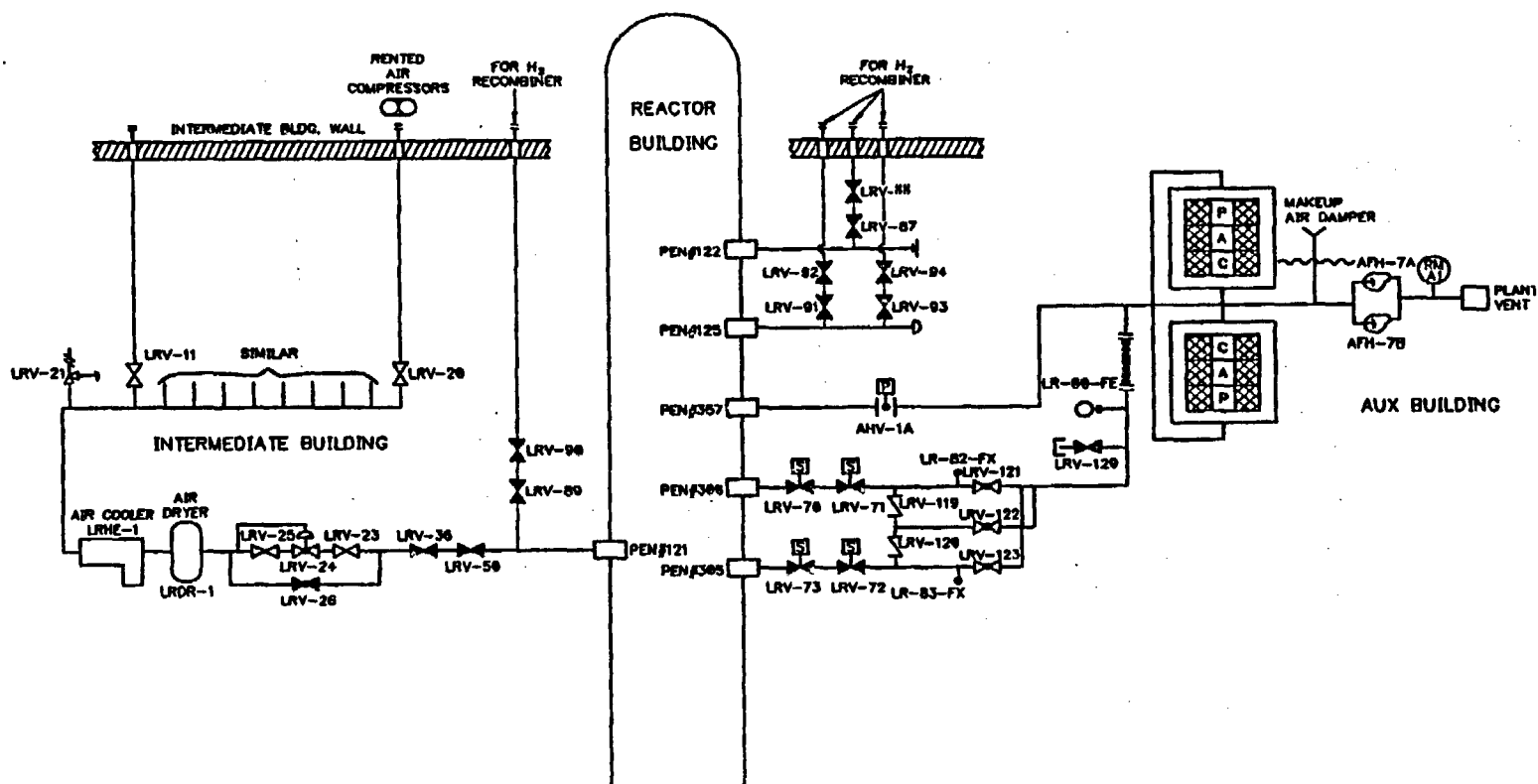


ACCESS ROUTES (Cont'd)



CONTINUOUS PURGE FLOW RATES AFTER A LOCA

HYDROGEN PURGE SYSTEM FLOW DIAGRAM



Summary of Changes (PRR 99315)

| SECTION | CHANGE |
|-----------------------------------|---|
| Enc. 5 (Steps 1.2 & 1.3) | Added Unlock per LAR 274 (NTM # 97679 #2 and PRR 99315)) (Reference LRV-36 , -88, -90, -92, -94) |
| Step 4.2 | Changed step 4.2 third bullet to reference RMT (Radiation Monitoring Team) vs DAT (Dose Assessment Team) – the wrong team was reference. editorial correction |
| Step 3.2.1, 3.3.7 and Enclosure 6 | Changed “prior to” to “before” – editorial correction |