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Fort Calhoun Station Unit No. 1
EMERGENCY PLAN IMPLEMENTING PROCEDURE
EPIP-OSC-16

EMERGENCY TEAM

I. PURPOSE

The purpose of this procedure is to provide instructions for personnel assigned to Emergency Team positions.

II. PREREQUISITE

Both the primary and alternate individuals filling a particular Emergency Team position, TAG No. 1 through TAG No. 24, have been fully trained and are aware of their duties and responsibilities.

III. PRECAUTIONS

None

IV. PROCEDURE

Upon activation of the Initial Response Organization, those individuals assigned to a position on the Emergency Team will carry out their assignment as detailed in Appendix 1 of this Implementing Procedure.

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Fort Calhoun Station Unit No. 1
EMERGENCY PLAN IMPLEMENTING PROCEDURE
EPIP-OSC-16

APPENDIX-1
EMERGENCY TEAM

A. TAG 1 -- RECORDER/PHONE TALKER

Reporting Location:

Technical Support Center

Reports To:

Site Director

Basic Responsibilities:

After receiving call to report to his/her duty station, Recorder/Phone talker will contact the other Recorder/Phone talker and determine who will report to the TSC and who will continue the Initial Response Organization Call List. If the Recorder/Phone talker who is going to continue the call list is contacted at home he/she will remain at home and continue the call list until completed for the Emergency Action Level, or until notified that no further calling is necessary. The other Recorder/Phone talker will report to the TSC, pick up the proper tag from the TSC Tag board and inform the Site Director of their presence.

Sets up, operates and maintains the tape recorder.

Briefs the Site Director on accident status and present conditions when he arrives.

Maintains emergency log book. Clerical assistance is available through the Security and Administrative Supervisor.

Performs telephone communications.

Receives Operational Data from the Control Room and posts this data on the "FCS Emergency Status Board."

Assumes responsibility for the Conference Operations (COP) Network from the Control Room when the Site Director assumes emergency response actions from the Shift Supervisor.

Man the Conference Operations (COP) Network and provide updated information to State and County officials as directed by the Site Director until transferring COP Network responsibility to the E.O.F. Communicator.

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APPENDIX-1
(Continued)

B. TAG 2, 3 - EMERGENCY RE-ENTRY TEAM

Reporting Location:

Operation Support Center Extension in Technical Support Center Building.

Report To:

Health Physics/Chemistry Supervisor when re-entry team required.

Basic Responsibilities:

Re-entry Team personnel will report and receive instructions from the HP/Chemistry Supervisor thru the Monitor Coordinator.

Procures emergency kit, monitor kits, air samplers, and breathing equipment from storage area.

Obtains and battery checks high range survey instruments.

Obtains a set of protective clothing. Dons shoe covers and coveralls, checks out and puts on a TLD and high range dosimeter. Has other protective clothing ready to don on instruction from Monitor Coordinator.

Checks out a self-contained breathing apparatus for readiness to use. Checks the mask for proper fit.

Prepares for entry to the Auxiliary Building, verifies proper dress with the Monitor Coordinator.

Enters the Auxiliary Building as directed by the Health Physics/Chemistry Supervisor and instructed by the Monitor Coordinator.

Performs assigned tasks such as (a) search and rescue of injured person(s), (b) emergency repair to equipment and (c) assistance to Operations in performing corrective actions.

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APPENDIX-1
(Continued)

C. TAG 4 - DOSE ASSESSMENT OPERATOR

Reporting Location:

Technical Support Center Building, Room 107

Reports To:

Health Physics/Chemistry Supervisor

Coordinates With:

Site Director until the Health Physics/Chemistry Supervisor arrives at the TSC.

Basic Responsibilities:

1. Sets up and establishes maps and overlays pertinent to the emergency conditions.

2. Establishes direct-line communications with the Control Room if information is not already available in the TSC to obtain meteorological and radiological data needed to perform Dose Assessment. FC-197 "Meteorological and Radiological Data Worksheet" will be used to record this data.

3. Obtain manual Dose Assessment Data from the Control Room and enter the information into the computer prior to performing normal computer operations.

4. The Meteorological and Radiological Data Worksheet (FC-197) revision number and date will be verified by referring to EPIP-EOF-6 Section H in the official set of Operating Manuals maintained in the TSC prior to their use.

5. Calculates airborne activity, dose rate and integrated dose for locations outside the plant structures and enters this data on FC-195.

6. Ensures the Health Physics/Chemistry Supervisor is receiving calculated data.

Assists the Site Director/HP/Chemistry Supervisor on evaluation of radiological data as required.

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APPENDIX-1
(Continued)

C. TAG 4 - DOSE ASSESSMENT OPERATOR (Continued)

Maintains data in a current status.

Refers to EPIP-EOF-6 Section H "Onsite and Offsite Dose Assessment using the computerized program" when performing dose assessment duties with the computer.

Refers to EPIP-EOF-6 "Onsite and Offsite Dose Assessment", for step-by-step Procedures using plant parameters and effluent monitors to determine source term.

Contact the National Weather Service in Omaha, telephone number 9-1-402-571-8351, and request projected meteorological weather information if necessary to make long term dose exposure projections.

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APPENDIX-1
(Continued)

D. TAG 5, 6, 7 and 8 - OFFSITE MONITOR

Reporting Location:

Operation Support Center Extension in Technical Support Center Building

Reports To:

Monitor Coordinator

Basic Responsibilities:

Obtains monitoring kit, air sampler, water sampling bottles and vehicle.

NOTE: A set of keys for the vehicles are located inside each of the offsite monitor team kits. Kits are numbered to correspond with the OPPD vehicle identification number.

Informs the Monitor Coordinator/Dose Assessment Specialist prior to any departures.

As directed, proceeds to designated location and takes samples as assigned and analyzes air samples.

Labels each sample and saves separately in plastic bags in accordance with EPIP-EOF-3, "Emergency Instrumentation and Equipment". This procedure describes in detail how the samples are to be collected and analyzed.

Reports results to the Monitor Coordinator by radio thru the radio operator, Tag 16. When the Recovery Organization has been activated, the offsite monitor team will be under the control of the Dose Assessment Specialist at the EOF.

Communicates with the Emergency Response Facilities on Channel No. 1, the dedicated radio line for emergency field communication. Other channels can be used if problems develop.

Review plant conditions and projected or known release information with Monitor Coordinator or Dose Assessment Specialist periodically while in plume sectors.

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APPENDIX-1
(Continued)

E. TAG 9 and 10 - GATE MONITOR

Reporting Location:

General Services Building

Reports To:

Monitor Coordinator

Basic Responsibilities:

Notifies the Monitor Coordinator by telephone when he arrives at his work location to obtain any special instructions.

Obtains available friskers from the storage area, checks batteries and makes preparations for monitoring personnel and equipment.

Monitors all personnel exiting the plant area: Paying particular attention to hands, feet and head area.

Sends contaminated personnel to the West entrance of the General Services Building for entry to the personnel decon station.

Monitors all emergency team members returning from the plant closely for contamination; properly bags anti-contamination clothing, if contaminated.

Monitors all vehicles leaving the plant; paying particular attention to vehicle tires and top. Vehicles returning to the site will not be routinely monitored unless specified by Monitor Coordinator.

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APPENDIX-1
(Continued)

F. TAG 11, 12, 13 and 14 - ONSITE MONITOR

Reporting Location:

Operation Support Center Extension in Technical Support Center Building

Reports To:

Monitor Coordinator

Basic Responsibilities:

Obtains a full set of protective clothing including a full face respirator, TLD and high range dosimeter.

Obtains a survey instrument, clipboard, pencil and survey maps from the emergency locker.

Reports to the monitor assembly room and informs the monitor Coordinator of his arrival.

Informs the Monitor Coordinator of any departures from the TSC.

Maintains survey of on site affected areas. One monitor team will use a vehicle for survey and inspection, if required.

May perform in-plant surveys as directed by the Site Director or Monitor Coordinator.

Visually inspect the owner controlled area for personnel occupancy. Owner controlled area consists of the property within the site boundary and the strip of exclusion land directly across the Missouri River which can be viewed from the screen house.

Performs habitability check of the Guard Building, Storeroom and a survey of the General Employee Training Building.

If the early warning sirens have sounded (site area and general emergencies) instruct all non-emergency workers to vacate the owner controlled area.

If a site or public evacuation has been declared, report all refusals to vacate by non-emergency workers immediately to the Monitor Coordinator who will notify the appropriate county sheriff.

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APPENDIX-1
(Continued)

F. TAG 11, 12, 13 and 14 - ONSITE MONITOR (Continued)

After initial surveys and inspection have been completed, report back to the monitor assembly area to receive more directions from the Monitor Coordinator for continuing surveys.

Return all sample and survey results to the Sample Counter/Dosimetry Issuance ET TAG 21.

Use dose rate sample log (Figure EPIP-OSC-13.1) to record all dose rate survey data which includes time of survey, location; type of survey, i.e. Beta or Gamma; dose rate in mrem per hour; and name of surveyor. Also at the top of the form, fill in the date and the instruments used and serial numbers.

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APPENDIX-1
(Continued)

G. TAG 15 - MONITOR COORDINATOR

Reporting Location:

Technical Support Center Building, Room 107

Reports To:

Health Physics/Chemistry Supervisor

Directs/Coordinates:

Emergency Re-entry Team
Offsite Monitor
Gate Monitor
Onsite Monitor
Radio Operator
Rescue Squad Monitor
Personnel Decontamination
Outside Coordinator

Basic Responsibilities:

Is responsible initially to the Site Director for all monitor team activities. When the HP/Chemistry Supervisor position is manned, Tag 15 shall report directly to this individual.

Ensures that the TSC Emergency Status Board indicates current conditions and assessments.

Ensures that all surveys and data are documented in the field by the monitor teams and delivered to the TSC.

Coordinates in plant first aid assistance as needed.

Ensures that all onsite personnel have been checked for contamination.

Ensures that a radiation survey of the Control Room, OSC AND TSC has been conducted.

When the Recovery Organization has been formed and the EOF activated, the Dose Assessment Specialist will assume responsibility for the Offsite Monitor Teams.

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APPENDIX-1
(Continued)

G. TAG 15 - MONITOR COORDINATOR (Continued)

In coordination with the HP/Chemistry Supervisor, directs onsite and offsite teams when to don protective clothing.

Ensures habitability checks are performed in the Guard Building, Storeroom, General Employees Training Building and the helipad as necessary.

Ensures all radio transmissions during drills and/or exercises start and end with "THIS IS A DRILL MESSAGE" or "THIS IS AN EXERCISE MESSAGE".

Ensures off-site and on-site monitor teams are briefed on changing plant conditions and known or projected release information, periodically when teams are in plume sectors.

Maintains dosimetry log on each of the off-site monitor team members.

Records, on the monitor locations map, monitor team location, survey results and time surveys were taken for each of the field monitoring teams (OPPD teams and state teams).

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APPENDIX-1
(Continued)

H. TAG-16 - RADIO OPERATOR

Reporting Location:

Operation Support Center Extension in Technical Support Center Building.

Reports To:

Monitor Coordinator

Basic Responsibilities:

Establishes and maintains radio communication with Offsite Monitor Teams, and the access road Security Guard from the TSC Building.

NOTE: The Offsite Monitor Teams will use dedicated radio Channel No. 1 for communication.

Records in writing, all messages received so that the information is distributed and/or transmitted by FAX.

Transmits radio messages as directed to field Emergency Team Members.

Authorizes onsite entry of the Recovery Organization and emergency response personnel from prepared list. Relays entry authorization of other personnel as directed by the Monitor Coordinator.

During drills and/or exercises ensures all radio transmissions start and end with "THIS IS A DRILL MESSAGE" or "THIS IS AN EXERCISE MESSAGE" as appropriate.

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APPENDIX-1
(Continued)

I. TAG 17 - MESSAGE DISTRIBUTION/CLERICAL SUPPORT

Reporting Location:

Operation Support Center Extension in Technical Support Center Building.

Reports To:

Security and Administrative Supervisor

Basic Responsibilities:

Reports to the TSC and checks in with the Security and Administrative Supervisor.

Responsible for the collection and distribution of message traffic within the TSC.

Performs other administrative duties as required.

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APPENDIX-1
(Continued)

J. TAG 18 - RESCUE SQUAD MONITOR

Reporting Location:

Operation Support Center Extension in Technical Support Center Building

Reports To:

Monitor Coordinator

Basic Responsibilities:

Receives instructions from the Monitor Coordinator i.e. name and location of injured personnel and if the injured person is contaminated.

Obtains a radiation survey instrument and performs operational check. Also, obtains a personnel air sampler.

Obtains four (4) high-range, zeroed pencil dosimeters.

Meets the Rescue Squad and issues a dosimeter to each member and ensures they are dressed in protective clothing if the injured person is contaminated. Briefs them on the location and probable condition of any casualties.

Briefs the Rescue Squad on radiation hazards and other precautions to be taken.

NOTE: The Rescue Squad personnel do not normally enter the auxiliary building unless personnel injuries dictate this entry is necessary. The squad will normally be met with the injured personnel at the north emergency exit.

Accompanies the Rescue Squad to pick up casualties and provide, radiological coverage during the trip to; the hospital.

Furnishes hospital personnel with the following information, if known:

(a) Types and extent of radiation exposure.

(b) Levels of external contamination.

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APPENDIX-1
(Continued)

J. TAG 18 - RESCUE SQUAD MONITOR (Continued)

(c) Probability of internal contamination.

Collects, reads and records pencil dosimeters from Rescue Squad personnel.

Ensures that the Squad members, vehicle and equipment are free of contamination prior to release.

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APPENDIX-1
(Continued)

K. TAG 19 - PERSONNEL DECONTAMINATION

Reporting Location:

Operation Support Center Extension in Technical Support Center Building

Alternate Location:

General Services Building

Reports To:

Monitor Coordinator

Basic Responsibilities:

Reports to the Monitor Coordinator for a briefing.

Will aid in the decontamination of personnel using facilities specified by the Monitor Coordinator.

The following equipment will be available for use:

(a) Frisker (RM-14/15/19)

(b) Step-off pad with undress area

(c) Containers for contaminated clothing.

NOTE: Each individual who is contaminated or who has contaminated clothing must have this clothing bagged individually with the person's name and the time placed on each bag.

(d) Cleaning materials (soap, brushes, towels, etc.)

(e) Clean clothing (i.e., paper coveralls and shoe-covers).

Uses procedure EPIP-EOF-10, "Personnel Decontamination", to brief personnel on decontamination methods to use (i.e., complete shower, wash hands, etc.).

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APPENDIX-1
(Continued)

K. TAG 19 - PERSONNEL DECONTAMINATION (Continued)

NOTE: Complete showers should be avoided unless absolutely necessary to prevent spread of contamination to other parts of individual's body.

Keeps Monitor Coordinator briefed on personnel decontamination status.

Records names and survey results, initial and final, of personnel admitted to decontamination station.

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APPENDIX-1
(Continued)

L. TAG 20 - CONTROL ROOM DATA COLLECTOR

Reporting Location:

FCS Control Room

Reports To:

Operations Support Manager

Basic Responsibilities:

1. Collect operational, meteorological and radiological data from instrumentation and computer equipment in the Control Room.

2. Information collected is recorded on appropriate Fort Calhoun forms.

   (a) Complete all items, as appropriate for accident, on FC-194. If a particular item does not apply enter "N/A".

   (b) Complete all items in Sections I and II, as appropriate for accident, on FC-197. For items that do not apply enter "N/A".

3. Deliver completed forms to; the Control Room communicator (phone talker) who will in-turn relay the information to phone talkers in the OSC, TSC and EOF.

4. Data must be collected and provided to the C. R. communicator every 15 minutes.

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APPENDIX-1
(Continued)

M. TAG 21 - SAMPLE COUNTER/DOSIMETRY ISSUANCE

Reporting Location:

Operation Support Center Extension in Technical Support Center Building.

Reports To:

Monitor Coordinator

Basic Responsibilities:

Ensures that all team members needing TLD"s and dosimeters have them.

NOTE: All dosimeters will be zeroed before being issued.

Maintains the TLD/dosimeter log.

Sets up a counting station and counts all samples brought into the TSC and reports results to the Monitor Coordinator. Ensures that all samples are saved and labeled for future counting if needed.

Collects radiation monitoring devices from team members as they return from assigned tasks.

Keeps the Monitor Coordinator informed on counting results/personnel exposure.

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APPENDIX-1
(Continued)

N. TAG 22 - OUTSIDE COORDINATOR

Reporting Location:

General Services Building

Reports To:

Monitor Coordinator

Supervises:

All personnel that have evacuated the plant

Basic Responsibilities:

Contacts the Monitor Coordinator in the TSC by telephone for instructions.

Coordinates outside activities in the vicinity of the entrance gate and general assembly area during NOE and Alert Emergencies.

Reports to the EOF for re-assignment during "Site Area Emergency" and "General" Emergencies requiring site evacuation.

Ensures that all personnel that have evacuated the plant are in two groups:

(a) Personnel exiting from the auxiliary building area
or

(b) Personnel exiting the uncontrolled areas of the plant.

Ensures that all contaminated personnel are sent to the emergency decon station.

Ensures that all vehicles leaving the plant area are monitored (except emergency vehicles).

Reports names of any contaminated/injured personnel to; the Monitor Coordinator.

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APPENDIX-1
(Continued)

O. TAG 23 - EOF INFORMATION SPECIALIST

Reporting Location:

Emergency Operations Facility

Reports To:

Site Director until the Recovery Manager takes full authority

Coordinates:

EOF Technical Liaison
Media Release Center
Site Director
Recovery Manager when Recovery Organization is activated

Responsibilities:

Monitors status of emergency and relays timely and accurate information to the Media Release Center (MRC).

Maintains information time log for post emergency reference.

Refer to M.2.6.2 for primary responsibility as related to the Recovery Organization.

Refer to EPIP-RR-40 for reporting assignment and basic duties.

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APPENDIX-1
(Continued)

P. TAG 24 - EOF TECHNICAL LIAISON

Reporting Location:

Emergency Operations Facility

Reports To:

EOF Information Specialist

Responsibilities:

Monitors status of emergency and assists EOF Information Specialist in collecting and interpreting nuclear-related data.

Serves as the EOF contact for technical liaison assigned to assist official spokesperson at the Media Release Center (MRC).

Refer to M.2.6.3 for primary responsibility as related to the secondary organization.

Refer to EPIP-RR-41 for reporting assignment and basic duties.

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Fort Calhoun Station Unit No. 1
Emergency Plan Implementing Procedure
EPIP-EOF-6

Onsite/Offsite Dose Assessment

I. PURPOSE

A. This procedure provides instructions and calculations necessary to determine projected:

1. Whole Body Dose Rates at the Site Boundary
2. Thyroid Dose Rates at the Site Boundary
3. Lung Dose Rates at the Site Boundary
4. Whole Body Dose Rates for Offsite Locations
5. Thyroid Dose Rates for Offsite Locations
6. Lung Dose Rates for Offsite Locations
7. Integrated Whole Body Doses for Selected Locations
8. Integrated Thyroid Doses for Selected Locations
9. Integrated Lung Doses for Selected Locations
10. Projected Activity at the M.U.D. Intake Due to Radioactive Liquid Releases

B. This procedure provides instructions and calculations necessary to determine actual offsite dose rates and verify activity release rates utilizing information from the onsite and offsite monitor teams.

C. This procedure provides instructions and calculations necessary to determine whole body dose from the contamination released through the plant stack and deposited on the ground.

D. This procedure provides step by step instructions for onsite/offsite dose assessment using the computer system.

II. PREREQUISITES

A. A radioactive release is suspected or known to be in progress.

B. The person performing dose assessment is trained in the use of and familiar with this procedure.

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III. PRECAUTIONS

A. This procedure has been prepared primarily for use by shift personnel in the Control Room. However, it may also be used by any dose assessment personnel as an alternate method to computer assessments. When so used, the appropriate personnel titles and emergency facility should be substituted for those identified in this procedure.

B. This procedure is divided into eight sections:

1. Section A - Assessment of airborne releases from the ventiliation stack. This section will be used for high readings on effluent monitors:

   a. RM-052 (use only if RM-062 is out of service)

   b. RM-060 (if RM-060 is offscale high, refer to OI-PAP-7 for using RM-063 accident filter)

   c. RM-062

   d. RM-063L

   e. RM-063M

   f. RM-063H

2. Section B - Assessment of airborne releases from the main steam line. This section will be used for high readings on:

   a. RM-064

3. Section C - Assessment of airborne releases from design containment leakage when the containment is isolated. This section will be used for high readings on:

   a. RM-070

   b. RM-071

   c. RM-072

   d. RM-073

   e. RM-074

   f. RM-075

   g. RM-091A/B (use only if RM-070 through RM-075 are offscale/inoperable)

4. Section D - Assessment of airborne releases using key isotopes from air samples. This section will be used if process monitors are offscale/inoperable.

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III. PRECAUTIONS (Continued)

5. Section E - Assessment of liquid releases indicated by high readings on RM-055/055A, or an uncontrolled release from the monitor tanks to the river.

6. Section F - Determination of actual offsite dose rates and verification of activity release rates by utilizing information from the onsite/offsite monitor teams.

7. Section G - Determination of contamination release through the plant stack by providing a relationship between the effluent radiation monitor readings and the amount of contamination on the ground and the resulting whole body gamma dose rates.

8. Section H - This section establishes step by step instructions for onsite/offsite dose assessment by use of the computerized program. Instructions for the operation of the Tektronix-4105 computer terminal and the GE Terminet printers are listed step by step.

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IV. PROCEDURE

A. Section A - Assessment of Airborne Releases From the Ventilation Stack.

1. The Shift Supervisor or his designee, upon receipt of an alert or alarm indication on one or more effluent process monitors, shall assign the Shift Chemist to perform dose assessment. The Shift HP will be used as the alternate.

2. The person assigned to dose assessment will perform dose assessment determinations for Site Boundary, 2 miles, 5 miles, and 10 miles every 15 minutes until relieved or directed to stop by the Shift Supervisor or his designee. Dose assessment will be completed in accordance with the following:

    a. Obtain the "Dose Assessment Forms Booklet" from the Control Room Emergency Gear Locker.

    b. Determine the process monitor to be used for the calculations in accordance with the following:

        1. For noble gas (whole body) stack release use:

            a. RM-062

            b. RM-052 (if RM-062 out of service)

            c. RM-063L, M, H (if RM-062/052 are offscale high)

        1. For iodine (thyroid dose) stack release use:

            a. RM-060

            b. RM-063 accident filter (I.A.W. OI-PAP-7) (If RM-060 is offscale high or out of service)

            c. Obtain Attachment A-1 "Airborne Release Data Record - Ventilation Stack". Collect and record the following data for each process monitor assessment:

                1. Date and Time

                2. Present (or Average) Wind Speed - Wind speed meter is located on the north wall of the Control Room above the fire control and alarm panels (AI-184), or obtain wind speed from the Plant Computer by requesting information from operations personnel. Record wind speed; use the estimated average if the reading is unstable. Average wind speed should be used if the release has been continuous.

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IV. PROCEDURE (Continued)

3. Present Wind Direction - Wind direction meter is located on the north wall of the Control Room above the fire control and alarm panels (AI-184), or obtain wind direction from the Plant Computer by requesting information from operations personnel. Record wind direction; use the estimated average if the reading is unstable.

   NOTE: This is the direction that the wind is coming from.

4. Present Delta Temperature (ΔT) - ΔT meter is located on the north wall of the Control Room above the fire control and alarm panels (AI-184), or obtain ΔT from the Plant Computer by requesting information from operations personnel.

5. Stability Class - Using the table and the ΔT from Step 4, determine the stability class and circle the correct designation. When a ΔT is common to two stability classes, use the class nearest to class G.

6. Stability Conversion Factors - All graphs are based on a single stability class to reduce the total number of graphs needed. Therefore, correction factors are needed to adjust dose rates for other stability classes. Simply locate the applicable stability class in the left column (from Step 5), and circle all four factors that fall to the right of the class. The factors will be used to adjust the dose rate value in a later step.

7. Affected Sectors - Using the overlay map located on the west wall of the Control Room, place the overlay centerline on the downwind exposure pathway (180° from the wind direction recorded in Step 3). Using the appropriate stability class, locate the applicable lines on the overlay. This will outline the projected plume width. Determine the sectors in the plume pathway and record these sectors.

8. Stack Flow Rate - Stack flow rate meter is located behind the control panel on AI-44. The meter number is FR-758. Meter reading is in standard cubic feet per minute (SCFM) times one thousand.

9. Stack Flow Factor - Graphs are based on a stack flow rate of 72,500 SCFM. If actual stack flow rate is different, the flow rate must be corrected. To correct this, divide the actual stack flow rate by 72,500.

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IV. PROCEDURE (Continued)

10. Process Monitor Reading (GCPM) - Record monitor reading(s) in gross counts per minute (GCPM) from affected monitor(s), or dose rate from the RM-063 filter. It may be necessary to use the chart recorder to determine GCPM if the release has been terminated.

11. Calculated Release Rate - Perform release rate calculation at the bottom of the graph(s). Record the results in curies/second.

12. Actual Release Rate - Multiply the calculated release rate (Step 11) by the stack flow factor (Step 9). Record the results in Curies/Second.

13. Projected Duration of Release - The Shift Supervisor or his designee must determine the projected duration of the release. This information is required to calculate the projected total dose to a given area. Record this number in hours or a decimal notation for a fraction of an hour.

14. Indicated Dose Rates - Using the selected graphs, locate GCPM at the bottom, plot up to the present wind speed. If wind speed falls between the indicated slopes, estimate where the lines would intersect. From the point of intersection, plot to the left to find the indicated dose rate. Record the dose rate in REM/Hr for each location.

    a. For RM-060 and RM-063 filter, a sample time must be used, which will affect the actual graph results. The graphs are based on a 15 minute sample time. To compensate, multiply the indicated dose rate from the graph by 15 minutes and divide by the actual sample time. This should be the time since the accident happened. Record the results in REM/Hr for each location.

15. Actual Dose Rate - Multiply the indicated dose rates (Step 14) by the Stability Conversion factors for each location (Step 6) and then multiply the result by the Stack Flow Factor (Step 9). Record the results in REM/Hr.

16. Total Projected Dose to a Selected Location - Multiply the actual dose rates (Step 15) by the projected duration of release (Step 13). Record total projected dose to the selected location in REM for each location.

ISSUED

IV. PROCEDURE (Continued)

17. Report Results to the Shift Supervisor or his designee - Much of the information that has been recorded will be used on required report forms which must be completed within 15 minutes of accident classification. Expedite the completion of this form in a clear and accurate manner. Then report this information to the Shift Supervisor or his designee.

18. Protective Action Recommendation - The Shift Supervisor or his designee will compare the total projected dose to a selected location (Step 16) to the Protective Action Guidelines on the bottom of the "Airborne Release Data Record - Ventilation Stack". After determining the proper recommended actions, he will initial Attachment A-1, and relay the information to the appropriate offsite government agencies.

d. After completion of the "Airborne Release Data Record - Ventilation Stack" for the affected monitors, standby to repeat the process using new data sheets. Dose assessment must be completed every 15 minutes until relieved or directed to stop by the Shift Supervisor or his designee.

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ATTACHMENT A-1
AIRBORNE RELEASE DATA RECORD
(VENTILATION STACK)

1. Date/Time ______ / ______

2. Wind Speed ______ MPH

3. Wind Direction From: ______ Degrees

4. Delta Temperature (ΔT) ______ °C

5. Stability Class
(Circle appropriate class)

ΔT	Class
<-1.9	A
-1.9 to -1.7	B
-1.7 to -1.5	C
-1.5 to -0.5	D
-0.5 to 1.5	E
1.5 to 4	F
>4.0	G

6. Stability Conversion Factors (Circle all four in appropriate stability class)

Class	S.B.	2 Mi.	5 Mi.	10 Mi.
A	$7.1E^{-3}$	$6.4E^{-3}$	$8.9E^{-3}$	$1.1E^{-2}$
B	$4.5E^{-2}$	$2.2E^{-2}$	$1.2E^{-2}$	$1.5E^{-2}$
C	$1.1E^{-1}$	$6.3E^{-2}$	$3.8E^{-2}$	$2.6E^{-2}$
D	$2.9E^{-1}$	$2.3E^{-1}$	$1.9E^{-1}$	$1.6E^{-1}$
E	$5.3E^{-1}$	$4.7E^{-1}$	$4.3E^{-1}$	$4.0E^{-1}$
F	1.0	1.0	1.0	1.0
G	1.7	2.1	2.3	2.4

7. Affected Sectors ______
(from Sector Map)

8. Stack Flow Rate ______ CFM

9. Stack Flow Factor ______
(Stack Flow Rate [Step 7] ÷ 72500)

10. Process Monitor Reading(s)

Whole Body

RM-052 ______ CPM
RM-062 ______ CPM
RM-063L ______ CPM
RM-063M ______ CPM
RM-063H ______ CPM

Thyroid

RM-060 ______ CPM
RM-063 Filter ______ R/Hr

11. Calculated release rate (perform calculation on bottom of applicable graph)

Whole Body ______ Ci/Sec

Thyroid ______ Ci/Sec

12. Actual Release Rate (Calculated Release Rate [Step 11] x Stack Flow Factor [Step 9]).

Whole Body ______ Ci/Sec

Thyroid ______ Ci/Sec

13. Projected Duration of Release ______ Hrs.
(From Shift Supervisor, in hours)

ATTACHMENT A-1 (Continued)
AIRBORNE RELEASE DATA RECORD
(VENTILATION STACK)

Indicated Dose Rates From Graph(s) REM/Hr	X	Stability Conversion Factors (Step 6)	X	Stack Flow Factor (Step 9) ______	=	Actual Dose Rate REM/Hr	X	Projected Duration of Release (Step 13) ______ Hrs	=	Total Projected Dose REM	Protective Action Recommendations From Guidelines Listed Below
Whole Body						**Whole Body**				**Whole Body**	
S.B. ______	X	______				S.B. ______				S.B. ______	
2 Mi. ______	X	______				2 Mi. ______				2 Mi. ______	
5 Mi. ______	X	______				5 Mi. ______				5 Mi. ______	
10 Mi. ______	X	______				10 Mi. ______				10 Mi. ______	S.B. ______
											2 Mi. ______
Thyroid						**Thyroid**				**Thyroid**	5 Mi. ______
Indicated Dose Rate X 15 Min. / Actual Sample Time (Min.)											10 Mi. ______
S.B. ______	X	______				S.B. ______				S.B. ______	
2 Mi. ______	X	______				2 Mi. ______				2 Mi. ______	
5 Mi. ______	X	______				5 Mi. ______				5 Mi. ______	
10 Mi. ______	X	______				10 Mi ______				10 Mi. ______	

PROTECTIVE ACTION GUIDELINES:

A. W.B. Dose < 1 REM Thyroid Dose < 5 REM
NO PROTECTIVE ACTION REQUIRED

B. W.B. Dose > 1 REM Thyroid Dose > 5 REM
< 5 REM < 25 REM
SEEK SHELTER, CONSIDER EVACUATION

C. W.B. Dose > 5 REM Thyroid Dose > 25 REM
CONDUCT MANDATORY EVACUATION

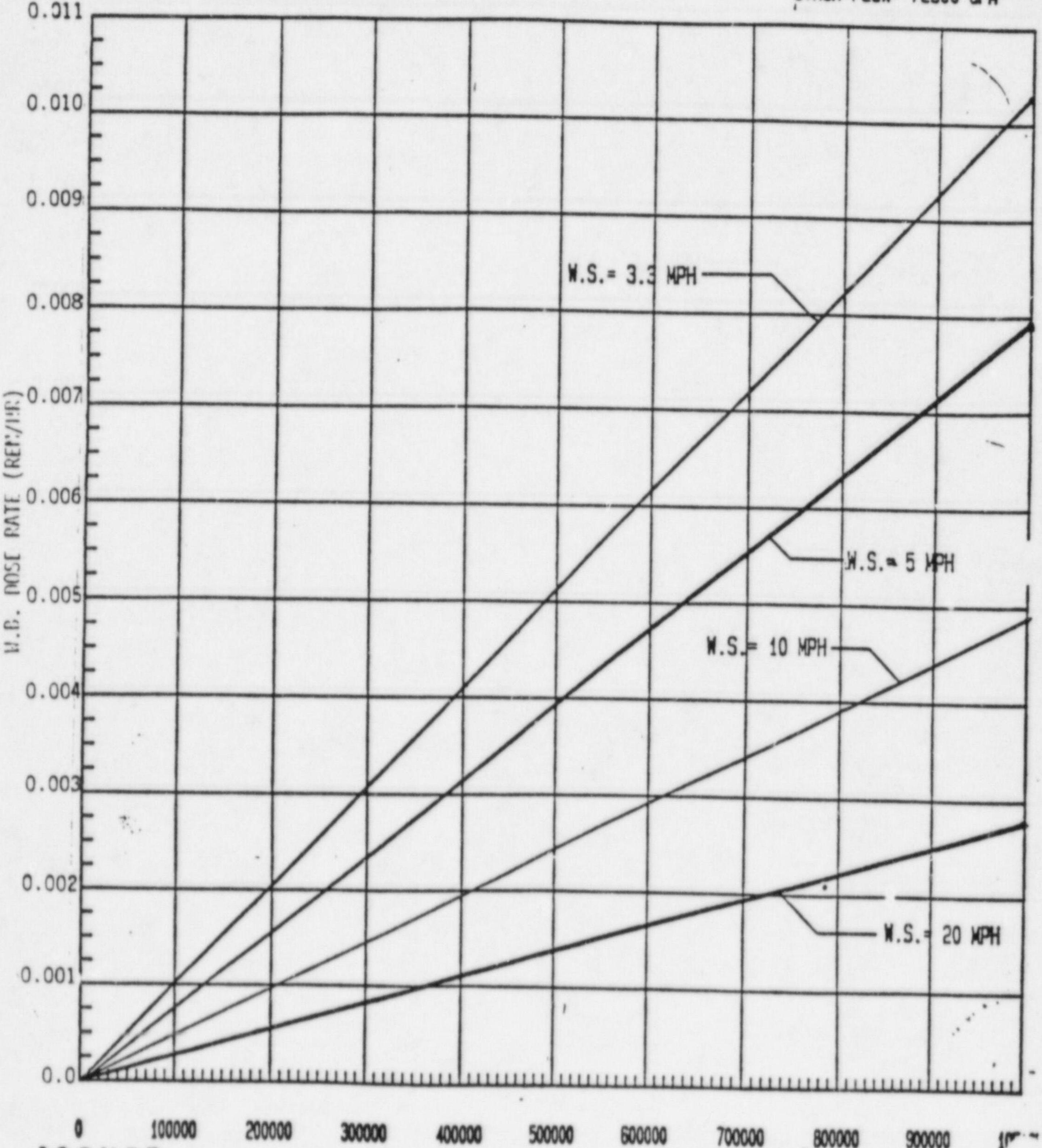
Shift Supervisor Review: ______________________

W.B. DOSE RATE AT S.B. (RM-052)

EPIP-EOF-6-A-7

(FOR VARIOUS WIND SPEEDS)

STACK FLOW= 72500 CFM



ISSUED

FEB 2 6 1987

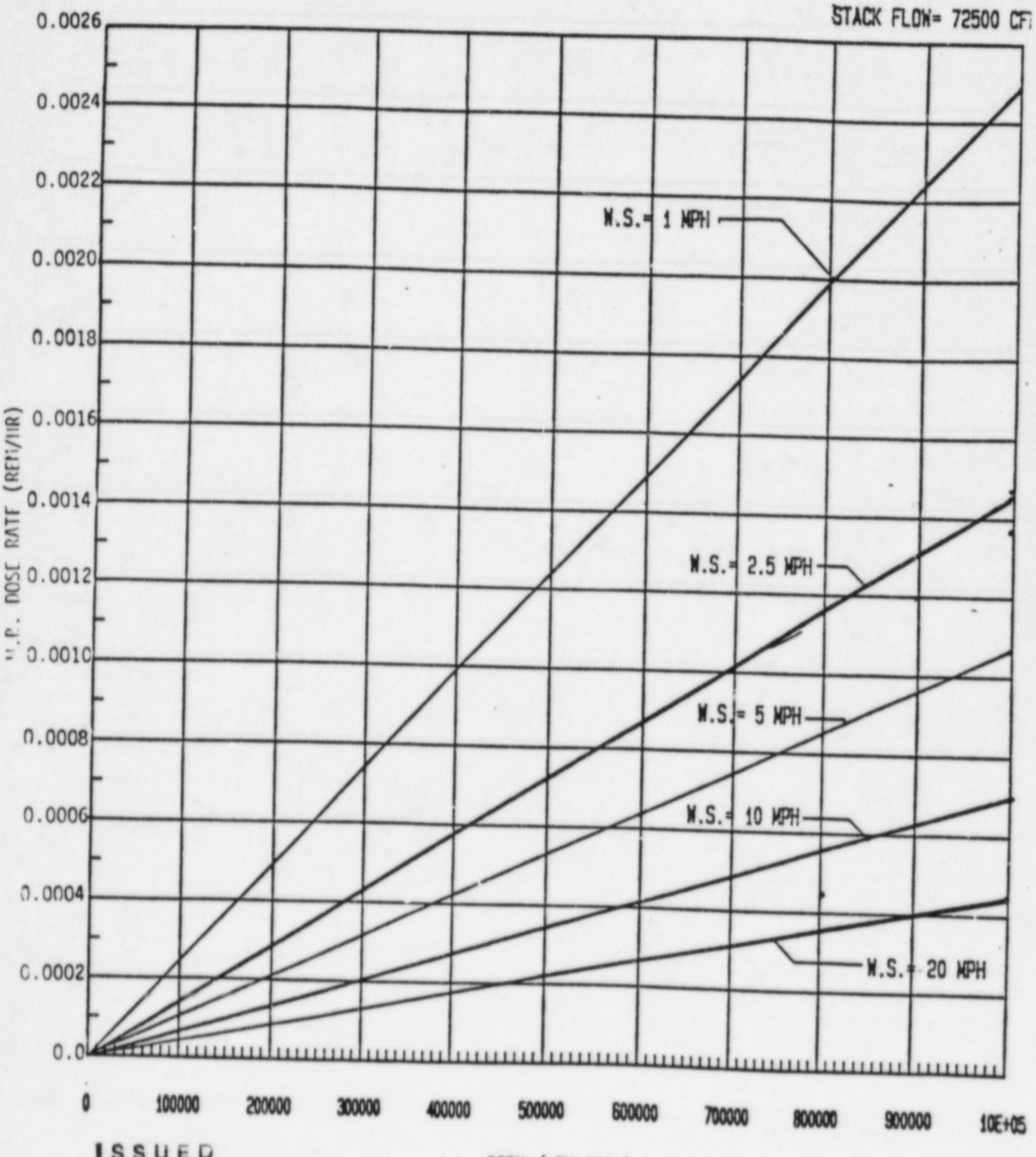
R10 02-26-87

Ci/Sec (NOBLE GAS) = (GCPM-10) × (1.34E-7)

W.B. DOSE RATE AT 2 MILES (RM-052)

(FOR VARIOUS WIND SPEEDS)

STACK FLOW= 72500 CF



ISSUED

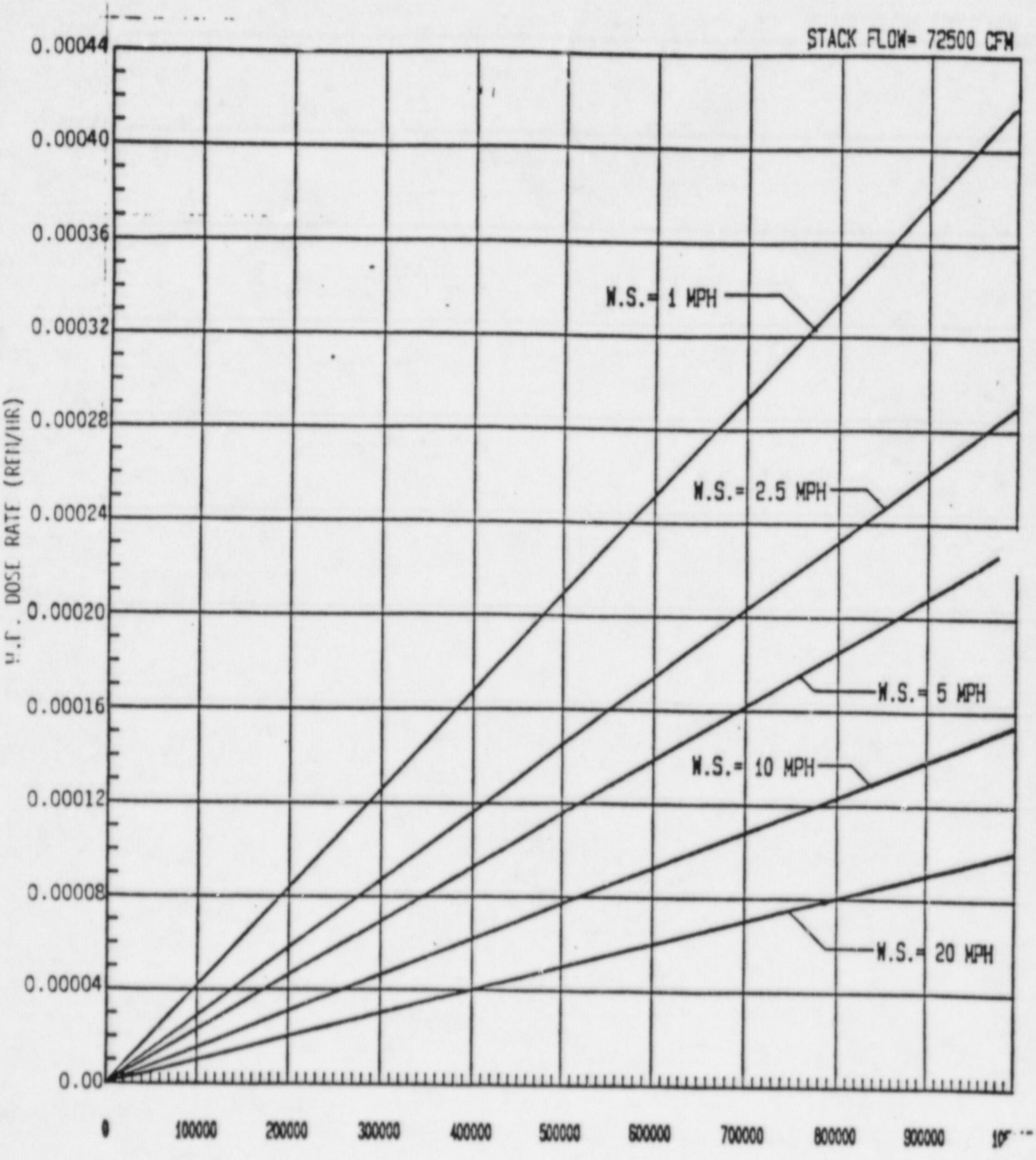
FEB 26 1987

R10 02-26-87

Ci/Sec (NOBLE GAS) = (GCPM-10) × (1.34E-7)

WHOLE BODY DOSE RATES AT 5 MILES (RM-052)

(FOR VARIOUS WIND SPEEDS)



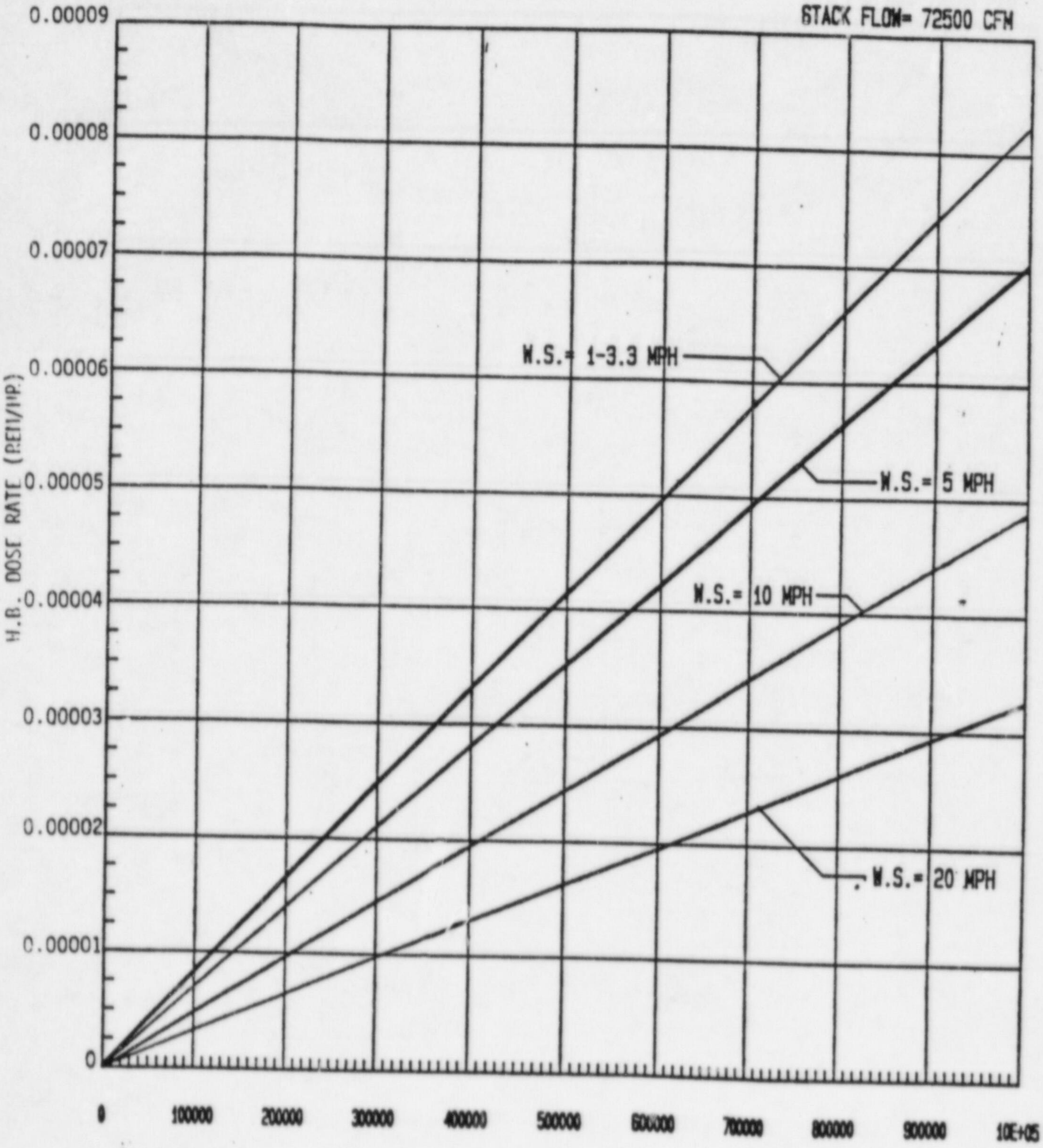
ISSUED
FEB 26 1987

R10 02-26-87

Ci/Sec (NOBLE GAS) = (GCPM-10) × (1.34E-7)

WHOLE BODY DOSE RATES AT 10 MILES (RM-052)

(FOR VARIOUS WIND SPEEDS)



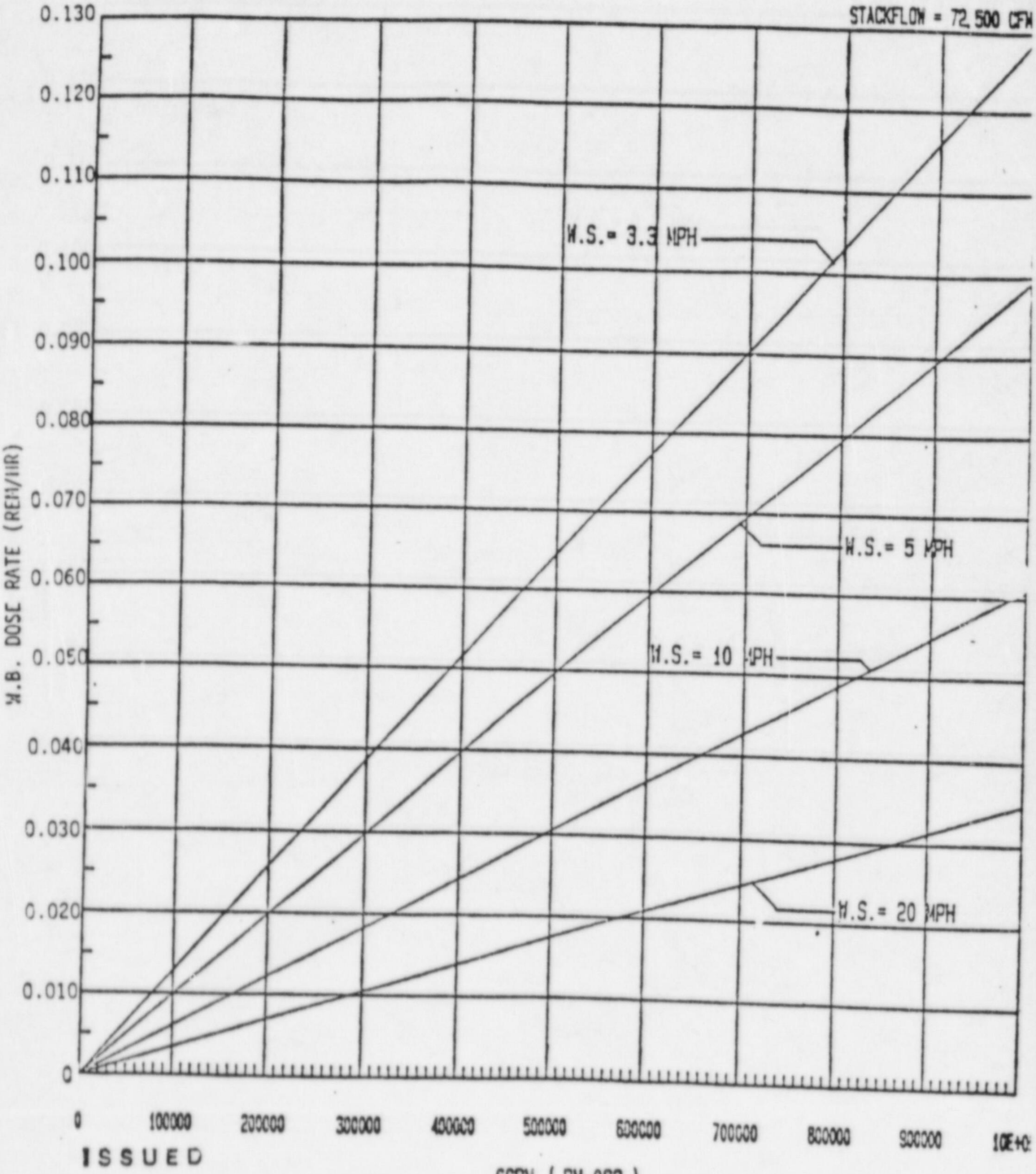
ISSUED
FEB 26 1987

Ci/Sec (NOBLE GAS) = (GCPM-10) × (1.34E-7)

W.B. DOSE RATES AT S.B. (RM-062)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-1



ISSUED
FEB 26 1987

Ci/Sec (NOBLE GAS) = (GCPM-37) × (1.68E-6)

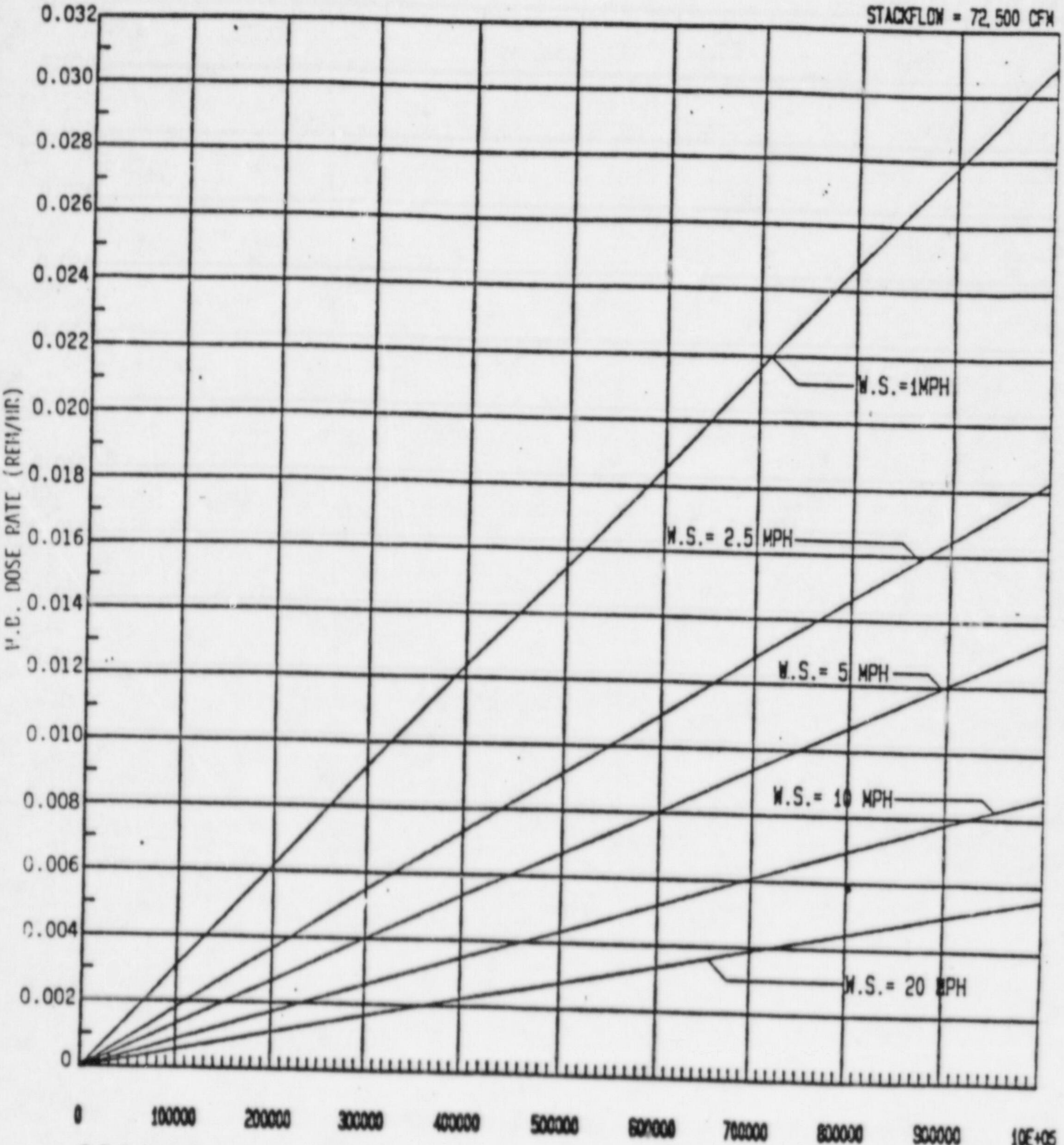
*NOTE: W.B. DOSE = 0 FOR WIND SPEEDS LESS THAN 3.3 MPH.

R10 02-26-87

W.B. DOSE RATES AT 2 MILES (RM-062)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-A-12



ISSUED

FEB 26 1987

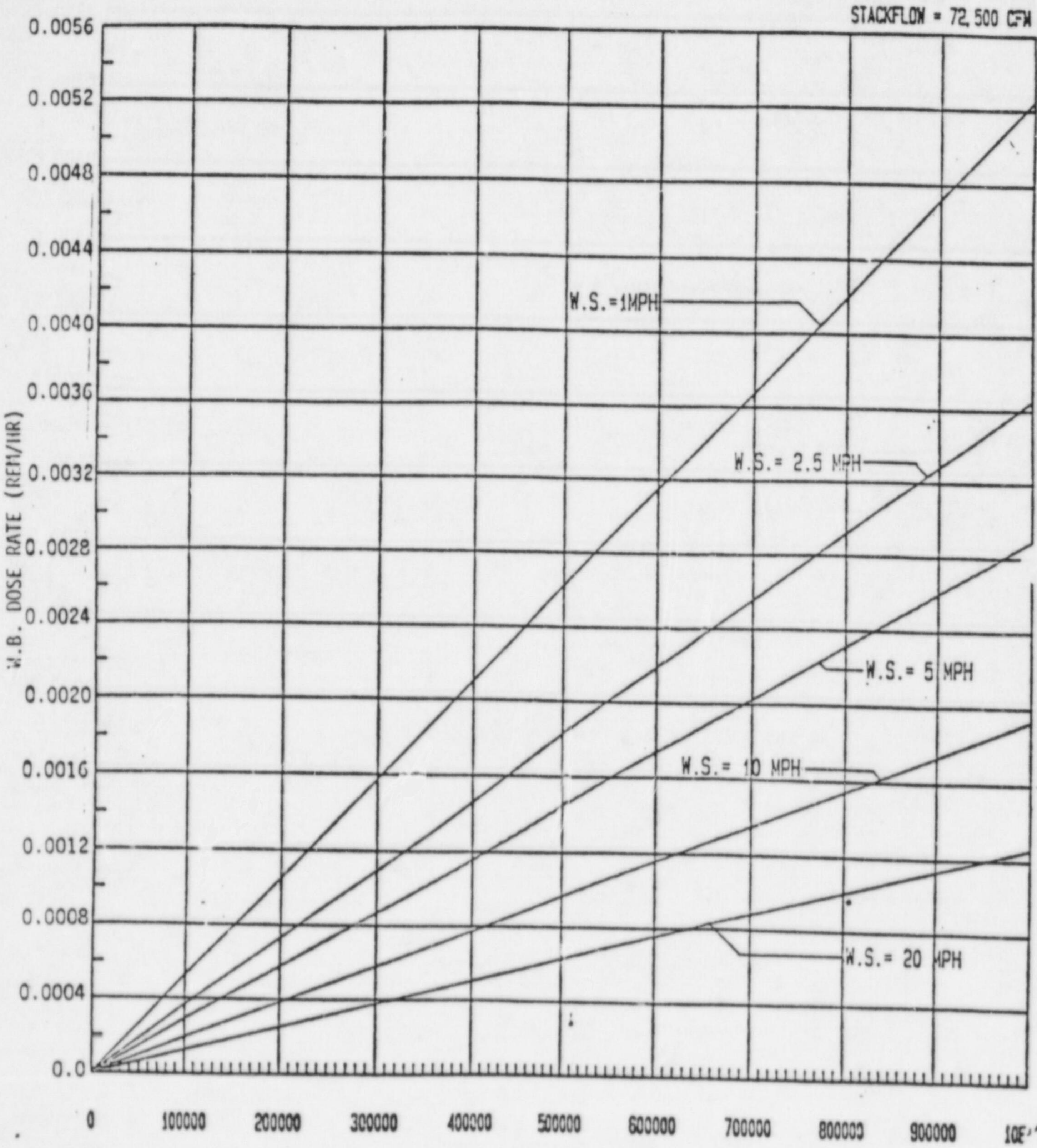
Ci/Sec (NOBLE GAS) = (GCPM-37) × (1.68E-6)

R10 02-26-87

W.B. DOSE RATES AT 5 MILES (RM-062)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF- 6-A-13



ISSUED
FEB 26 1987

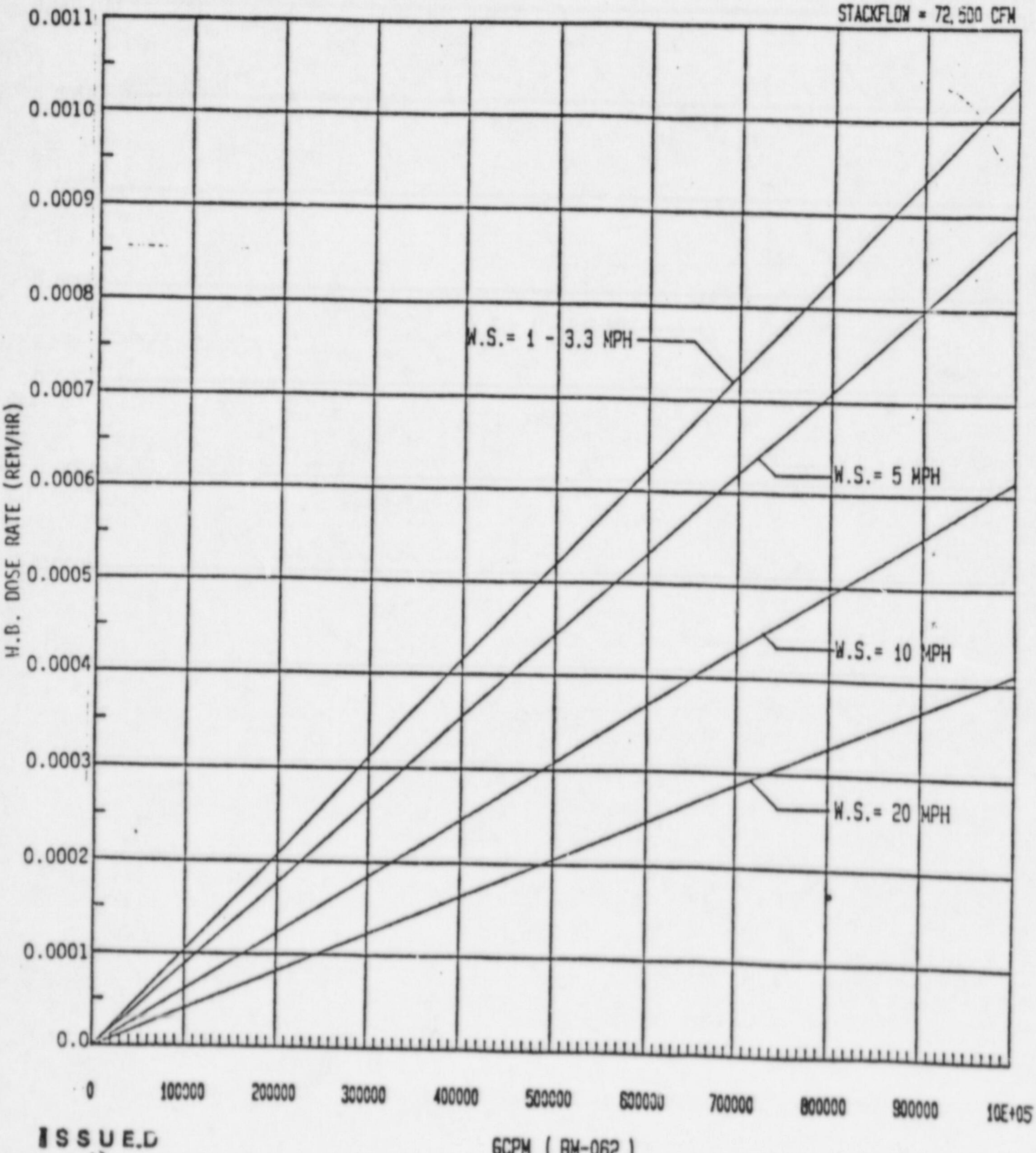
Ci/Sec (NOBLE GAS) = (GCPM-37) × (1.68E-6)

R10 02-26-87

W.B. DOSE RATES AT 10 MILES (RM-062)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-A-14



ISSUED
FEB 26 1987

Ci/Sec (NOBLE GAS) = (GCPM-37) × (1.68E-6)

R10 02-26-87

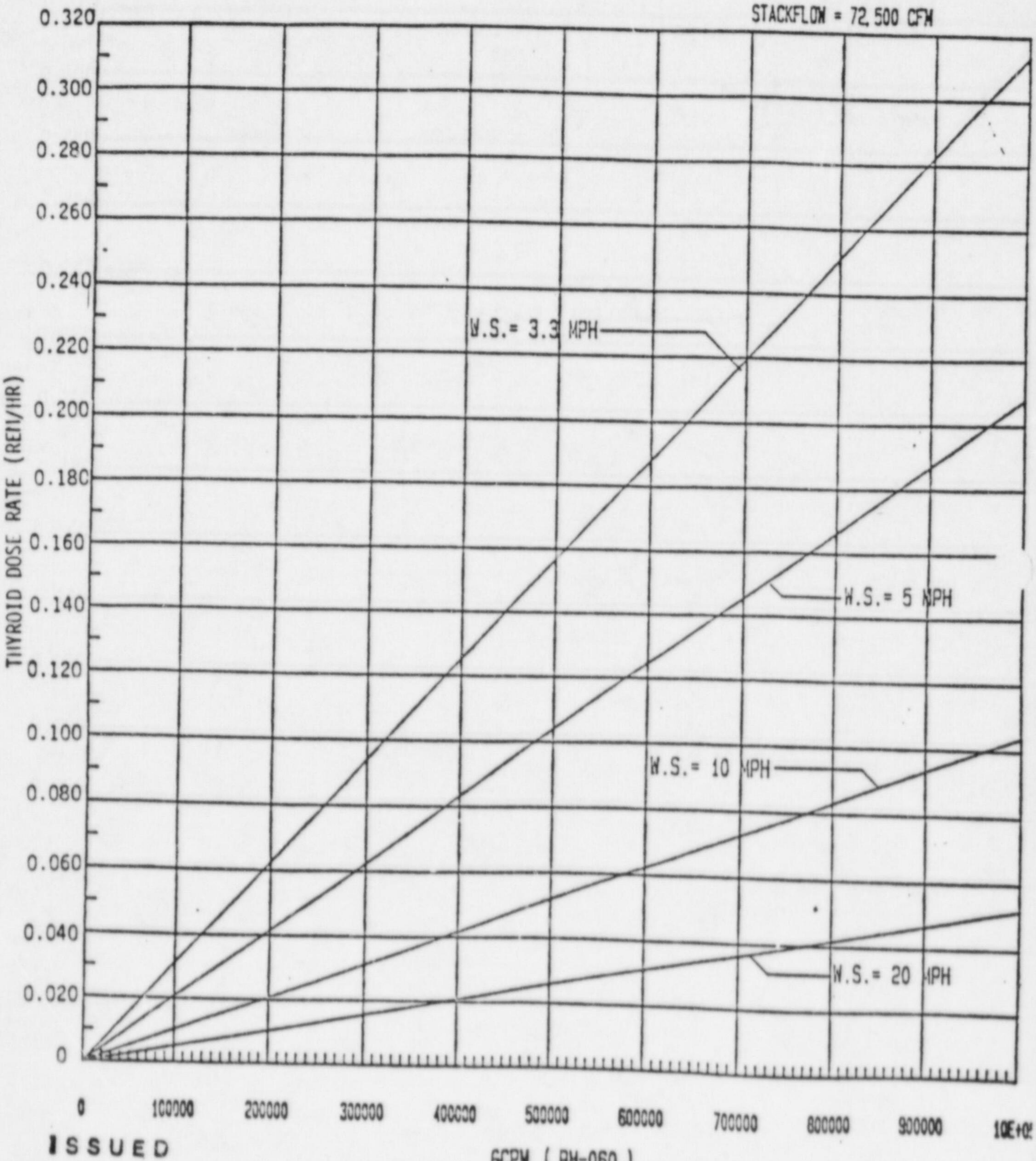
THYROID DOSE RATES AT S.B. (RM-060)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-A-15

15 Min. Cartridge Time

STACKFLOW = 72,500 CFM



ISSUED

FEB 26 1987

Ci/Sec (IODINE) = (GCPM-75) × (3.7E-9)

R10 02-26-87

*NOTE: THYROID DOSE= 0 FOR WIND SPEEDS LESS THAN 3.3 MPH

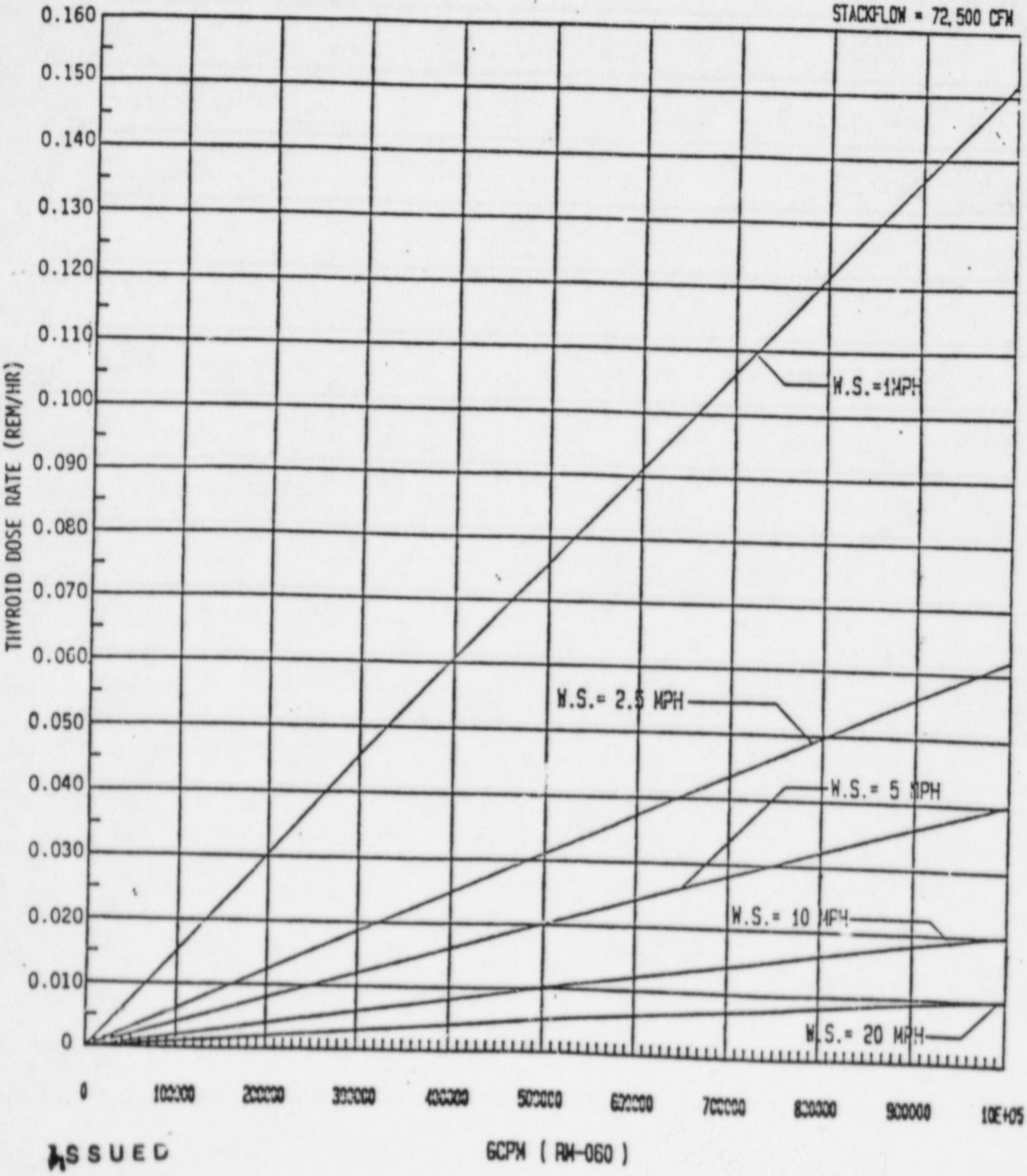
THYROID DOSE RATES AT 2 MILES (RM-060)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-A-16

15 Min. Cartridge Time

STACKFLOW = 72,500 CFM



ISSUED
FEB 26 1987

Ci/Sec (IODINE) = (GCPM-75) × (3.7E-9)

R10 02-26-87

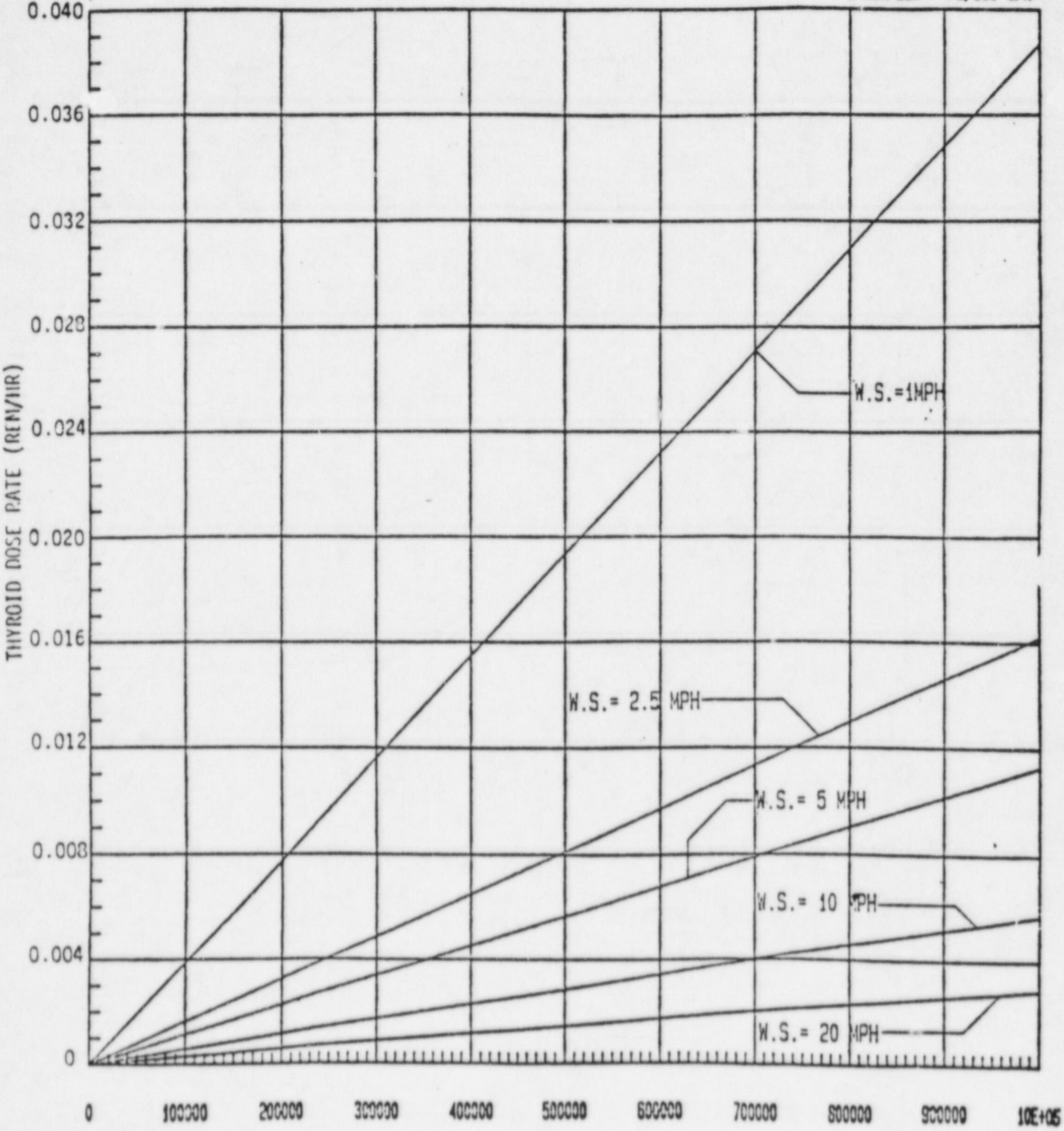
THYROID DOSE RATES AT 5 MILES (RM-060)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-A-17

15 Min. Cartridge Time

STACKFLOW = 72,500 CFM



ISSUED
FEB 26 1987

Ci/Sec (IODINE) = (GCPM-75) × (3.7E-9)

R10 02-26-87

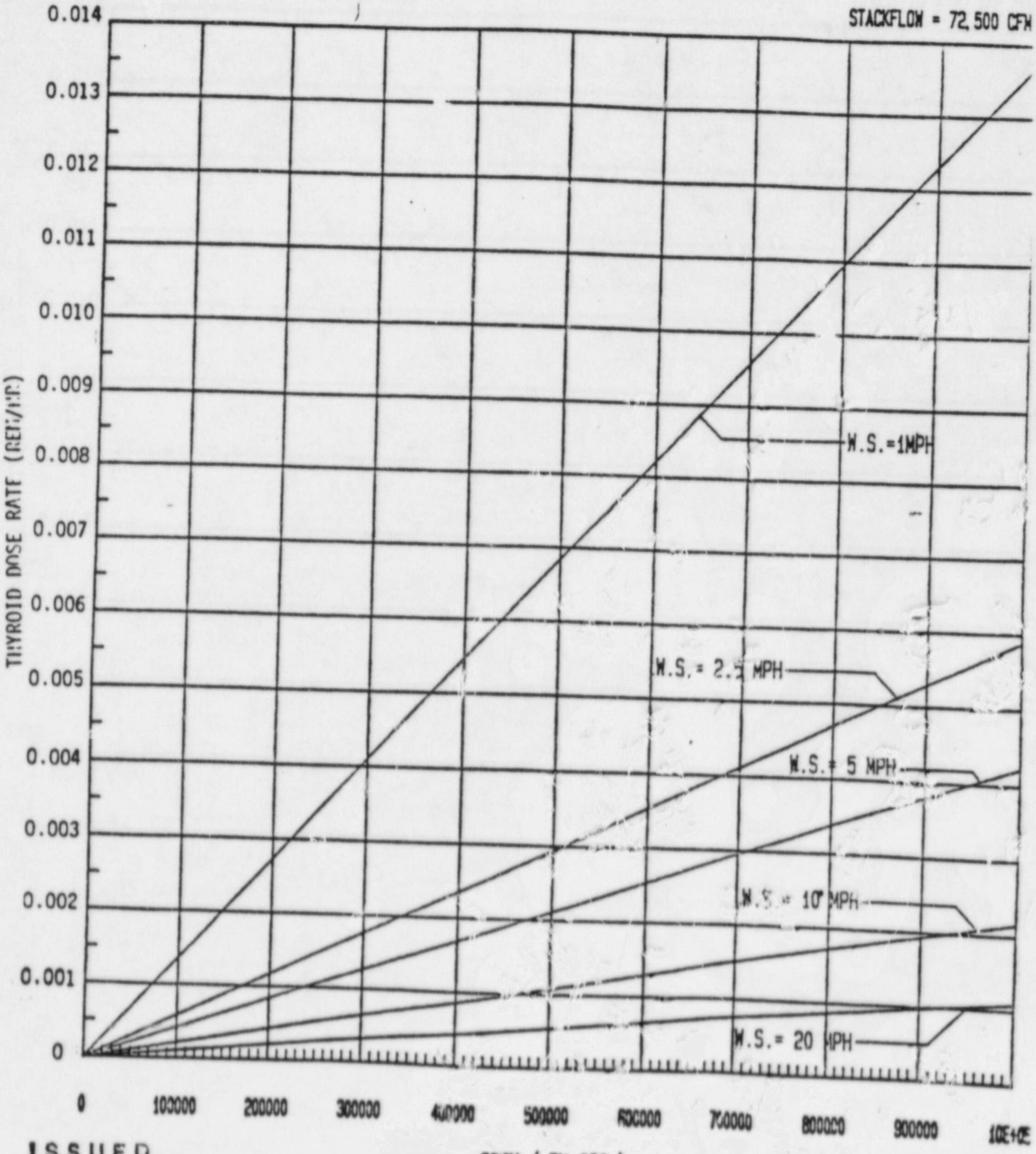
THYROID DOSE RATES AT 10 MILES (RM-060)

(FOR VARIOUS WIND SPEEDS)

EPIP-EC'-6-A-18

15 Min. Cartridge Time

STACKFLOW = 72,500 CFM



ISSUED

FEB 26 1987

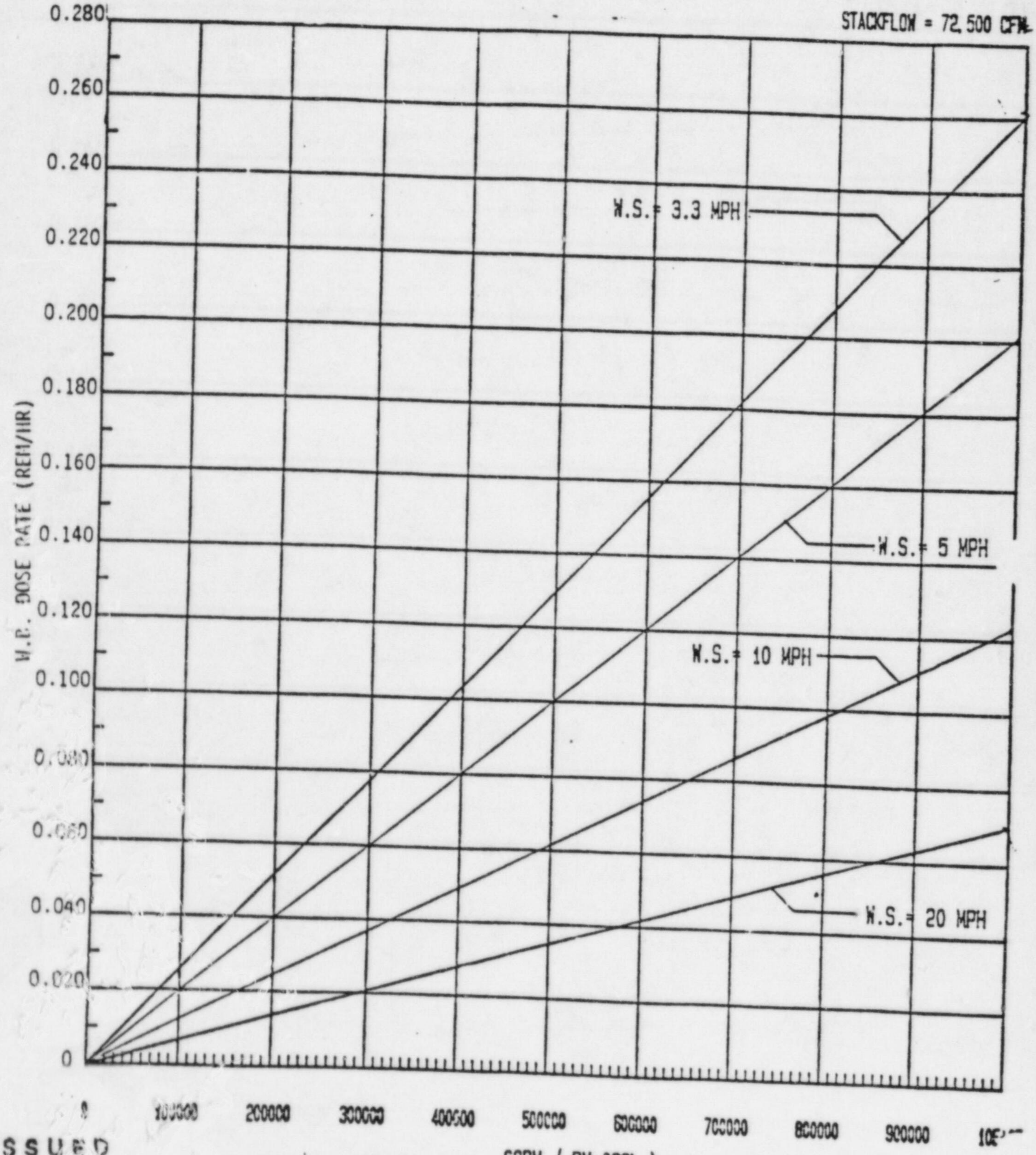
R10 02-26-87

Ci/Sec (IODINE) = (GCPM-75) × (3.7E-9)

W.B. DOSE RATES AT S.B. (RM-063L)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-A-19



ISSUED
FEB 26 1987

Ci/Sec (NOBLE GAS) = (GCPM-17) × (3.39E-6)

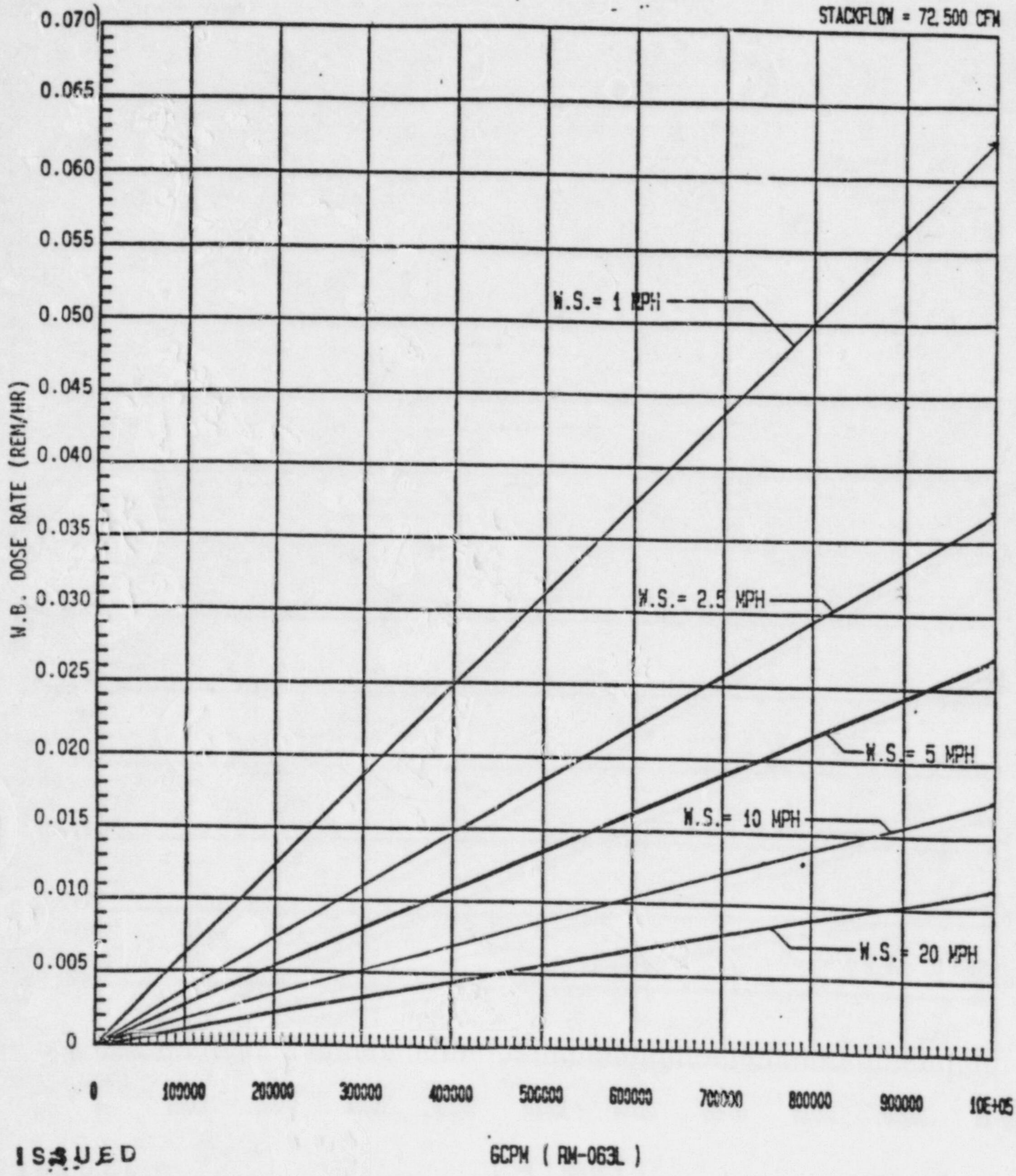
R10 02-26-87

*NOTE: W.B. DOSE = 0 FOR WIND SPEEDS LESS THAN 3.3 MPH

W.B. DOSE RATES AT 2 MILES (RM-063L)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-A-20



ISSUED
FEB 26 1987

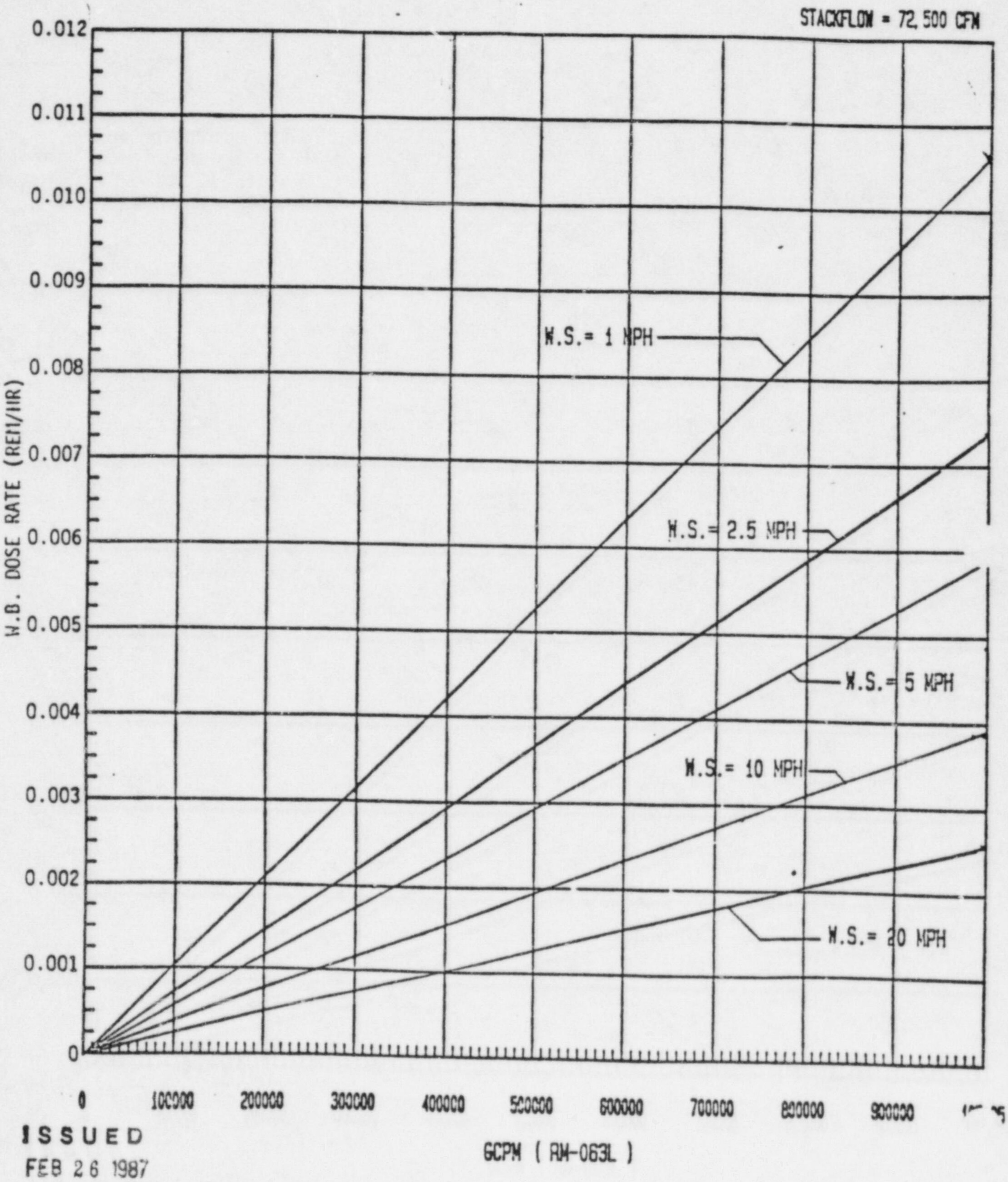
Ci/Sec (NOBLE GAS) = (GCPM-17) × (3.39E-6)

R10 02-26-87

W.B. DOSE RATES AT 5 MILES (RM-063L)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-A



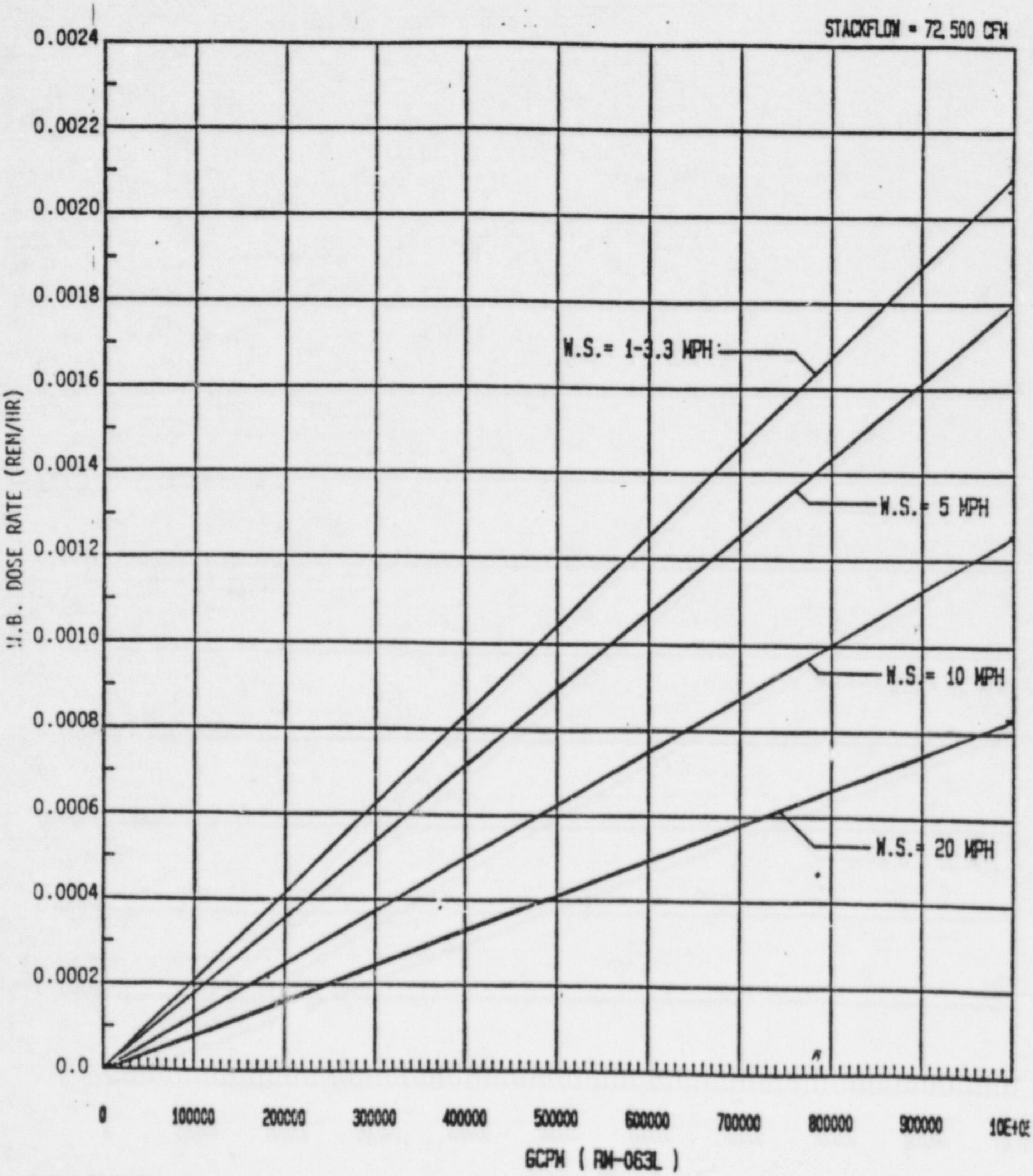
ISSUED
FEB 26 1987

R10 02-26-87

Ci/Sec (NOBLE GAS) = (GCPM-17) X (3.39E-6)

W.B. DOSE RATES AT 10 MILES (RM-063L)

(FOR VARIOUS WIND SPEEDS)



ISSUED
FEB 26 1987

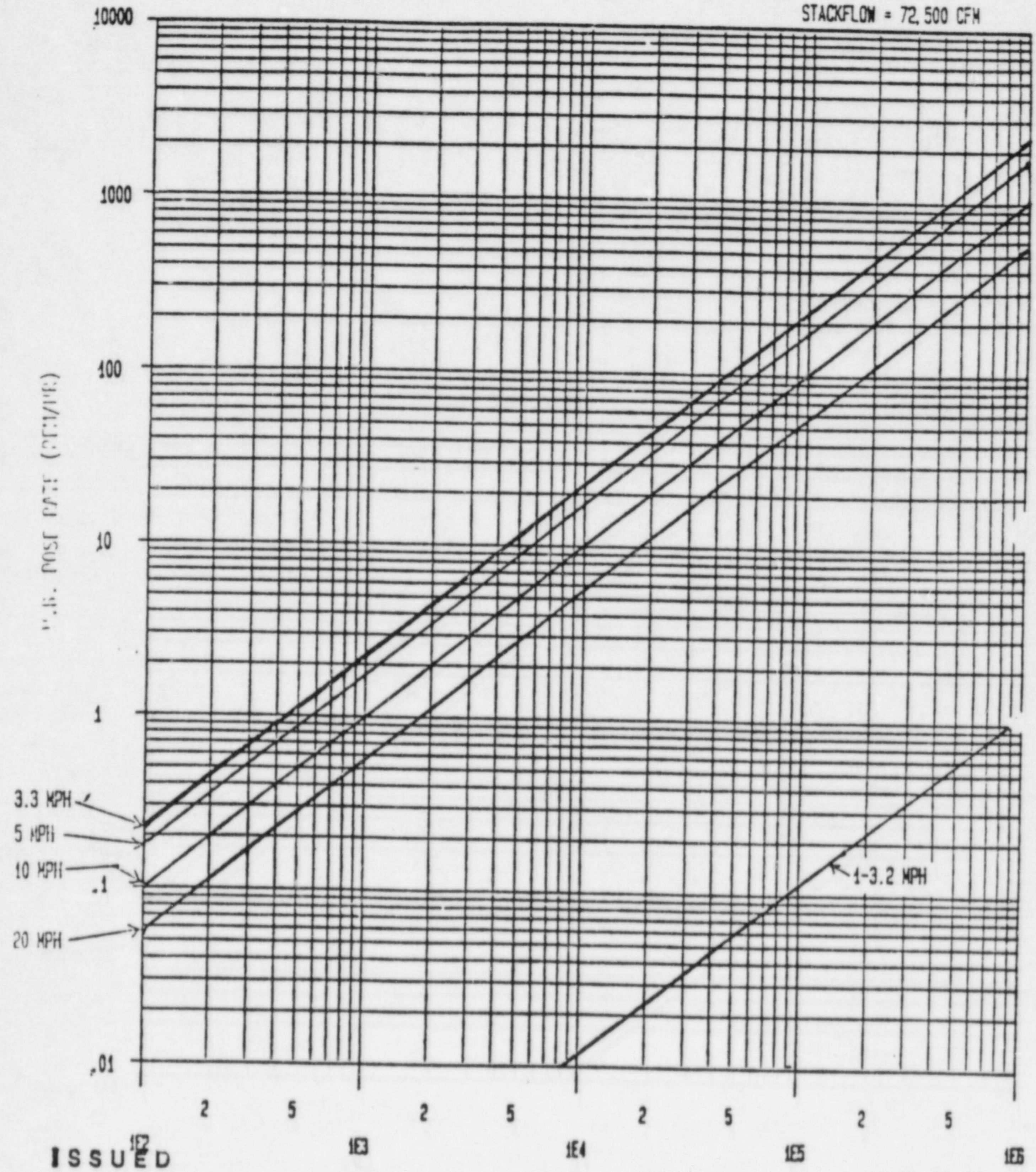
R10 02-26-87

Ci/Sec= (GCPM-17) × (3.39E-6)

EPIP-EOF-6-A-23

W.B. DOSE RATES AT S.B. (RM-063M)

(FOR VARIOUS WIND SPEEDS)



ISSUED
FEB 2 S 1987

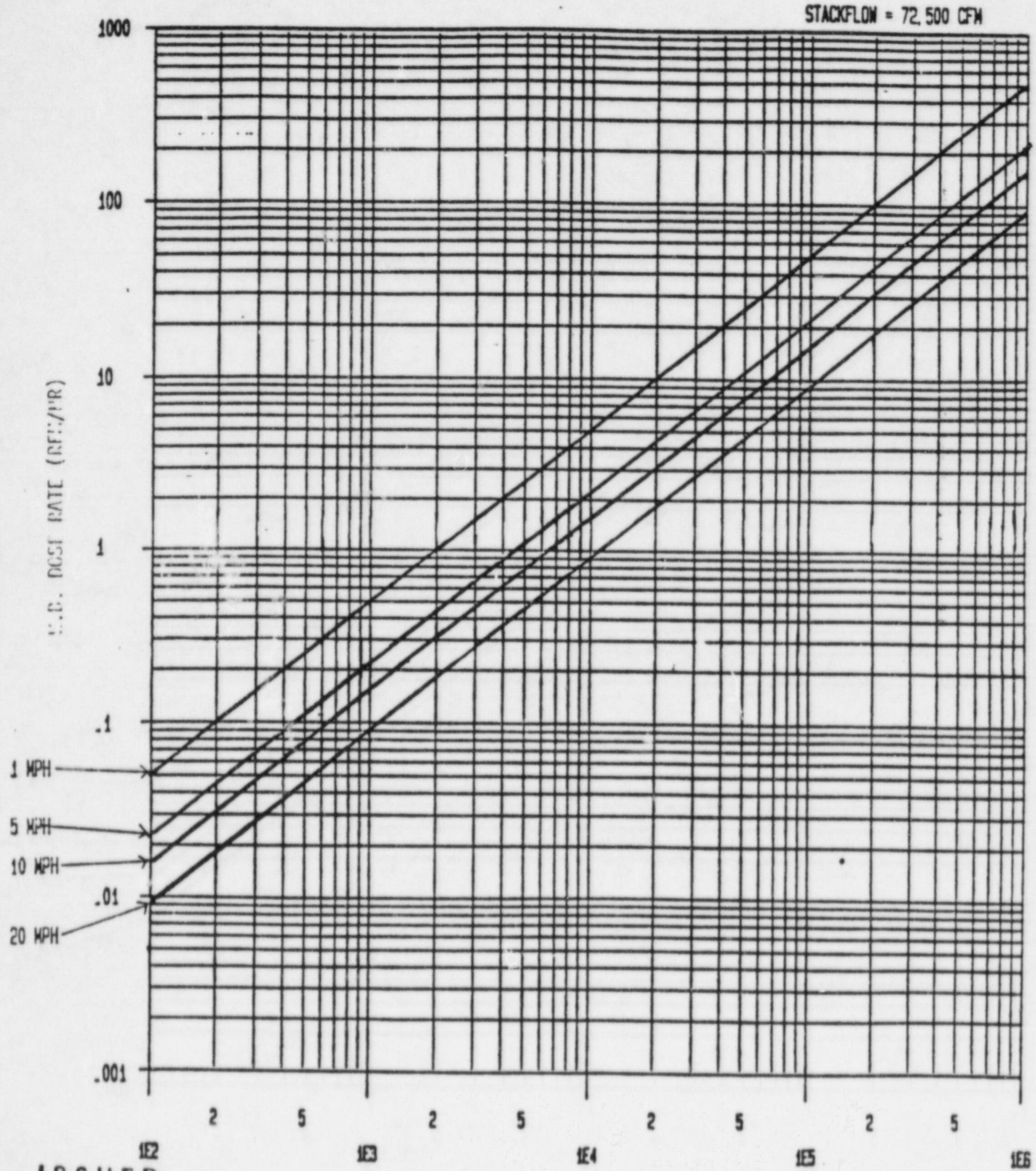
GCPM (RM-063M)

R10 02-26-87

Ci/Sec (NOBLE GAS) = (GCPM-15) X (2.73E-2)

W.B. DOSE RATES AT 2 MILES (RM-063M)

(FOR VARIOUS WIND SPEEDS)



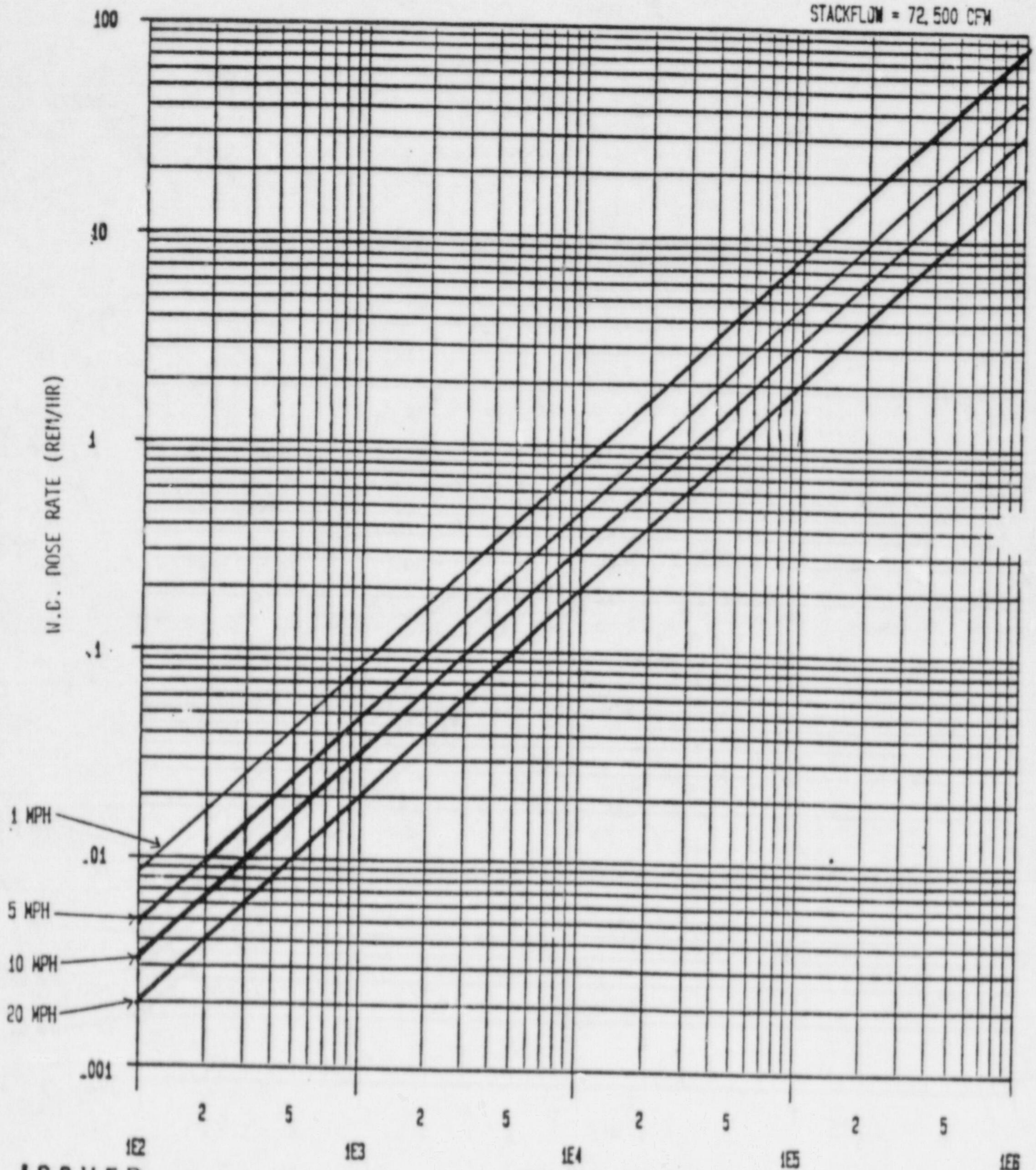
ISSUED
FEB 26 1987

R10 02-26-87

C1/Sec (NOBLE GAS) = (GCPM-15) × (2.73E-2)

W.B. DOSE RATES AT 5 MILES (RM-063M)

(FOR VARIOUS WIND SPEEDS)



ISSUED

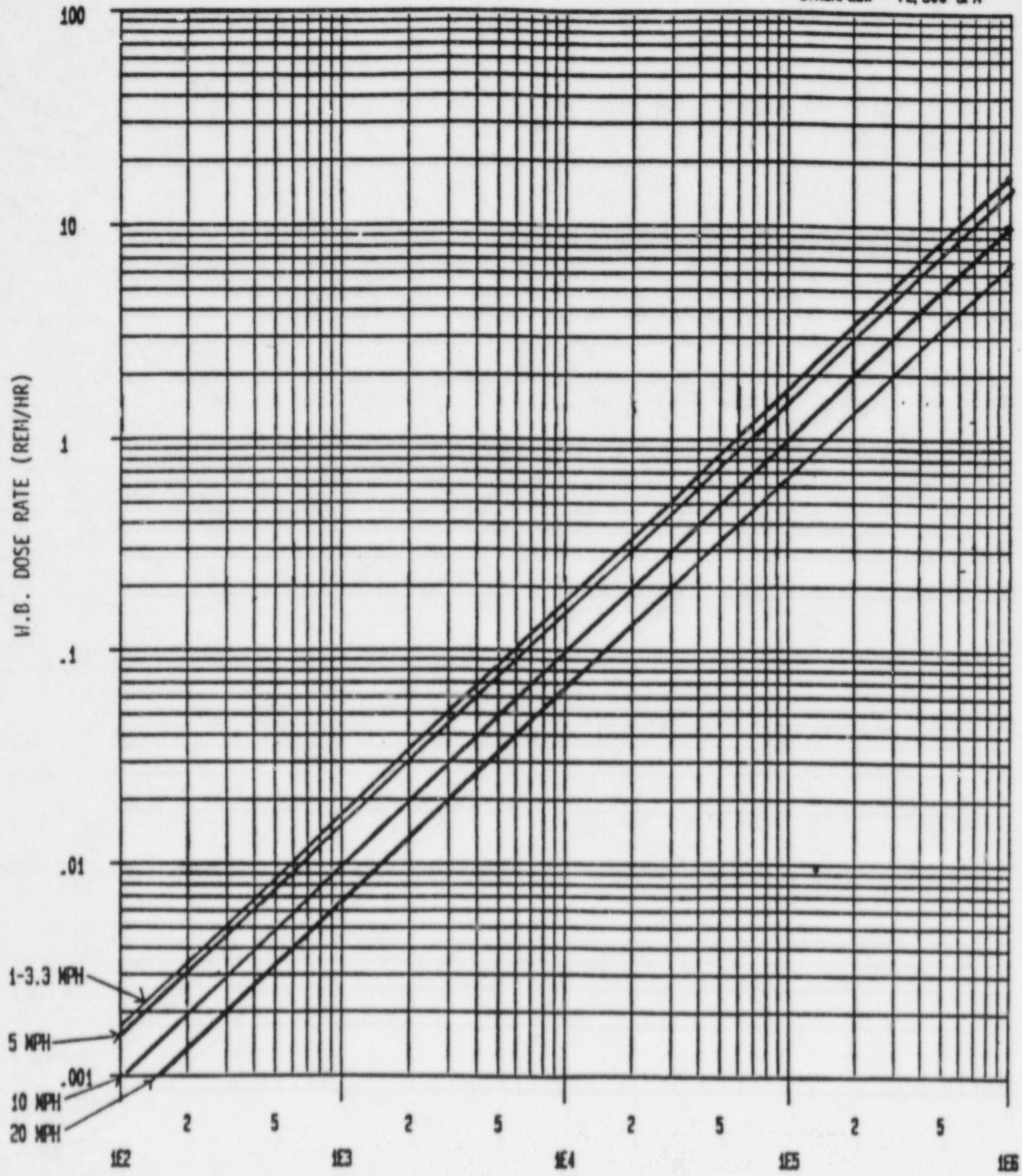
FEB 26 1987

R10 02-26-87

Ci/Sec (NOBLE GAS) = (GCPM-15) × (2.73E-2)

W.B. DOSE RATES AT 10 MILES (RM-063M)

(FOR VARIOUS WIND SPEEDS)



ISSUED
FEB 26 1987

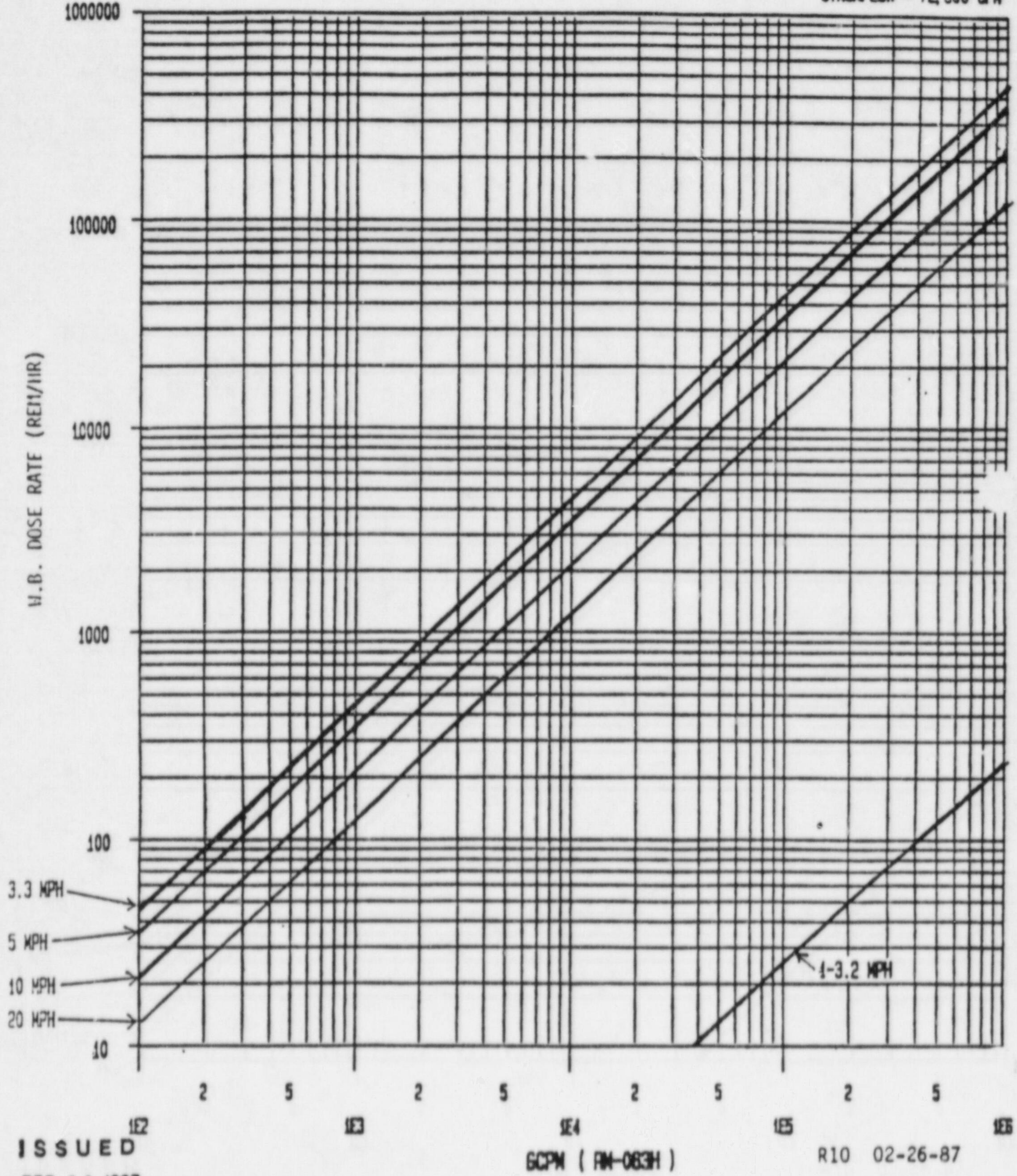
R10 02-26-87

Ci/Sec (NOBLE GAS) = (GCPM-15) × (2.73E-2)

W.B. DOSE RATES AT S.B. (RM-063H)

(FOR VARIOUS WIND SPEEDS)

STACKFLOW = 72,500 CFM



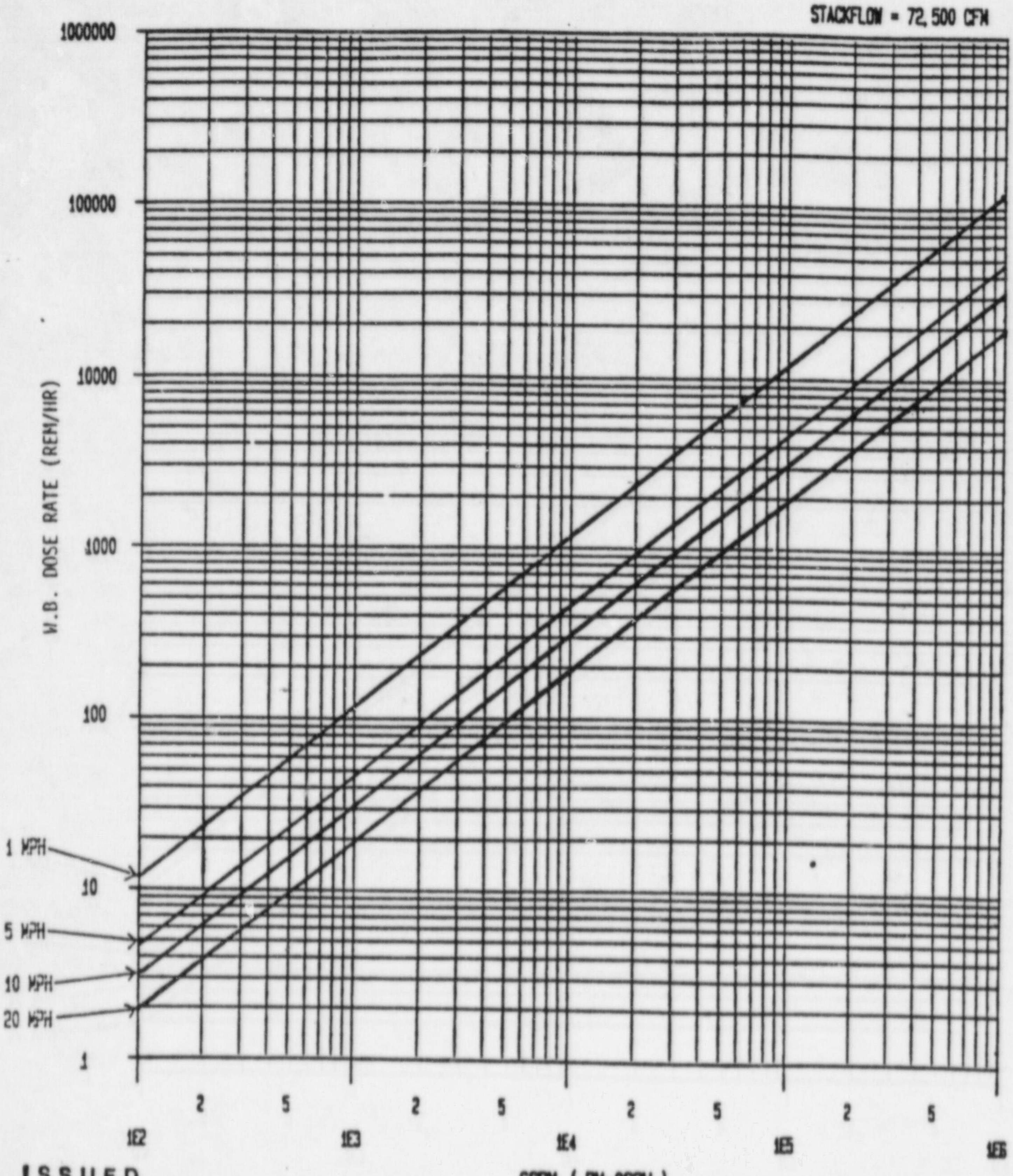
ISSUED
FEB 26 1987

R10 02-26-87

Ci/Sec (NOBLE GAS) = (GCPM-15) X (5 [illegible])

W.B. DOSE RATES AT 2 MILES (RM-063H)

(FOR VARIOUS WIND SPEEDS)



ISSUED
FEB 26 1987

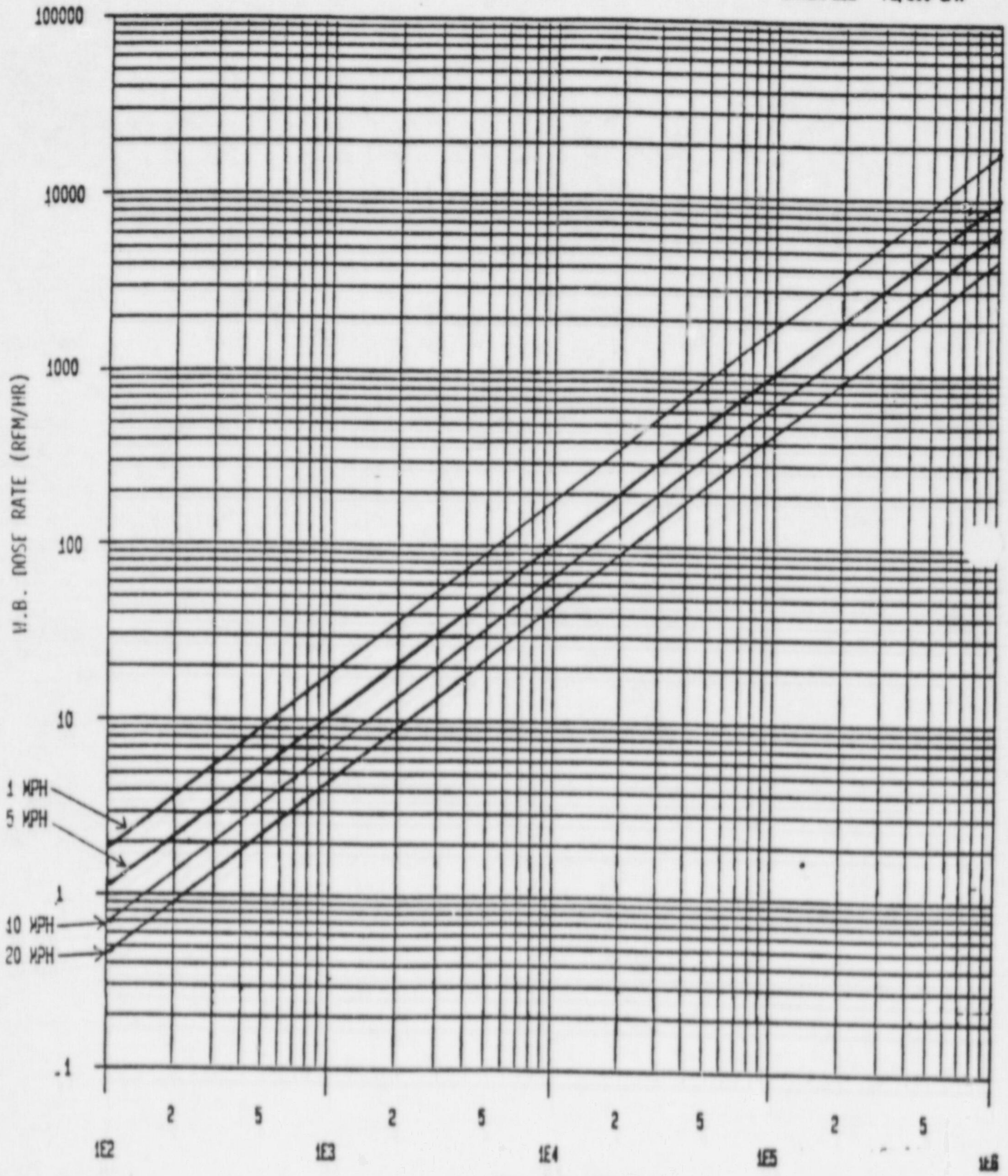
Ci/Sec (NOBLE GAS) = (GCPM-15) × (5.93)

R10 02-26-87

W.B. DOSE RATES AT 5 MILES (RM-063H)

(FOR VARIOUS WIND SPEEDS)

STACKFLOW = 72,500 CFM



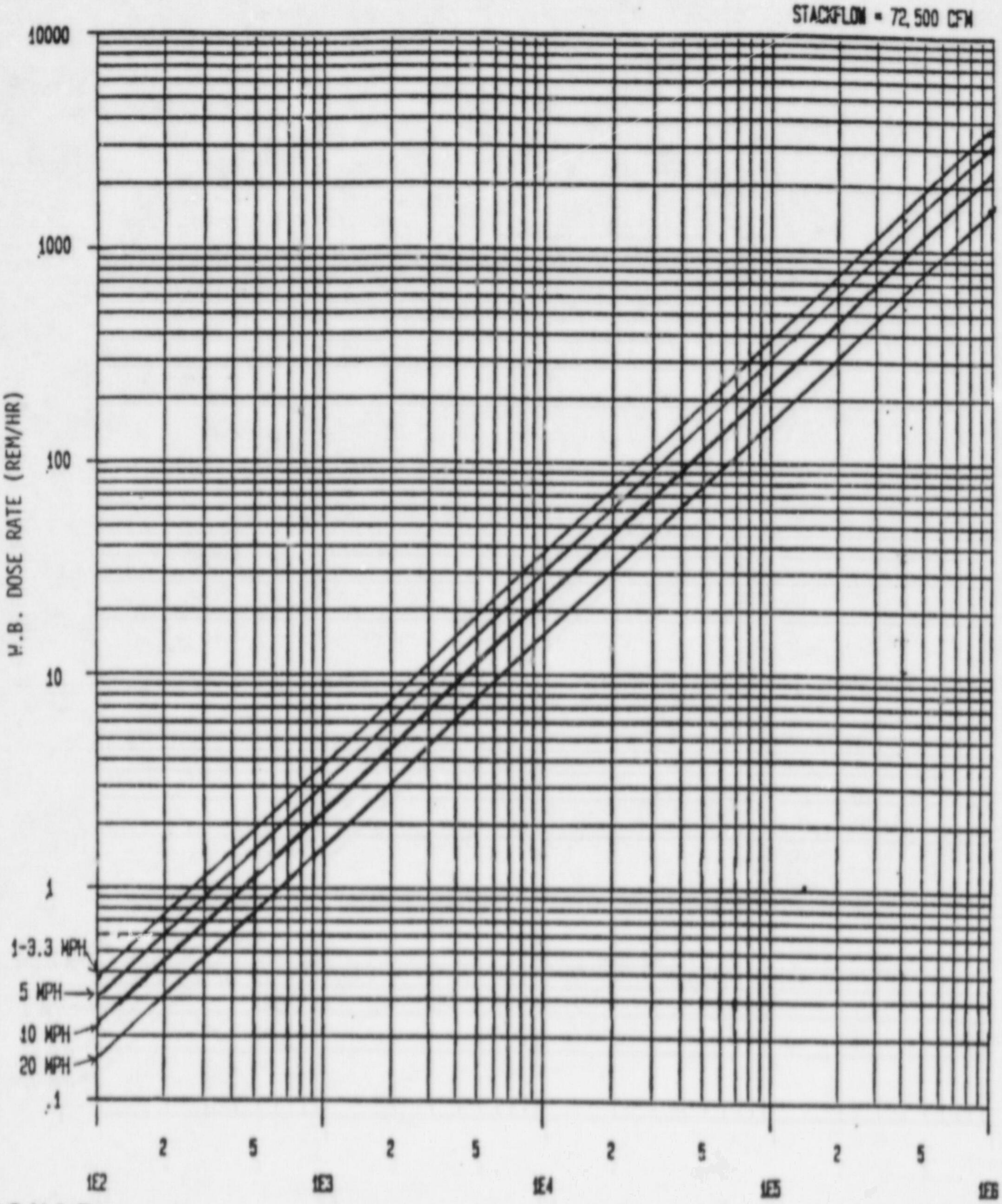
ISSUED
FEB 26 1987

R10 02-26-87

C1/Sec (NOBLE GAS) = (GCPM-15) × (5.93)

W.B. DOSE RATES AT 10 MILES (RM-063H)

(FOR VARIOUS WIND SPEEDS)



ISSUED
FEB 26 1987

R10 02-26-87

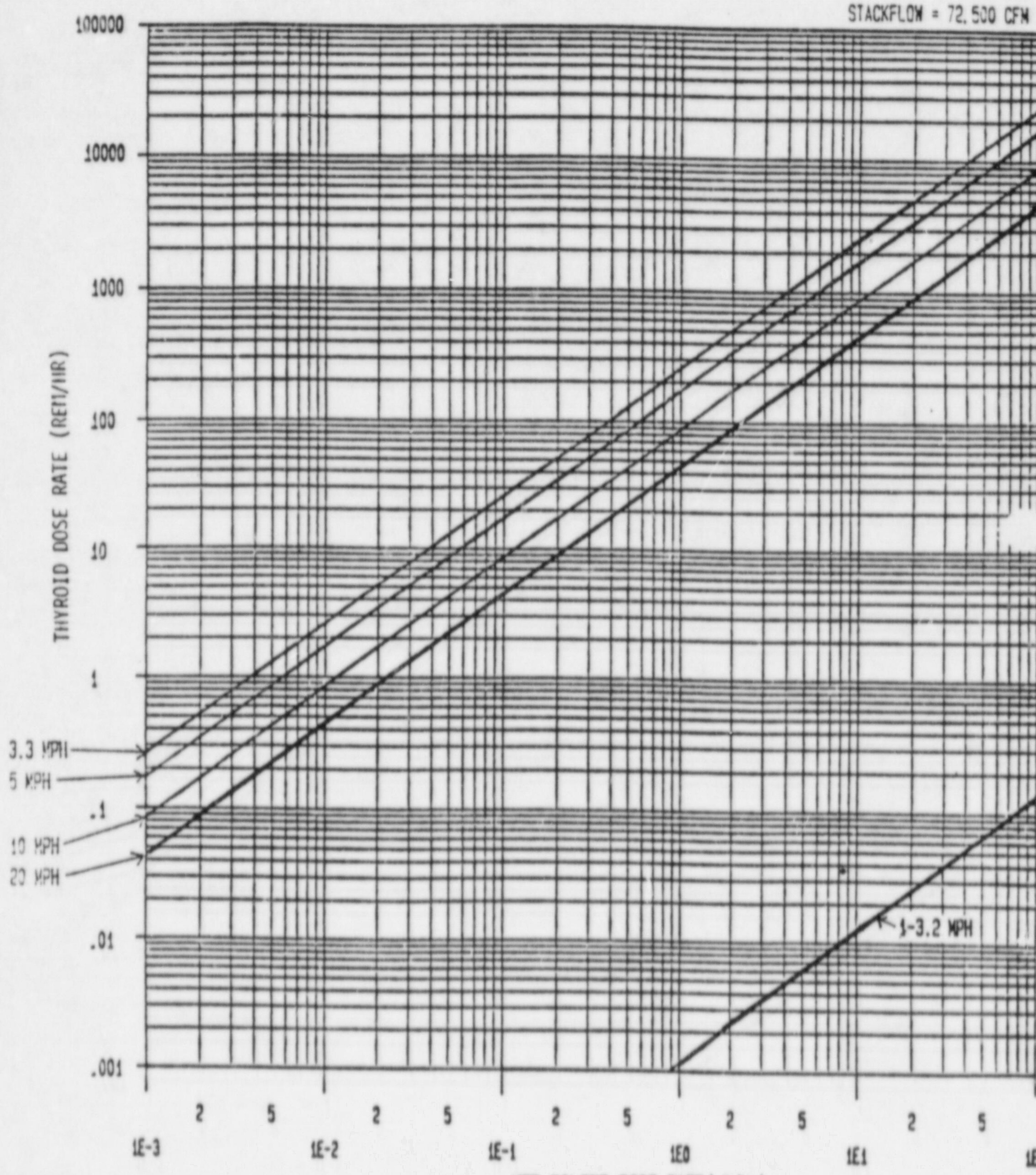
Ci/Sec (NOBLE GAS) = (GCPM-15) X (5.83)

THYROID DOSE RATES AT S.B. (RM-063 FILTER)

(FOR VARIOUS WIND SPEEDS)

15 Min. Sample Time

STACKFLOW = 72,500 CFM



ISSUED
FEB 26 1987

R10 02-26-87

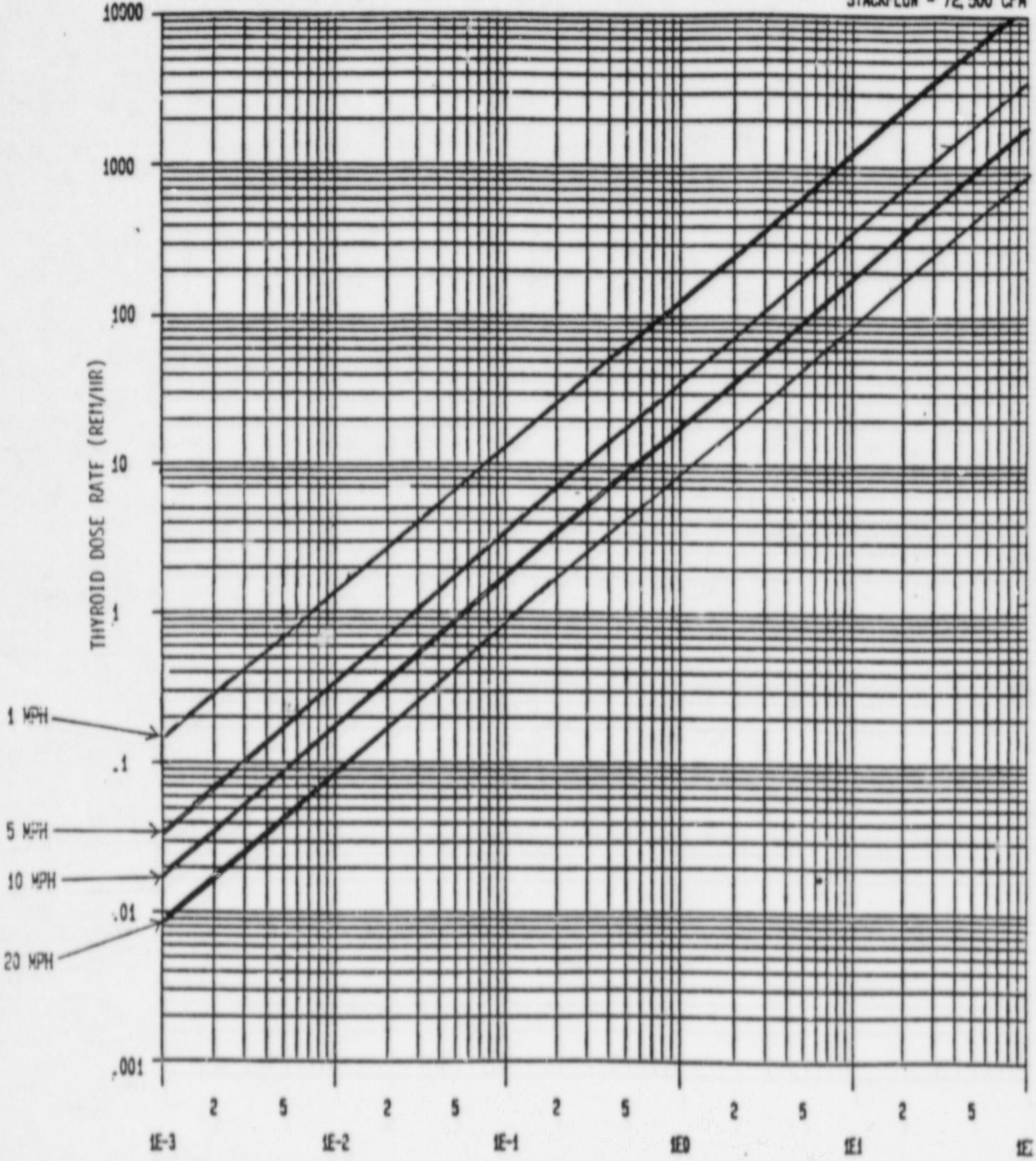
Ci/Sec (IODINE) = (NET FILTER DOSE RATE) × (3.21E-3)

THYROID DOSE RATES AT 2 MILES (RM-063 FILTER)

(FOR VARIOUS WIND SPEEDS)

15 Min. Sample Time

STACKFLOW = 72,500 CFM



ISSUED

FEB 26 1987

R10 02-26-87

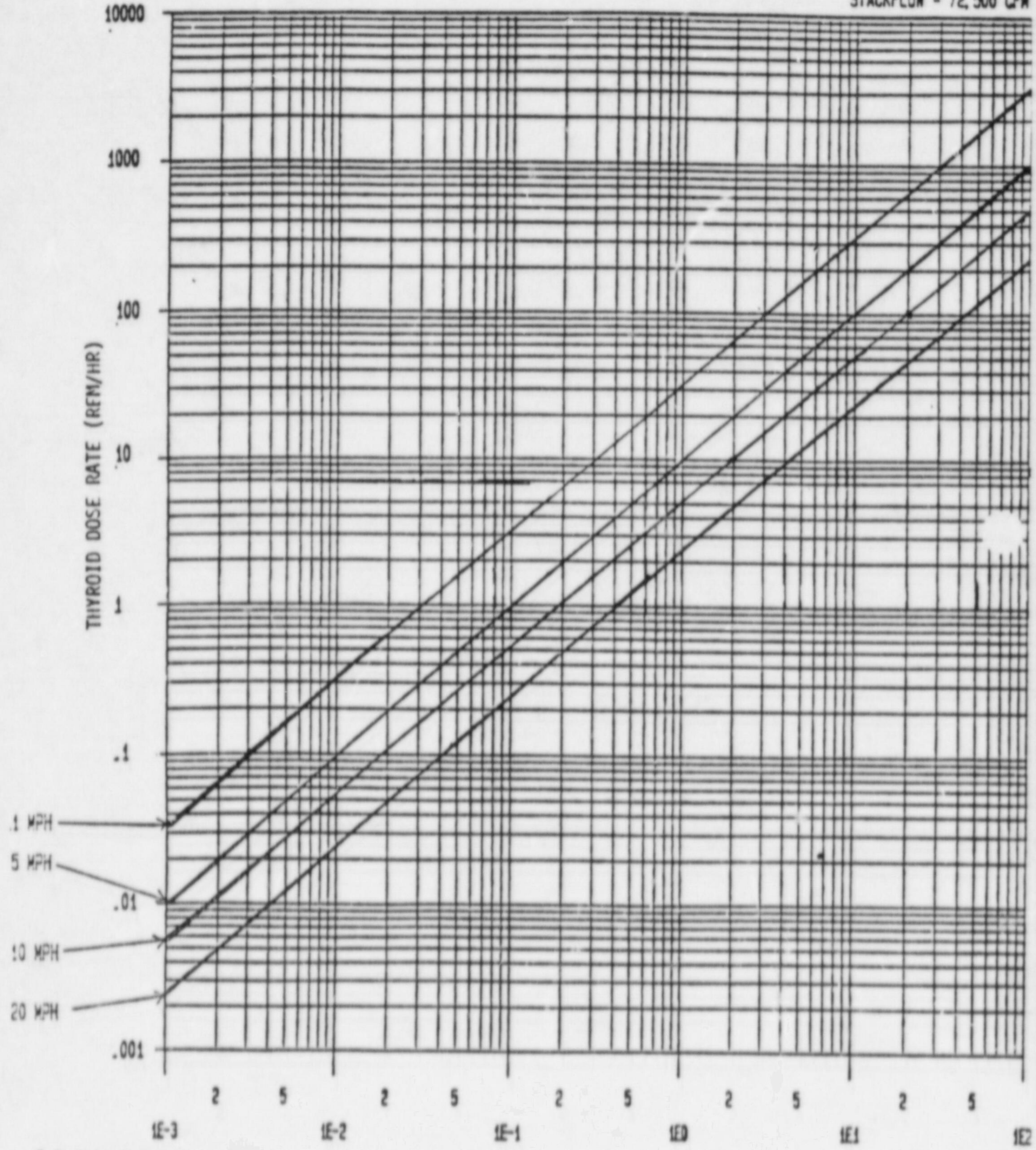
Ci/Sec (IODINE) = (NET FILTER DOSE RATE) × (3.21E-3)

THYROID DOSE RATES AT 5 MILES (RM-063 FILTER)

(FOR VARIOUS WIND SPEEDS)

15 Min. Sample Ti...

STACKFLOW = 72,500 CFM



ISSUED

FEB 26 1987

R10 02-26-87

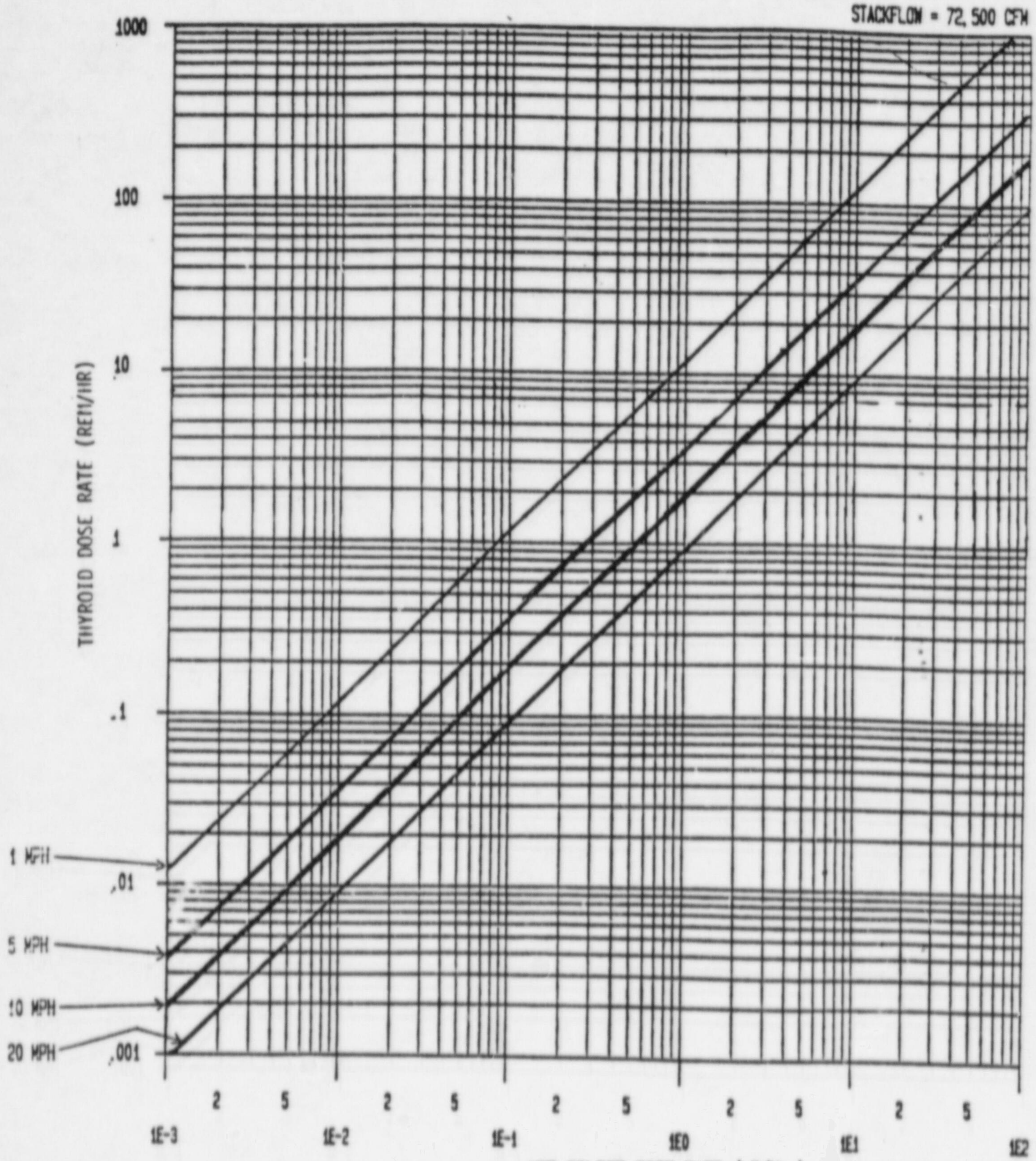
Ci/Sec (IODINE) = (NET FILTER DOSE RATE) × (3.21E-3)

THYROID DOSE RATES AT 10 MILES (RM-063 FILTER)

(FOR VARIOUS WIND SPEEDS)

15 Min. Sample Time

STACKFLOW = 72,500 CFM



ISSUED

FEB 2 6 1987

R10 02-26-87

Ci/Sec (IODINE) = (NET FILTER DOSE RATE) × (3.21E-3)

IV. PROCEDURE (Continued)

B. Section B - Assessment of Airborne Releases From the Main Steam Line Using RM-064.

1. The Shift Supervisor or his designee, upon receipt of an alert or alarm indication on RM-064, shall assign the Shift Chemist to perform dose assessment. The Shift HP will be used as the alternate.

2. The person assigned to dose assessment will perform dose assessment determinations for Site Boundary, 2 Miles, 5 Miles, and 10 Miles every 15 minutes until relieved or directed to stop by the Shift Supervisor or his designee. Dose assessment will be completed in accordance with the following:

   a. Obtain the "Dose Assessment Forms Booklet" from the Control Room Emergency Gear Locker.

   b. Determine the release pathway from the main steam line. Operations personnel will determine this by use of OI-PAP-8 and other applicable procedures.

   c. This procedure is primarily for initial assessments using RM-064. For more detailed release rate calculations and procedures for use when RM-064 is offscale, refer to OI-PAP-8.

   d. Obtain Attachment B-1 "Airborne Release Data Record - Main Steam Line (RM-064)". Collect and record the following data for each assessment:

      1. Date and Time

      2. Present (or Average) Wind Speed - Wind speed meter is located on the north wall of the Control Room above the fire control and alarm panels (AI-184), or obtain wind speed from the Plant Computer by requesting information from operations personnel. Record wind speed; use the estimated average if the reading is unstable. Average wind speed should be used if the release has been continuous.

      3. Present Wind Direction - Wind direction meter is located on the north wall of the Control Room above the fire control and alarm panels (AI-184), or obtain wind direction from the Plant Computer by requesting information from operations personnel. Record wind direction; use the estimated average if the reading is unstable.

         NOTE: This is the direction that the wind is coming from.

ISSUED

IV. PROCEDURE (Continued)

4. Present Delta Temperature (ΔT) - ΔT meter is located on the north wall of the Control Room above the fire control and alarm panels (AI-184), or obtain ΔT from the Plant Computer by requesting information from operations personnel.

5. Stability Class - Using the table and the ΔT from Step 4, determine the stability class and circle the correct designation. When a ΔT is common to two stability classes, use the class nearest to Class G.

6. Stability Conversion Factors - All graphs are based on a single stability class to reduce the total number of graphs needed. Therefore, correction factors are needed to adjust dose rates for other stability classes. Simply locate the applicable stability class in the left column (from Step 5), and circle all four factors that fall to the right of the class. The factors will be used to adjust the dose rate value in a later step.

7. Affected Sectors - Using the overlay map located on the west wall of the Control Room, place the overlay centerline on the downwind exposure pathway (180° from the wind direction recorded in Step 3). Using the appropriate stability class, locate the applicable lines on the overlay. This will outline the projected plume width. Determine the sectors in the plume pathway and record these sectors.

8. Release Pathway - Circle the determined release pathway. This will be: steam safeties, aux. feed pump, or atmospheric dump.

9. Flow Ratio - A correction for actual flow from each release pathway must be determined, as it affects release rate and total dose rate. The ratio is based on maximum flow through individual (or combinations of) open flowpaths, which is then divided by 3.268E+06 lbm/Hr (the maximum flow rate for all flowpaths). To determine flow ratio, the Shift Supervisor must have determined the release pathway. For aux. feed pump or HCV-1040 (steam dump) use the listed ratio. For steam safeties, a determination of main steam pressure must be made. If steam pressure is below 1000 psig, no safeties will be open. As pressure increases, the safeties will open progressively, increasing the ratio as each opens. Determine the steam pressure; find ratio value on the chart. Circle the value determined. NOTE: If more than one pathway is releasing, add applicable flow rates.

ISSUED

IV. PROCEDURE (Continued)

10. RM-064 Gross Counts Per Minute (GCPM) - Record the indicated GCPM from RM-064. It may be necessary to use the chart recorder to determine GCPM if the release has been terminated.

11. Release Rate Calculation - Subtract 30 from RM-064 GCPM (Step 10), then multiply the result by the flow ratio (Step 9), then multiply the result by the indicated constant. Record the results in curies/second.

12. Projected Duration of Release - The Shift Supervisor or his designee must determine the projected duration of the release. This information is required to calculate the projected total dose to a given area. Record this number in hours or a decimal notation for a fraction of an hour.

13. Indicated Dose Rate - Using the graphs, locate GCPM at the bottom, plot up to the present wind speed. If wind speed falls between the indicated slopes, estimate where the lines would intersect. From the point of intersection, plot left to the associated dose rate. Record the results in R/Hr.

14. Actual Dose Rate - Multiply the indicated dose rate (Step 13) by the stability conversion factors for each location (Step 6) and then multiply the result by the flow ratio (Step 9). Record the results in Rem/Hr.

15. Total Projected Dose to a Selected Location - Multiply the actual dose rate (Step 14) by the projected duration of release (Step 12). Record total projected dose to the selected location in REM.

16. Report Results to the Shift Supervisor or his designee - Much of the information that has been recorded will be used on required report forms which must be completed within 15 minutes of accident classification. Expedite the completion of this form in a clear and accurate manner. Then report this information to the Shift Supervisor or his designee.

17. Protective Action Recommendation - The Shift Supervisor or his designee will compare the total projected dose to a selected location (Step 15) to the Protective Action Guidelines on the bottom of the "Airborne Release Data Record - Main Steam Line (RM-064)". After determining the proper recommended actions he will initial Attachment B-1, and relay the information to the appropriate offsite government agencies.

ISSUED

IV. PROCEDURE (Continued)

e. After completion of the "Airborne Release Data Record - Main Steam Line (RM-064)", standby to repeat the process using a new data sheet. Dose assessment must be completed every 15 minutes until relieved or directed to stop by the Shift Supervisor or his designee.

ISSUED

ATTACHMENT B-1
AIRBORNE RELEASE DATA RECORD
MAIN STEAM LINE (RM-064)

1. Date/Time ________/________
2. Wind Speed ________ MPH
3. Wind Direction From: ________ Degrees
4. Delta Temperature (ΔT) ________ °C
5. Stability Class (Circle appropriate class)

ΔT	Class
< -1.9	A
≤ -1.9 to -1.7	B
-1.7 to -1.5	C
-1.5 to -0.5	D
-0.5 to 1.5	E
1.5 to 4.0	F
> 4.0	G

6. Stability Conversion Factors (Circle all four in appropriate stability class)

Class	S.B.	2 Mi.	5 Mi.	10 Mi.
A	$7.1E^{-3}$	$6.4E^{-3}$	$8.9E^{-3}$	$1.1E^{-2}$
B	$4.5E^{-2}$	$2.2E^{-2}$	$1.2E^{-2}$	$1.5E^{-2}$
C	$1.1E^{-1}$	$6.3E^{-2}$	$3.8E^{-2}$	$2.6E^{-2}$
D	$2.9E^{-1}$	$2.3E^{-1}$	$1.9E^{-1}$	$1.6E^{-1}$
E	$5.3E^{-1}$	$4.7E^{-1}$	$4.3E^{-1}$	$4.0E^{-1}$
F	1.0	1.0	1.0	1.0
G	1.7	2.1	2.3	2.4

7. Affected Sectors (from Sector Map) ________________
8. Release Pathway (Circle the applicable pathways)
   - Steam Safeties
   - Aux. Feed Pump
   - Atmospheric Dump
9. Flow Ratio (From Table Below): Circle Determined Value:

Steam Safeties		Aux. Feed	Atmospheric
Steam Pressure	Flow Ratio	Pump (FW-10)	Dump (HCV-1040)
> 1000 psia	.0453	.00275	.0459
≥ 1015 psia	.284		
≥ 1025 psia	.523		
≥ 1040 psia	.761		
≥ 1050 psia	1.0		

NOTE: If more than one pathway is releasing, add applicable flow ratios.

10. RM-064 Reading ________ GCPM
11. Release Rate Calculation: Ci/Sec=(RM-064 GCPM-30)(Flow Ratio)(6.16)=________ Ci/Sec
12. Projected Duration of Release: (From Shift Supervisor, in Hours) ________ Hrs

ISSUED FEB 26 1987

ATTACHMENT B-1 (Continued)
AIRBORNE RELEASE DATA RECORD
MAIN STEAM LINE (RM-064)

Indicated Dose Rates From Graph(s) REM/Hr	X	Stability Conversion Factors (Step 6)	X	Flow Ratio (Step 9) ______	=	Actual Dose Rate REM/Hr	X	Projected Duration of Release (Step 12) ______ Hrs	=	Total Projected Dose REM	Protective Action Recommendations From Guidelines Listed Below
Whole Body						Whole Body				Whole Body	
S.B. ______	X	______				S.B. ______				S.B. ______	S.B. ______
2 Mi. ______	X	______				2 Mi. ______				2 Mi. ______	2 Mi. ______
5 Mi. ______	X	______				5 Mi. ______				5 Mi. ______	5 Mi. ______
10 Mi. ______	X	______				10 Mi. ______				10 Mi. ______	10 Mi. ______

PROTECTIVE ACTION GUIDELINES:

A. W.B. Dose < 1 REM
NO PROTECTIVE ACTION REQUIRED

B. W.B. Dose > 1 REM
< 5 REM
SEEK SHELTER, CONSIDER EVACUATION

C. W.B. Dose > 5 REM
CONDUCT MANDATORY EVACUATION

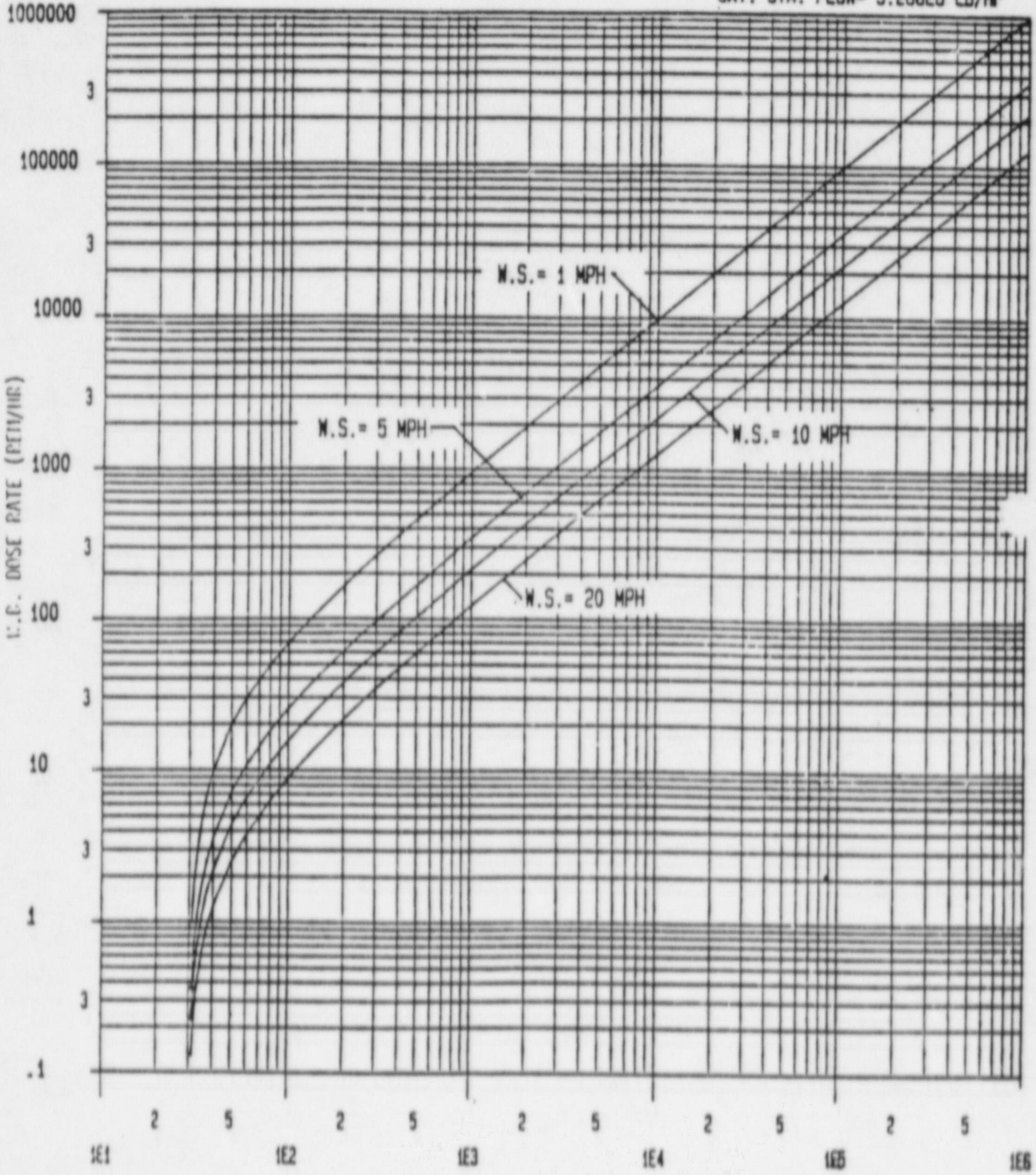
Shift Supervisor Review: ______________________

W.B. DOSE RATES AT S.B. (RM-064)

EPIP-EOF-6-8-7

(FOR VARIOUS WIND SPEEDS)

SAT. STM. FLOW= 3.268E6 LB/Hr



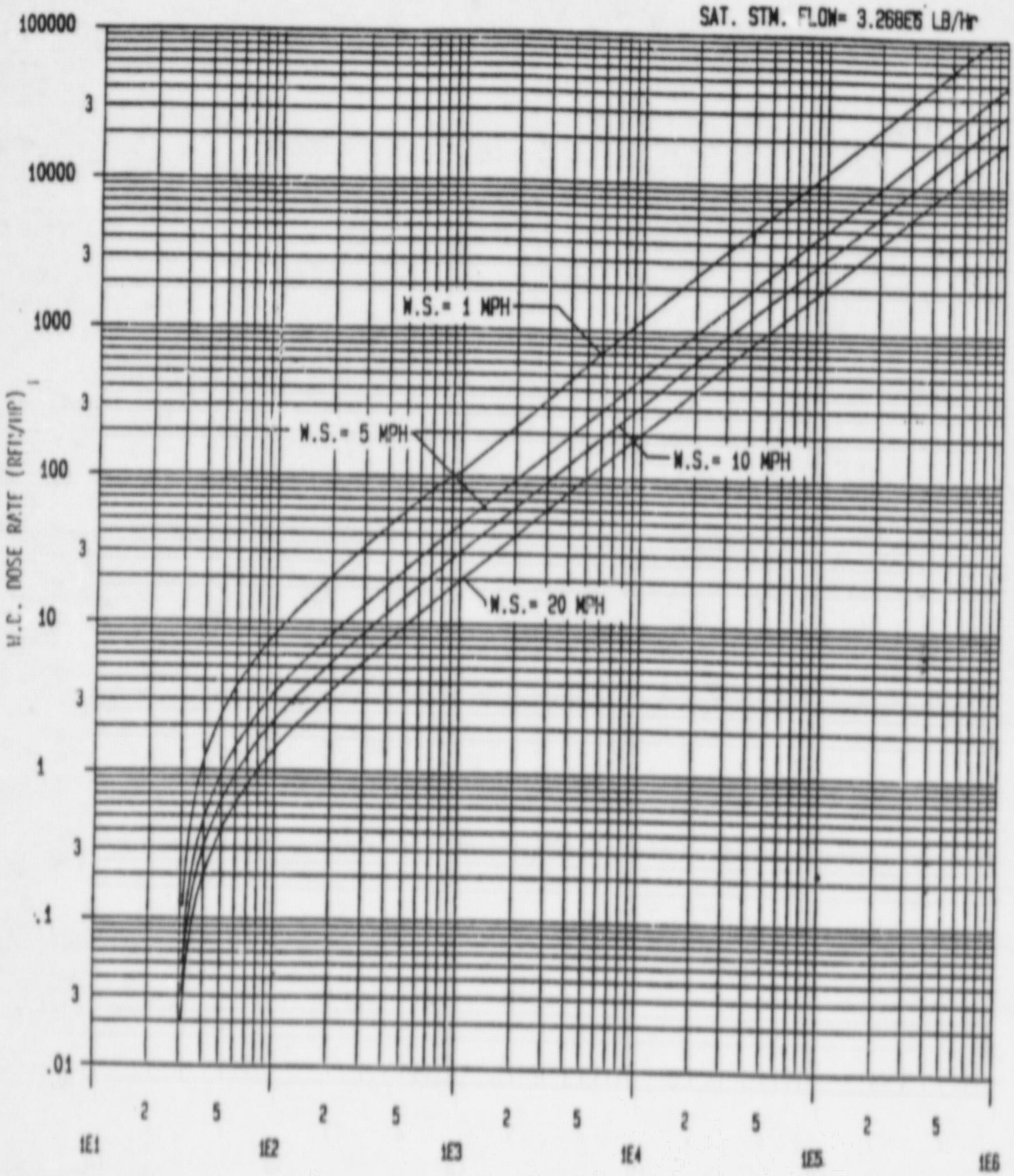
ISSUED
FEB 2 6 1987

R10 02-26-87

W.B. DOSE RATES AT 2 MILES (RM-064)

EPIP-EOF-6-8-8

(FOR VARIOUS WIND SPEEDS)

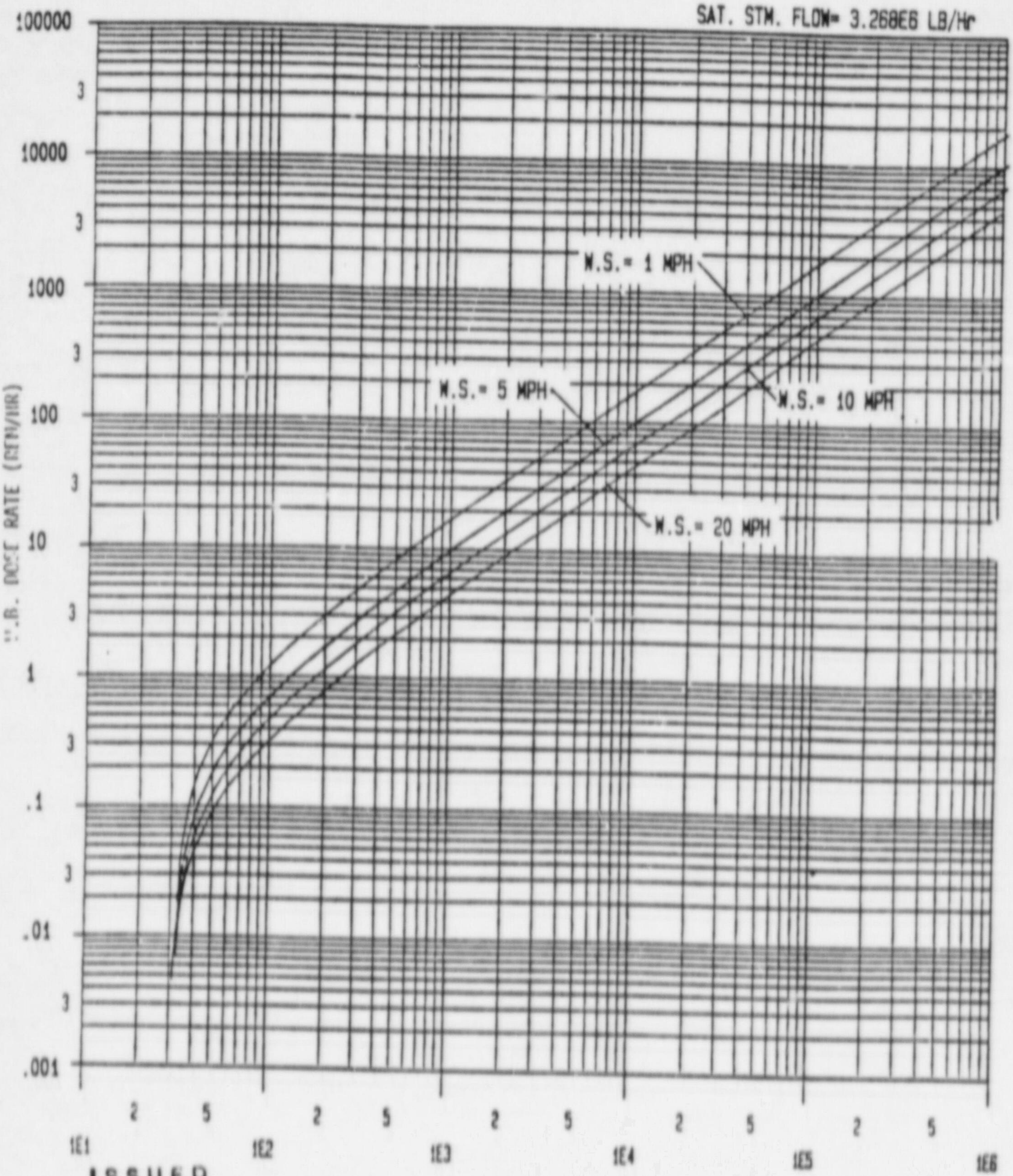


ISSUED
FEB 26 1987

R10 02-26-87

W.B. DOSE RATES AT 5 MILES (RM-064)

(FOR VARIOUS WIND SPEEDS)



ISSUED

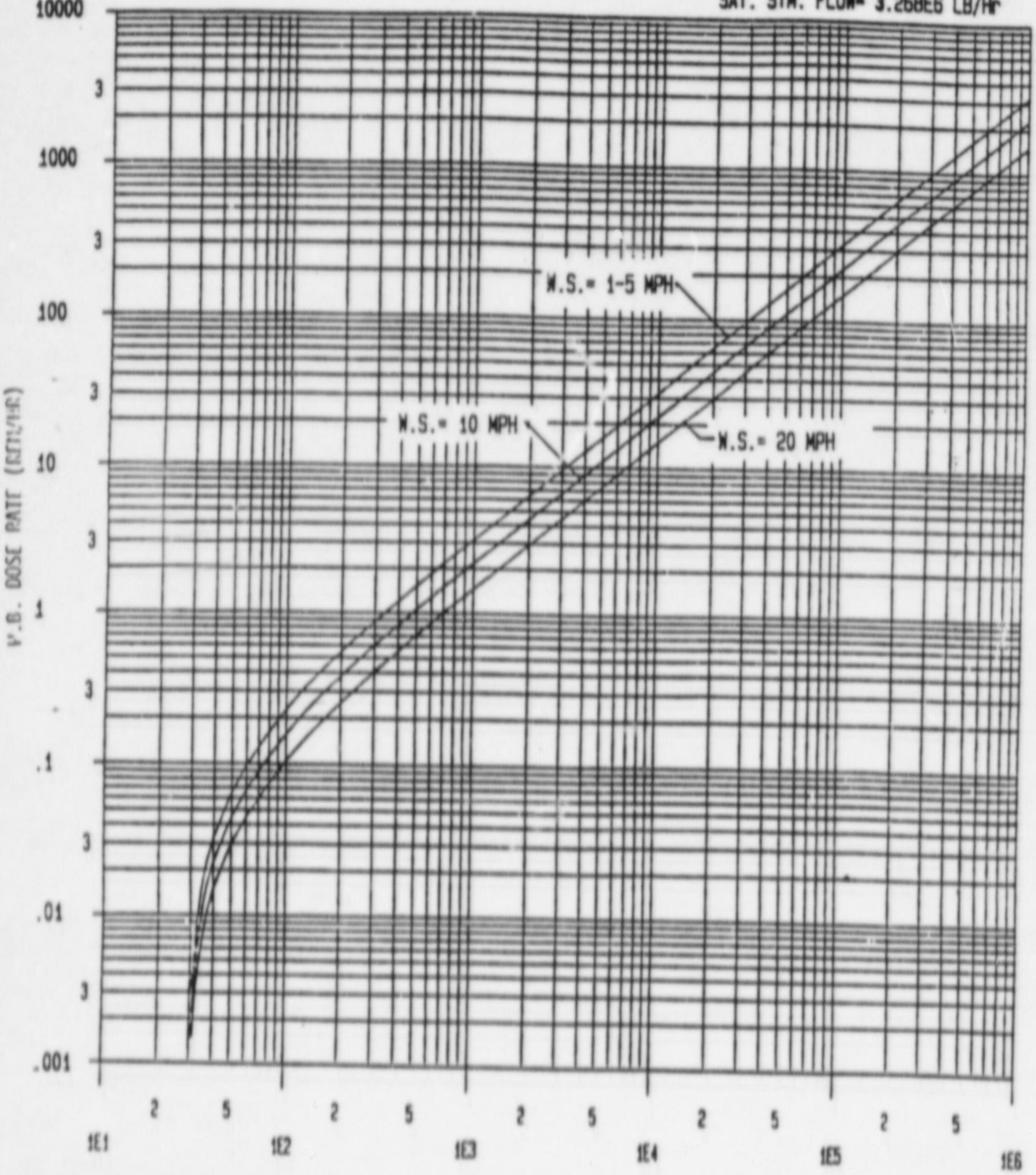
FEB 26 1987

R10 02-26-87

W.B. DOSE RATES AT 10 MILES (RM-064)

(FOR VARIOUS WIND SPEEDS)

SAT. STM. FLOW= 3.268E6 LB/Hr



ISSUED
FEB 26 1987

IV. PROCEDURE (Continued)

C. Section C - Assessment of Airborne Releases From Containment Design Leakage.

1. The Shift Supervisor or his designee, upon receipt of an alert or alarm indication on RM-070, RM-071, RM-072, RM-073, RM-074, RM-075, RM-091A, or RM-091B shall assign the Shift Chemist to perform dose assessment. The Shift HP will be used as the alternate.

2. The person assigned to dose assessment will perform dose assessment determinations for Site Boundary, 2 Miles, 5 Miles, and 10 Miles every 15 minutes until relieved or directed to stop by the Shift Supervisor or his designee. Dose assessment will be completed in accordance with the following:

   a. Obtain the "Dose Assessment Forms Booklet" from the Control Room Emergency Gear Locker.

   b. Determine the need to perform this method of dose assessment based on one or more of the following:

      1. High or offscale readings on Containment area monitors.

      2. High readings on RM-050/051.

      3. Loss of coolant accident (LOCA) in the Containment.

      4. Previous criteria combined with no stack flow, indicating that any release will be from Containment leakage.

   c. Obtain Attachment C-1 "Containment Release Data Record" from the Dose Assessment Forms Booklet. Collect and record the following data for each assessment:

      1. Date and Time

      2. Present (or Average) Wind Speed - Wind speed meter is located on the north wall of the Control Room above the fire control and alarm panels (AI-184), or obtain wind speed from the Plant Computer by requesting information from operations personnel. Record wind speed; use the estimated average if the reading is unstable. Average wind speed should be used if the release has been continuous.

      3. Present Wind Direction - Wind direction meter is located on the north wall of the Control Room above the fire control and alarm panels (AI-184), or obtain wind direction from the Plant Computer by requesting information from operations personnel. Record wind direction; use the estimated average if the reading is unstable.

      NOTE: This is the direction that the wind is coming from.

ISSUED

IV. PROCEDURE (Continued)

4. Present Delta Temperature (ΔT) - ΔT meter is located on the north wall of the Control Room above the fire control and alarm panels (AI-104), or obtain ΔT from the Plant Computer by requesting information from operations personnel.

5. Stability Class - Using the chart and the ΔT from Step 4, determine the stability class and circle the correct designation. When a ΔT is common to two stability classes, use the class nearest to Class G.

6. Stability Conversion Factors - All graphs are based on a single stability class to reduce the total number of graphs needed. Therefore, correction factors are needed to adjust dose rates for other stability classes. Simply locate the applicable stability class in the left column (from Step 5), and circle all four factors that fall to the right of the class. The factors will be used to adjust the dose rate value in a later step.

7. Affected Sectors - Using the overlay map located on the west wall of the Control Room, place the overlay centerline on the downwind exposure pathway (180° from the wind direction recorded in Step 3). Using the appropriate stability class, locate the applicable lines on the overlay. This will outline the projected plume width. Determine the sectors in the plume pathway and record these sectors.

8. Area Monitor Number/Dose Rate Reading - Determine the highest reading area monitor. Record the monitor number and the monitor reading in REM/Hr.

   a. If all containment area monitors are inoperable or offscale, a direct reading (with a Teletector or other high range instrument) must be taken at the appropriate containment penetrations. See Attachments C-11 and C-12 for the exact location of these penetrations. Record the reading and circle the appropriate units.

   b. A correction factor is required to account for the difference between the location of the area monitor and the location of the penetration. Using Attachment C-10, locate the time since the accident at the bottom of the graph, plot down to the penetration/area monitor used, then plot to the left, to the appropriate multiplication factor. Record the results.

ISSUED

IV. PROCEDURE (Continued)

8. c. The actual monitor reading is determined by multiplying the direct reading at the penetration by the multiplication factor (Step b). Record the results in REM/Hr.

9. Calculated Release Rate - Perform release rate calculation at the bottom of the graph(s). Record the results in Curies/second.

10. Projected Duration of Release - The shift supervisor or his designee must determine the projected duration of release. This information is required to calculate the projected total dose to a given area. Record this number in hours or a decimal notation for a fraction of an hour.

11. Indicated Dose Rates - Using the selected graph(s), locate REM/Hr at the bottom, plot up to the present wind speed. If wind speed falls between the indicated slopes, estimate where the lines would intersect. From the point of intersection, plot to the left to find the indicated dose rate. Record the dose rate in REM/Hr for each location.

12. Actual Dose Rate - multiply the indicated dose rates (Step 11) by the Stability conversion factors for each location (Step 6). Record the results in REM/Hr.

13. Total Projected Dose to a Selected Location - Multiply the actual dose rate(s) (Step 12) by the projected duration of release (Step 10). Record the total projected dose to the selected locations in REM for each location.

14. Report Results to the Shift Supervisor or his designee - Much of the information that has been recorded will be used on required report forms which must be completed within 15 minutes of accident classification. Expedite the completion of this form in a clear and accurate manner. Then report this information to the Shift Supervisor or his designee.

15. Protective Action Recommendation - The Shift Supervisor or his designee will compare the total projected whole body dose and the total projected thyroid dose to the protective action guidelines on the bottom of the "Containment Release Data Record". After determining the proper recommended actions he will initial Attachment C-1 and relay the information to the appropriate offsite government agencies.

d. After completion of the "Containment Release Data Record", standby to repeat the process using new data sheets. Dose assessment must be completed every 15 minutes until relieved or directed to stop by the Shift Supervisor or his designee.

ISSUED

FEB 26 1987

ATTACHMENT C-1
CONTAINMENT RELEASE DATA RECORD

1. Date/Time ________/________

2. Wind Speed ________ MPH

3. Wind Direction From: ________ Degrees

4. Delta Temperature (ΔT) ________ °C

5. Stability Class
(Circle appropriate class)

ΔT	Class
<-1.9	A
-1.9 to -1.7	B
-1.7 to -1.5	C
-1.5 to -0.5	D
-0.5 to 1.5	E
1.5 to 4	F
>4.0	G

6. Stability Conversion Factors (Circle all four in appropriate stability class)

Class	S.B.	2 Mi.	5 Mi.	10 Mi.
A	$7.1E^{-3}$	$6.4E^{-3}$	$8.9E^{-3}$	$1.1E^{-2}$
B	$4.5E^{-2}$	$2.2E^{-2}$	$1.2E^{-2}$	$1.5E^{-2}$
C	$1.1E^{-1}$	$6.3E^{-2}$	$3.8E^{-2}$	$2.6E^{-2}$
D	$2.9E^{-1}$	$2.3E^{-1}$	$1.9E^{-1}$	$1.6E^{-1}$
E	$5.3E^{-1}$	$4.7E^{-1}$	$4.3E^{-1}$	$4.0E^{-1}$
F	1.0	1.0	1.0	1.0
G	1.7	2.1	2.3	2.4

7. Affected Sectors ________

8. Affected Monitor Number/
Dose Rate Reading RM- ________ / ________ REM/Hr
If area monitor reading is unavailable or off scale, calculate the dose rate by using the following:

A. Take a direct radiation reading at containment penetration H-4 or C-2 (see attachments C-11 and and C-12 for exact locations).
________ REM/Hr

B. Using Attachment C-10, locate time since accident, plot down to penetration/monitor used, plot left to multiplication factor.
____

C. Direct reading (Step 8A) x multiplication factor (Step 8B) = actual monitor reading. Record this value in REM/Hr, in Step 8.

9. Calculated Release Rate
(Perform calculation on bottom of graph)

Whole Body	Thyroid
________ Ci/Sec	________ Ci/Sec

10. Projected Duration of Release ________ Hrs
(From Shift Supervisor, in Hours)

ATTACHMENT C-1 (Continued)
CONTAINMENT RELEASE DATA RECORD

ISSUED
FEB 26 1987

Indicated Dose Rates From Graph(s) REM/Hr		Stability Conversion Factor (Step 6)		Actual Dose Rate REM/Hr		Projected Duration of Release (Step 10) ____ Hrs		Total Projected Dose REM	Protective Action Recommendations From Guidelines Listed Below
X			=		X		=		

Whole Body				Whole Body	Whole Body	Protective Action Recommendations
S.B. ______	X	______	=	______	S.B. ______	S.B. ______
2 Mi. ______	X	______	=	______	2 Mi. ______	2 Mi. ______
5 Mi. ______	X	______	=	______	5 Mi. ______	5 Mi. ______
10 Mi. ______	X	______	=	______	10 Mi. ______	10 Mi. ______
Thyroid				**Thyroid**	**Thyroid**	
S.B. ______	X	______	=	______	S.B. ______	
2 Mi. ______	X	______	=	______	2 Mi. ______	
5 Mi. ______	X	______	=	______	5 Mi. ______	
10 Mi. ______	X	______	=	______	10 Mi. ______	

PROTECTIVE ACTION GUIDELINES:

A. W.B. Dose < 1 REM Thyroid Dose < 5 REM
NO PROTECTIVE ACTION REQUIRED

B. W.B. Dose > 1 REM Thyroid Dose > 5 REM
< 5 REM < 25 REM
SEEK SHELTER, CONSIDER EVACUATION

C. W.B. Dose > 5 REM Thyroid Dose > 25 REM
CONDUCT MANDATORY EVACUATION

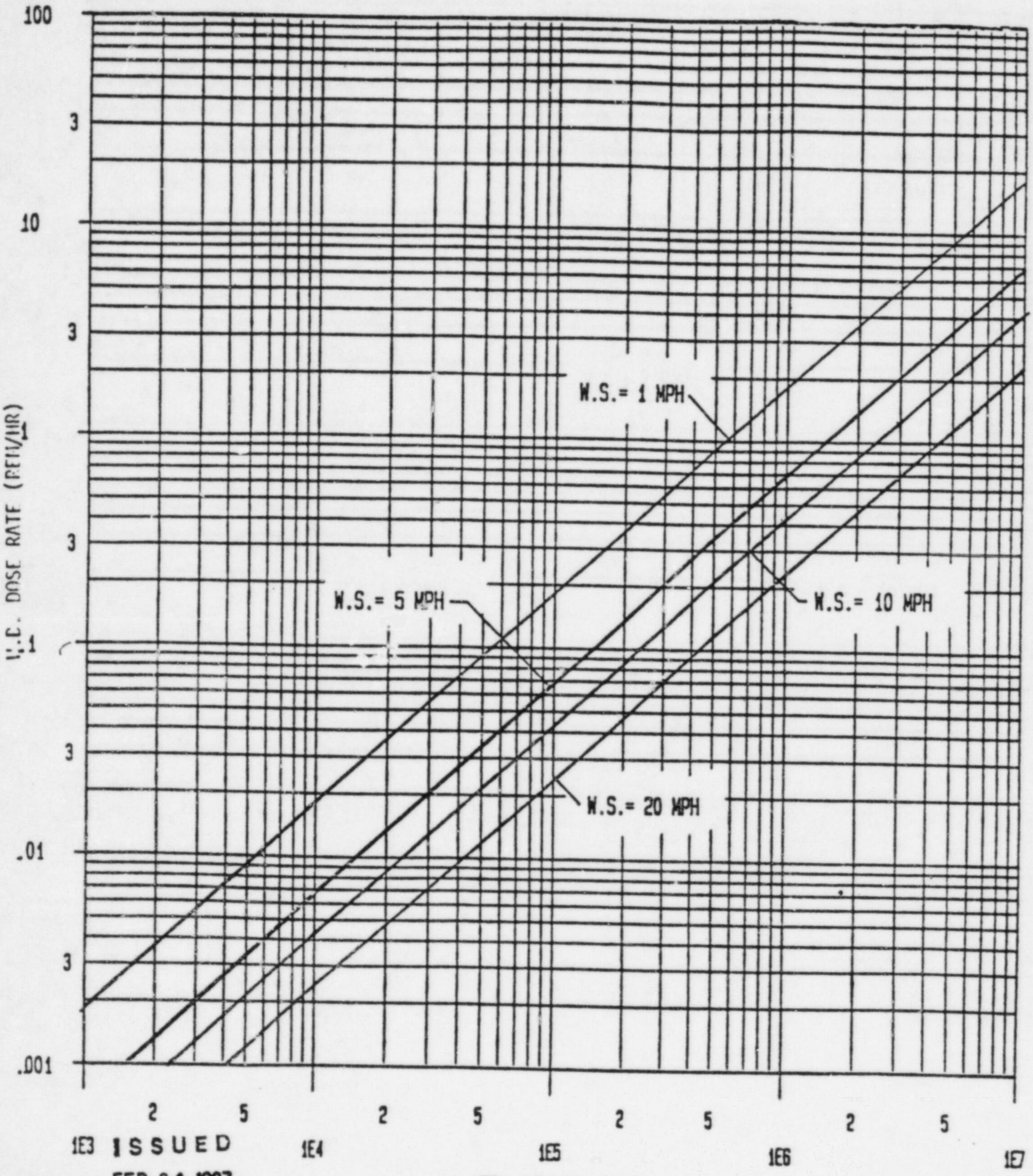
Shift Supervisor Review:______________________

EPIP-EOF-6-C-6

W.B. DOSE RATES AT S.B. (CONTAINMENT MONITORS)

(FOR VARIOUS WIND SPEEDS)

CONT. LEAK= 1.5 CFM



ISSUED
FEB 26 1987

R10 02-26-87

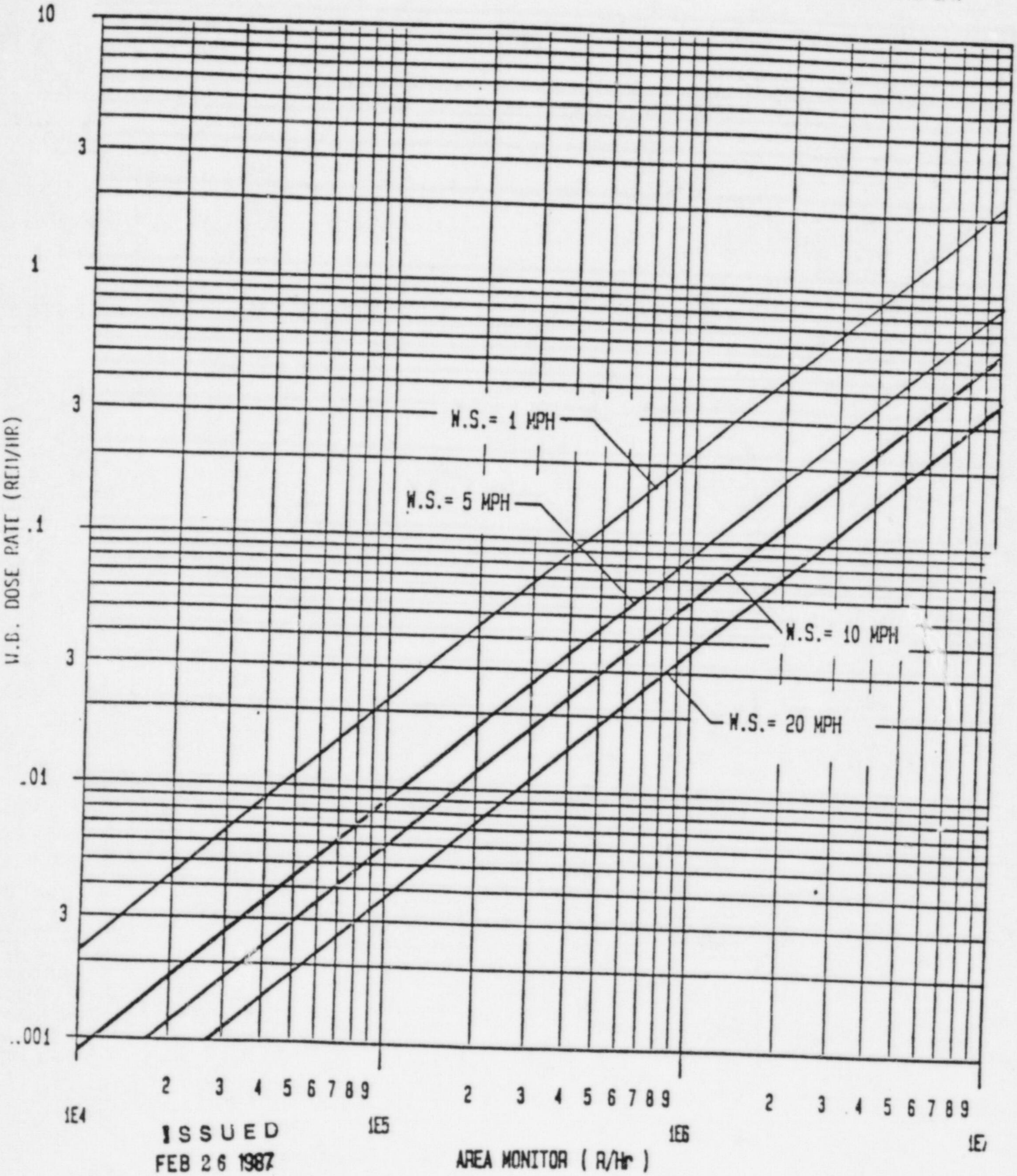
Ci/Sec (NOBLE GAS) = AREA MONITOR (R/Hr) × (1.12E-5)

W.B. DOSE RATES AT 2 MILES (CONTAINMENT MONITORS)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-C-7

CONT. LEAK= 1.5 CFM



ISSUED
FEB 26 1987

Ci/Sec (NOBLE GAS) = AREA MONITOR (R/Hr) X (1.12E-5)

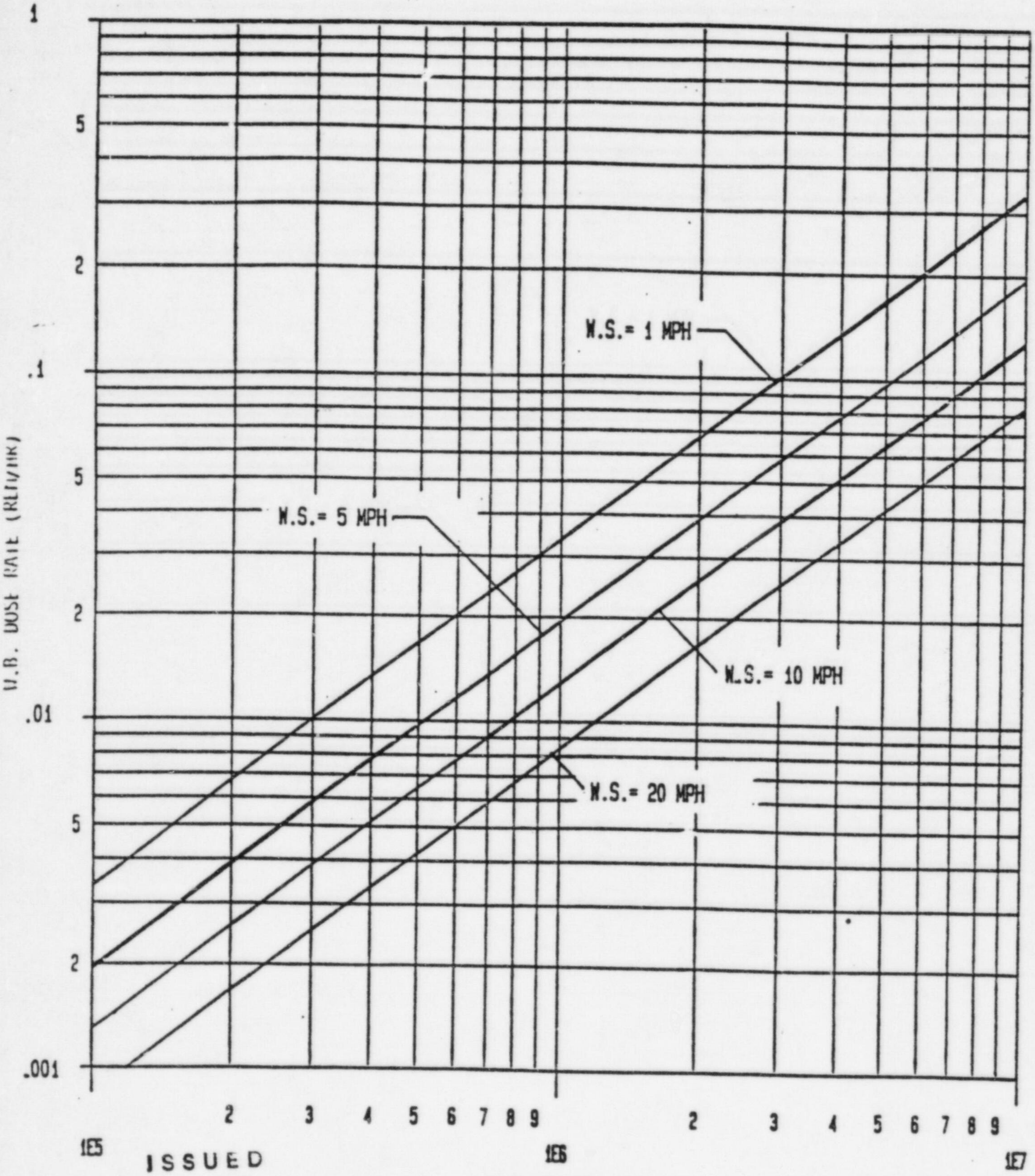
R10 02-26-87

W.B. DOSE RATES AT 5 MILES (CONTAINMENT MONITORS)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-C-8

CONT. LEAK= 1.5 CFM



ISSUED
FEB 26 1987

Ci/Sec (NOBLE GAS) = AREA MONITOR (R/Hr) × (1.12E-5)

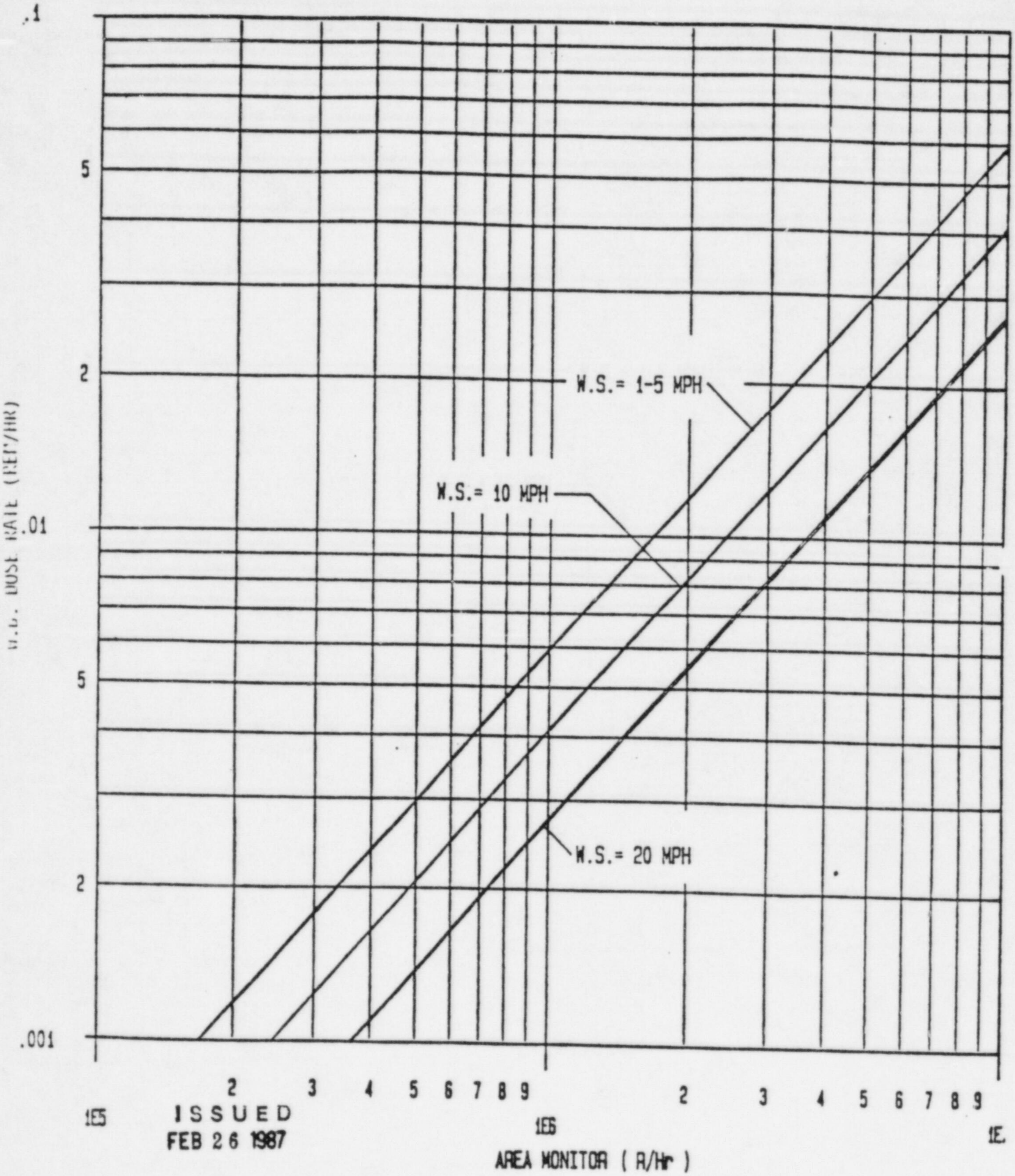
R10 02-26-87

W.B. DOSE RATES AT 10 MILES (CONTAINMENT MONITORS)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-C-9

CONT. LEAK= 1.5 CFM



ISSUED
FEB 26 1987

Ci/Sec (NOBLE GAS) = AREA MONITOR (R/Hr) × (1.12E-5)

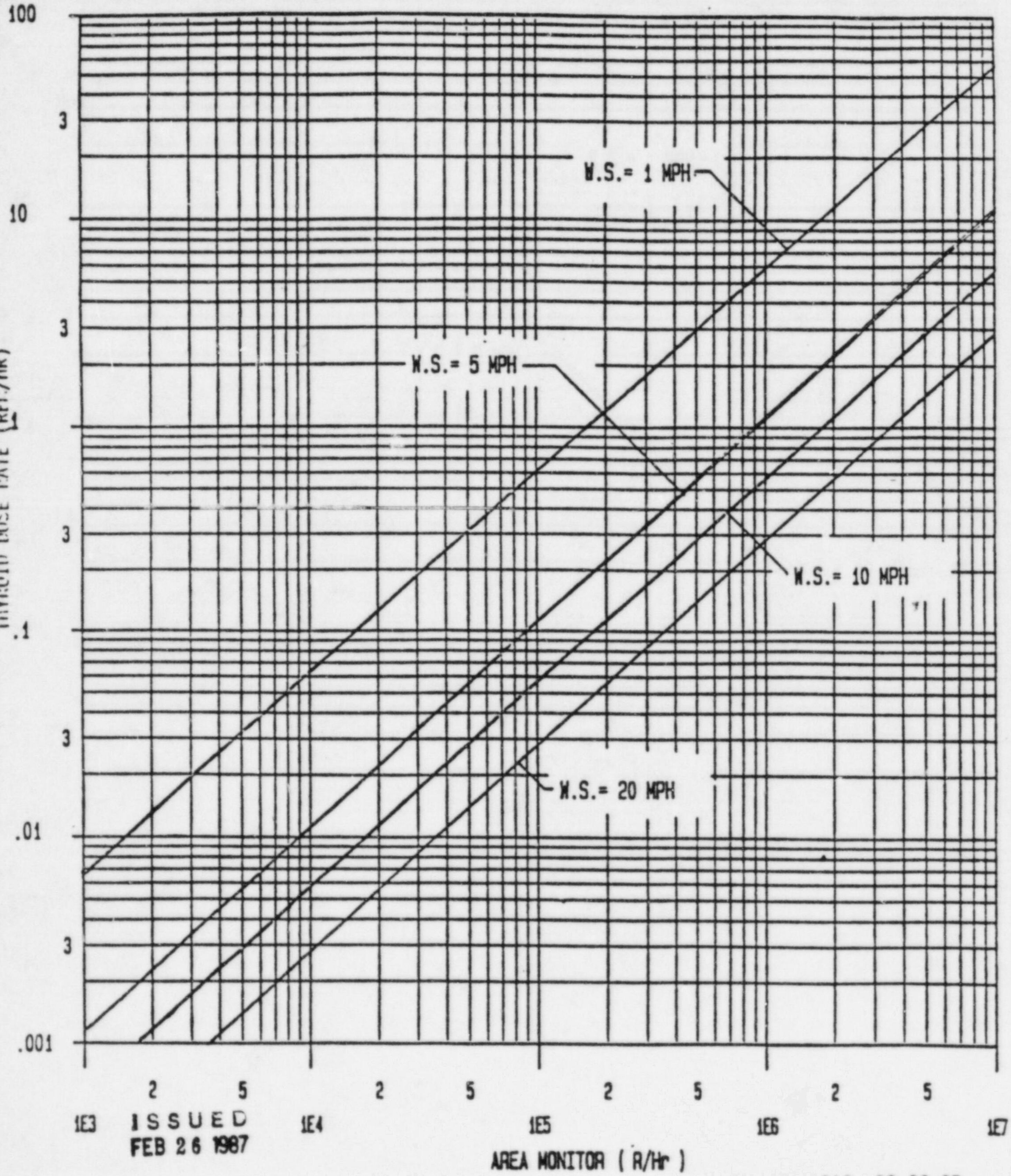
R10 02-26-87

THYROID DOSE RATES AT S.B. (CONTAINMENT MONITORS)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-C-10

CONT. LEAK= 1.5 CFM



ISSUED
FEB 26 1987

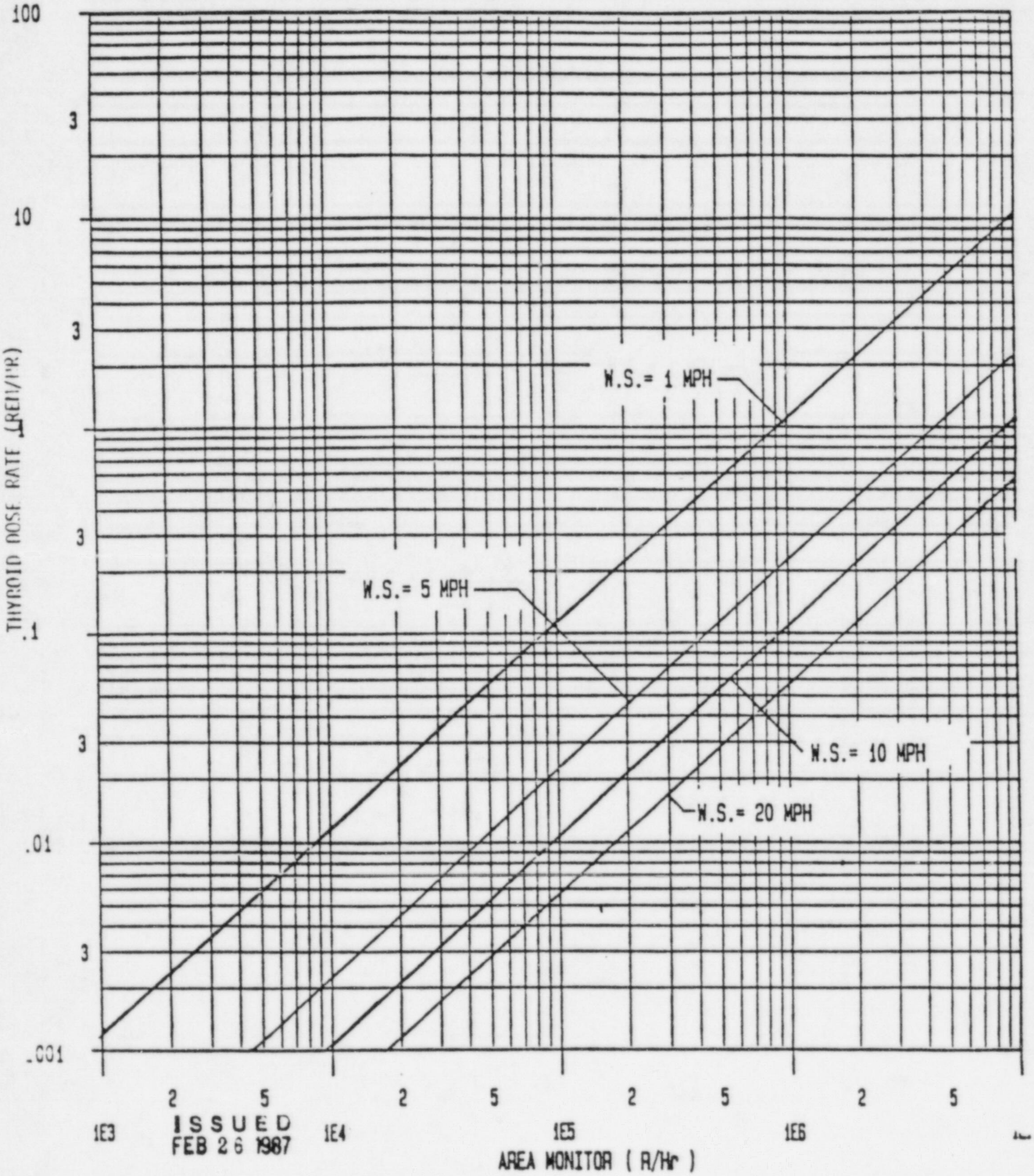
R10 02-26-87

Ci/Sec (IODINE) = AREA MONITOR (R/Hr) × (2.07E-8)

THYROID DOSE RATES AT 2 MILES (CONTAINMENT MONITORS)

(FOR VARIOUS WIND SPEEDS)

CONT. LEAK= 1.5 CFM



ISSUED
FEB 26 1987

R10 02-26-87

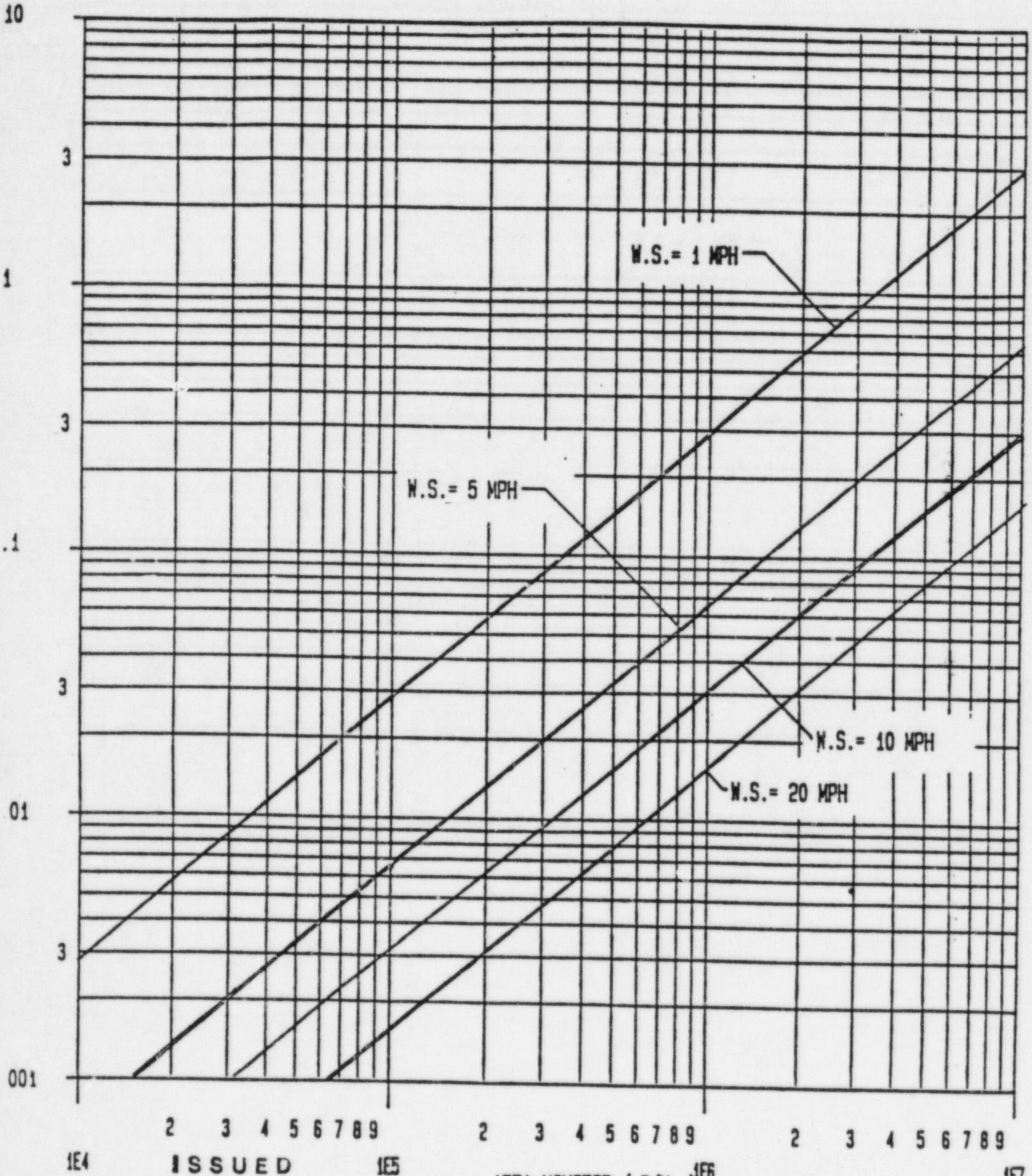
Ci/Sec (IODINE) = AREA MONITOR (R/Hr) × (2.07E-8)

THYROID DOSE RATES AT 5 MILES (CONTAINMENT MONITORS)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-C-12

CONT. LEAK= 1.5 CFM



ISSUED

FEB 26 1987

R10 02-26-87

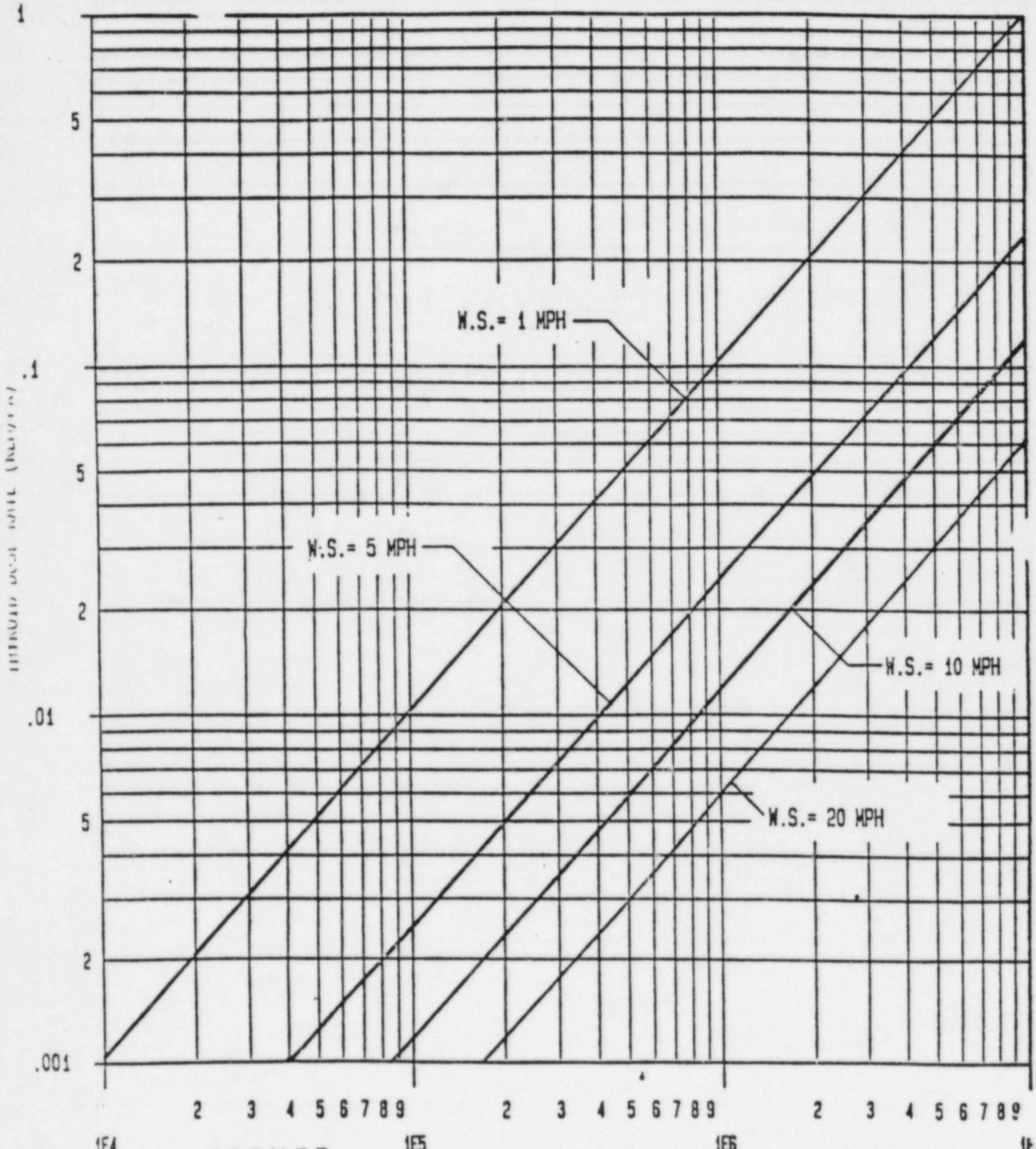
Ci/Sec (IODINE) = AREA MONITOR (R/Hr) X (2.07E-8)

THYROID DOSE RATES AT 10 MILES (CONTAINMENT MONITORS)

(FOR VARIOUS WIND SPEEDS)

EPIP-EOF-6-C-1

CONT. LEAK= 1.5 CFM



ISSUED

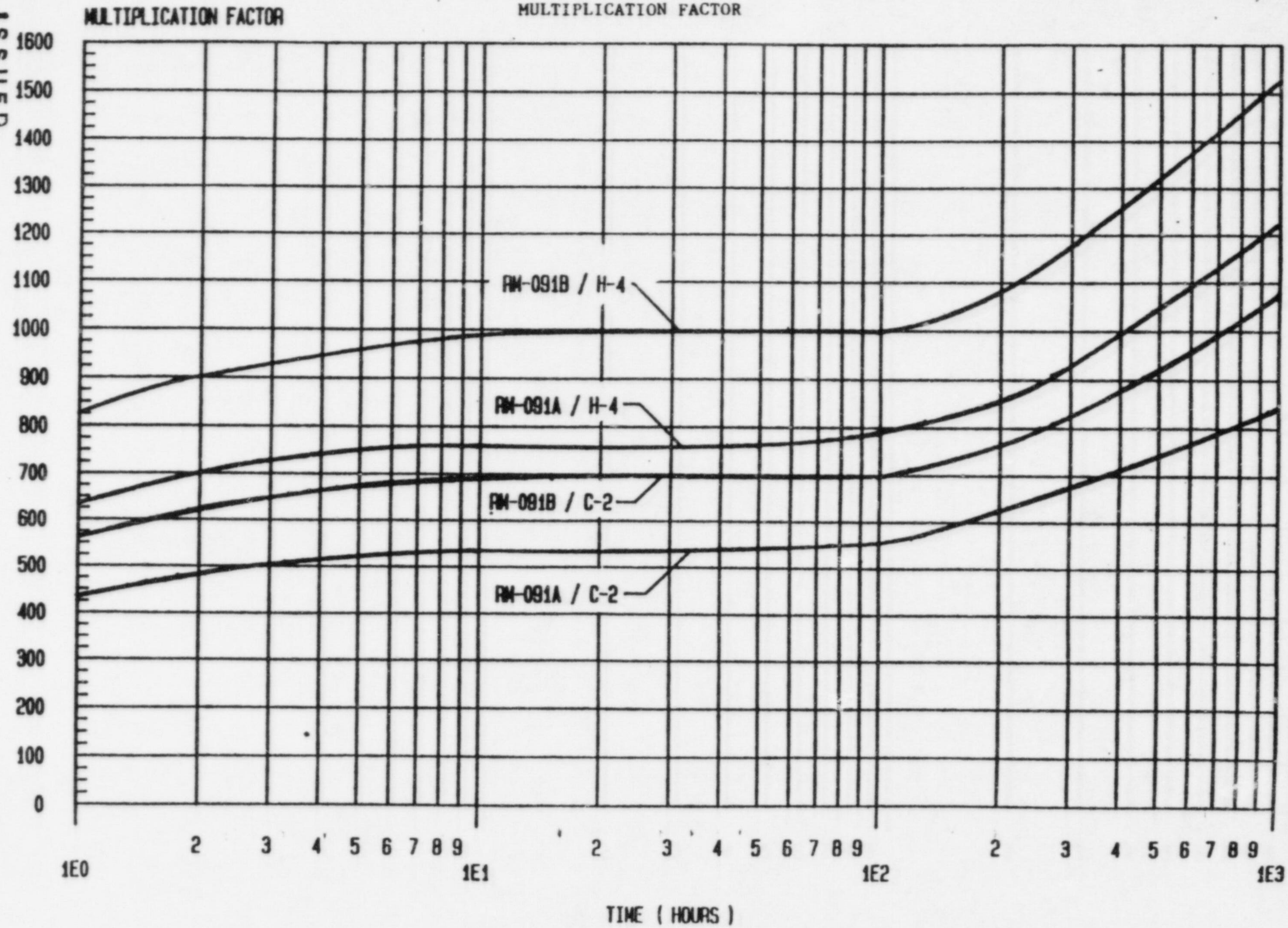
FEB 26 1987

R10 02-26-87

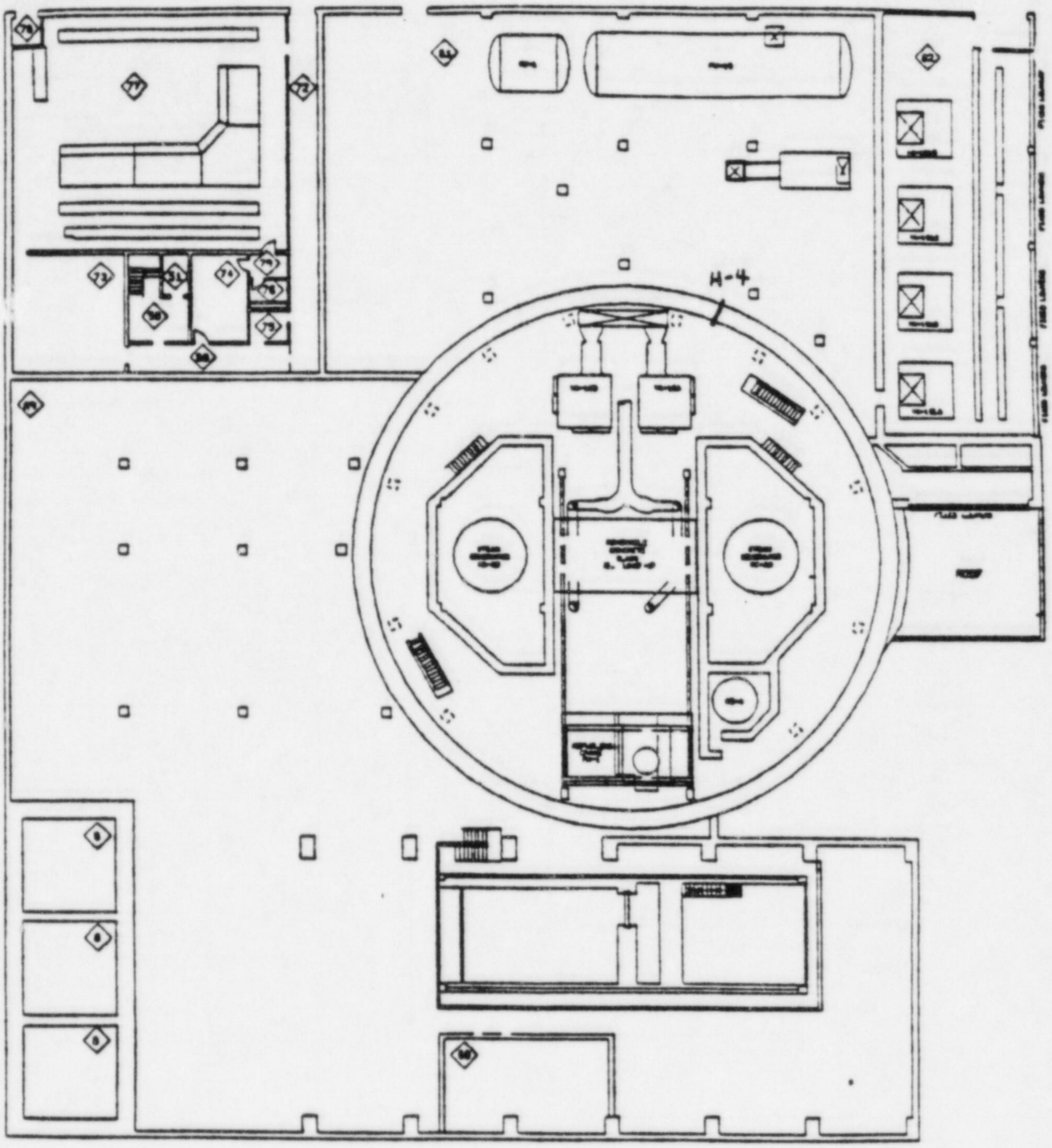
Ci/Sec (IODINE) = AREA MONITOR (R/Hr) x (2.07E-8)

ATTACHMENT #C - 10
MULTIPLICATION FACTOR

ISSUED
FEB 26 1987

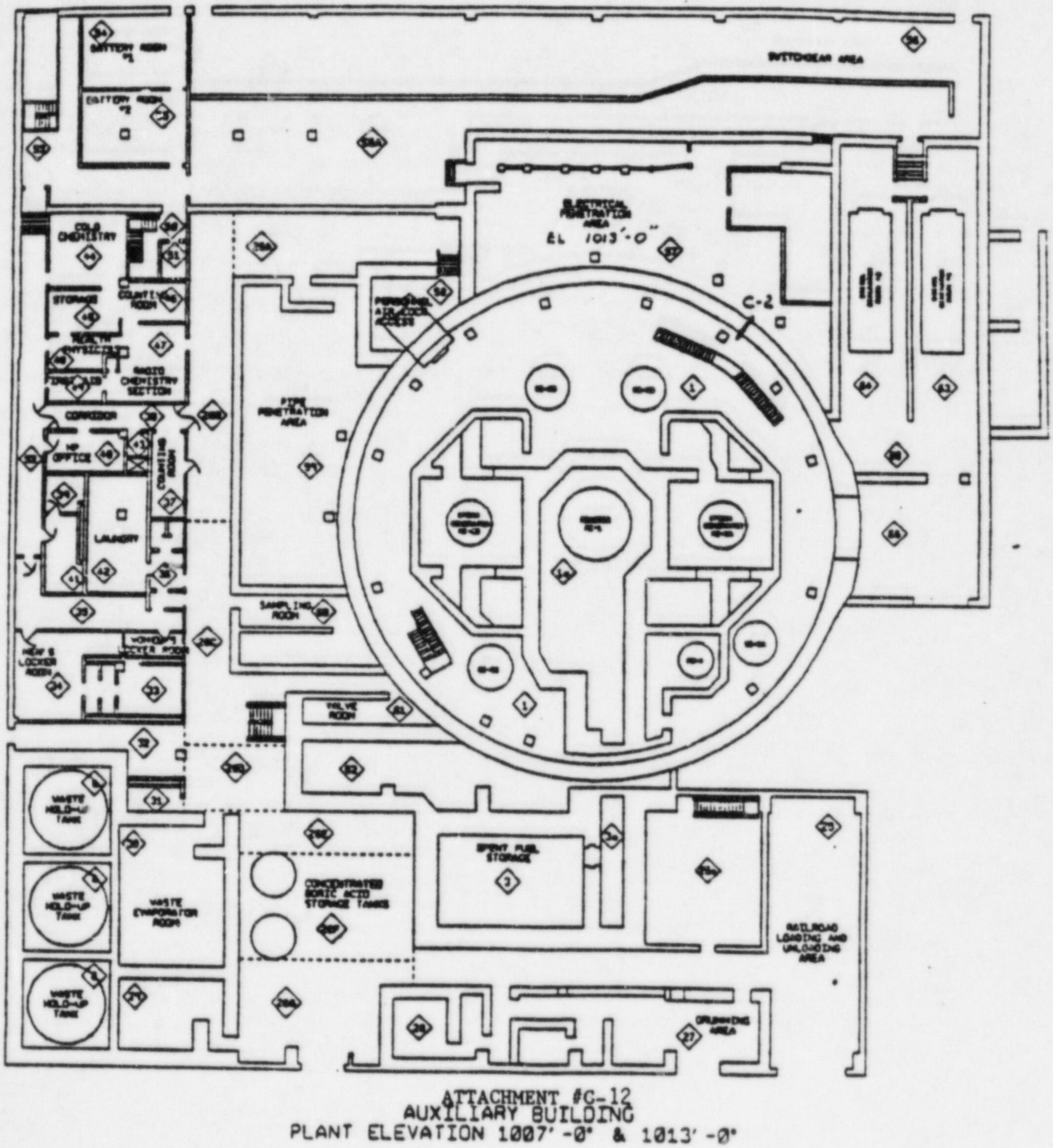


R10 02-26-87



ATTACHMENT #C-11
AUXILIARY BUILDING
PLANT ELEVATION 1036'-0"

ISSUED
FEB 26 1987



ATTACHMENT #C-12
AUXILIARY BUILDING
PLANT ELEVATION 1007'-0" & 1013'-0"

ISSUED

FEB 26 1987

IV. PROCEDURE (Continued)

D. Section D - Assessment of Airborne Releases Using Key Isotopes From Air Samples.

1. The Shift Supervisor or his designee, upon receipt of an alarm indication on one or more process monitors or power failure to the process monitors, shall assign the Shift Chemist to perform dose assessment. The Shift HP will be used as the alternate.

2. The person assigned to dose assessment will perform dose assessment determinations until relieved or directed to stop by the shift supervisor or his designee. Dose assessment will be completed in accordance with the following:

a. Obtain the "Dose Assessment Forms Booklet" from the Control Room Emergency Gear Locker.

b. Perform dose assessment as described in Sections A through C of the dose assessment procedure if possible.

c. Should all monitors for a release pathway fail due to loss of power or are offscale, use this method of dose assessment.

d. Obtain Attachment D-1 "Key Isotope Data Record" from the Dose Assessment Forms Booklet. Collect and record the following data for the affected pathway:

1. Date and Time

2. Selected Location - Circle the selected location for the calculation being performed. This will be: Site Boundary, 2 miles, 5 miles, or 10 miles.

3. Present (or Average) Wind Speed - Wind speed meter is located on the north wall of the Control Room above the fire control and alarm panels (AI-184), or obtain wind speed from the Plant Computer by requesting information from operations personnel. Record wind speed; use the estimated average if the reading is somewhat unstable. Average wind speed should be used if the release has been continuous.

4. Present Wind Direction - Wind direction meter is located on the north wall of the Control Room above the fire control and alarm panels (AI-184), or obtain wind direction from the Plant Computer by requesting information from operations personnel. Record wind direction; use the estimated average if the reading is somewhat unstable. NOTE: This is the direction that the wind is coming from.

ISSUED

IV. PROCEDURE (Continued)

5. Present Delta Temperature (ΔT) - ΔT meter is located on the north wall of the Control Room above the fire control and alarm panels (AI-184), or obtain ΔT from the Plant Computer by requesting information from operations personnel.

6. Stability Class - Using the chart at the end of Attachment D-1 and the ΔT from Step 5, determine the stability class and circle the correct designation. When a ΔT is common to two stability classes, use the class nearest to Class A.

7. Affected Sectors - Using the overlay map located on the west wall of the Control Room, place the overlay centerline on the exposure pathway (180° from the wind direction recorded in Step 4). Using the appropriate stability class, locate the applicable lines on the overlay. This will outline the projected plume width. Determine the sectors in the plume pathway and record these sectors. Record adjacent sectors if plume is close to the boundaries.

8. Stack Flow Rate - Stack flow rate meter is located behind the control panel on AI-44. The meter number is FR-758. Meter reading is in standard cubic feet per minute (SCFM) times one thousand.

9. Present Main Steam Flow Rate - If the release is from primary to secondary, refer to OI-PAP-8 to determine the main steam flow rate. Record the results in cubic feet per minute (CFM).

10. X/Q at Site Boundary - This is required to calculate dose rate if the site boundary is the selected location. Obtain site boundary X/Q by requesting information from operations personnel or use the following formula:

$$X/Q \; (\text{sec}/\text{m}^3) = \frac{1.0E\text{-}04}{(\text{Wind Speed})(.447)}$$

11. a. X/Q for Downwind Locations - This is required to calculate dose rate for a downwind location. Using the stability class from Step 6 and the selected location, read chart on the "Key Isotope Data Record" to determine the diffusion factor for the selected location. Circle the diffusion factor to be used.

ISSUED

FEB 26 1987

IV. PROCEDURE (Continued)

11. b. Now calculate X/Q for the selected location using the following formula:

$$X/Q\ ({}^{sec}/_{M^3}) = \frac{(\text{Diffusion Factor})}{(\text{Wind Speed})(.447)}$$

12. Whole Body Dose Rate - A determination of specific isotopic concentrations must be made to determine the projected whole body dose rate.

a. Request that Chemistry obtain an air sample using a Gas Marinelli from RM-061 for a stack release or RM-057 for a primary to secondary release, and perform an isotopic analysis on the sample, using the applicable procedures.

b. Obtain Attachment D-2 "Whole Body Dose Rate Calculation Sheet". Obtain the isotopic concentration for each nuclide listed in Column I from the analysis report. Then record the required nuclide concentrations in Column II in Ci/m^3. NOTE: 1 $\mu Ci/cc$ = 1 Ci/m^3.

c. Calculate the radionuclide release by use of the following formula:

Radionuclide Release Rate (Ci/sec) = (Column II Concentrations) X (Stack Flow Rate/ or Main Steam Flow Rate) X (4.72E-04)

Record results in Column III.

d. Calculate the whole body dose rate factor for each isotope by use of the following formula:

Whole Body Dose Rate Factor = (Release Rates From Column III) X (Average Gamma Energy in Column IV)

Record results in Column V.

e. Determine the total whole body dose rate.factor by adding all values recorded in Column V. Record the total.

ISSUED

FEB 26 1987

IV. PROCEDURE (Continued)

f. Calculate the whole body dose rate for a selected location by use of the following formula:

Whole Body Dose Rate (mR/Hr)	=	(Total Whole Body Dose Rate Factor from From Step 12c) X (X/Q) X (9.0E+05)

Record results on the "Key Isotope Data Record" in mR/Hr.

13. Thyroid Dose Rate - A determination of specific isotopic concentrations must be made to determine the projected dose rate.

a. Request that Chemistry obtain an air sample using a charcoal cartridge from RM-060 and perform an isotopic analysis on the sample, using the applicable procedures. The sample should be collected for a time long enough to allow significant activity deposition.

b. Obtain Attachment D-3 "Thyroid Dose Rate Calculation Sheet". Obtain the isotopic concentration for each nuclide listed in Column I, from the analysis report. Then record the required nuclide concentrations in Column II, in Ci/m^3. NOTE: 1 $\mu Ci/cc$ = 1 Ci/m^3.

c. Calculate the radionuclide release by use of the following formula:

Radionuclide Release Rate (Ci/sec)	=	(Column II Concentrations) X (Stack Flow Rate) X (4.72E-04)

Record the results in Column III.

d. Calculate the thyroid dose rate factor for each isotope by use of the following formula:

Thyroid Dose Rate Factor	=	(Release Rate (From Column III)) X (Dose Conversion Factor (From Column IV))

Record the results in Column V.

e. Determine the total thyroid dose rate factor by adding all values recorded in Column V. Record the total.

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IV. PROCEDURE (Continued)

f. Calculate the thyroid dose rate for a selected location as follows:

1. For time intervals between 0 and 8 hours from the time of the accident use the following formula:

Thyroid Dose Rate (mR/Hr) = (Total Thyroid Dose Rate Factor From Step 13e) X (X/Q) X (1.25E+03)

2. For time intervals greater than 8 hours from the time of the accident use the following formula:

Thyroid Dose Rate (mR/Hr) = (Total Thyroid Dose Rate Factor From Step 13e) X (X/Q) X (8.35E+02)

Record the results on the "Key Isotope Data Record" in mR/Hr.

14. Lung Dose Rate - A determination of specific isotopic concentrations must be made to determine the projected lung dose rate.

a. Lung dose is not limiting unless thyroid blocking drugs have been administered or there is a long delay between the time of accident and the time of release, during which much of the iodine would have decayed.

b. Request that Chemistry obtain an air sample using a charcoal cartridge from RM-060 and perform isotopic analysis on the sample, using the applicable procedures. The sample should be collected for a time long enough to allow significant activity deposition.

c. Obtain Attachment D-4 "Lung Dose Rate Calculation Sheet". Obtain the isotopic concentration for each isotope listed in Column I, from the analysis report. Then record the required nuclide concentrations in Column II, in Ci/m^3.
NOTE: 1 $\mu Ci/cc$ = 1 Ci/m^3.

ISSUED

IV. PROCEDURE (Continued)

d. Calculate the radionuclide release by use of the following formula:

Radionuclide Release Rate (Ci/sec) = (Column II Concentration) X (Stack Flow Rate) X (4.72E-04)

Record the results in Column III.

e. Calculate the lung dose rate factor for each isotope by use of the following formula:

Lung Dose Rate Factor = (Release Rate) (Column III) X (Dose Conversion Factor) (Column IV)

Record the results in Column V.

f. Determine the total lung dose rate factor by adding all values in Column V. Record the total.

g. Calculate the lung dose rate for a selected location as follows:

1. For time intervals between 0 and 8 hours from the time of the accident use the following formula:

Lung Dose Rate (mR/Hr) = (Total Lung Dose Rate Factor) (Step 14f) X (X/Q) X (1.25E+03)

2. For time intervals greater than 8 hours from the time of the accident use the following formula:

Lung Dose Rate (mR/Hr) = (Total Lung Dose Rate Factor) (Step 14f) X (X/Q) X (8.35E+02)

Record the results on the "Key Isotope Data Record" in mR/Hr.

15. Projected Duration of Release - The Shift Supervisor or his designee must determine the projected duration of release. This information is required to calculate the projected total dose to a given area. Record this number in hours or a decimal notation for a fraction of an hour.

16. Total Projected Dose to a Selected Location - Multiply the actual dose rate (whole body, thyroid, or lung) by the projected duration of release (Step 15). Record the results on the key isotope data record and circle the appropriate units.

ISSUED

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IV. PROCEDURE (Continued)

17. Report Results to the Shift Supervisor or his designee - Much of the information that has been recorded will be used on required report forms which must be completed within 15 minutes of accident classification. Expedite the completion of this form in a clear and accurate manner. Then report this information to the Shift Supervisor or his designee.

18. Protective Action Recommendation - The Shift Supervisor or his designee will compare the total projected dose to a selected location (Step 16) to the Protective Action Guidelines at the end of the "Key Isotope Data Record". After determining the proper recommended actions he will relay the information to the appropriate offsite government agencies.

e. After completion of the "Key Isotope Data Record", standby to repeat the process using a new data sheet. Dose assessment must be completed until relieved or directed to stop by the Shift Supervisor or his designee.

ISSUED

ATTACHMENT D-1

KEY ISOTOPE DATA RECORD

	Circle Appropriate Answers or Units
1. Date and Time	______ / ______
2. Selected Location	Site Boundary / 2 Mi. / 5 Mi. / 10 Mi.
3. Present (or Average) Wind Speed	______ MPH
4. Present Wind Direction	______ DEGREES
5. Present Delta Temperature (ΔT)	______ DEGREES "C"
6. Stability Class (from chart at the end of this form)	A/B/C/D/E/F/G
7. Affected Sectors (from overlay map)	______
8. Present Stack Flow Rate	______ CFM
9. Present Main Steam Flow Rate (for primary/secondary release only refer to OI-PAP-8)	______ CFM

10. X/Q at Site Boundary
(from operations personnel or calculate using:)

$$X/Q = \frac{1.04E-4}{(\text{Wind Speed})(.447)}$$
(Step 3)

______ SEC/M³

11. X/Q for Downwind:

A. Use the following chart to determine the diffusion factor (Circle Diffusion Factor)

STABILITY CLASSES

	A	B	C	D	E	F	G
2 Mi.	5.53E-8	7.84E-7	5.80E-6	2.15E-5	4.35E-5	1.00E-4	2.28E-4
5 Mi.	2.55E-8	3.20E-8	1.20E-6	5.50E-6	1.24E-5	3.21E-5	7.38E-5
10 Mi.	1.40E-8	1.80E-8	3.95E-7	2.05E-6	5.50E-6	1.38E-5	3.33E-5

B. Calculate X/Q using:

$$\frac{\text{Diffusion Factor (Step 11.A.)}}{(\text{Wind Speed})(.447)}$$
(Step 3)

2mi = ______ SEC/M³

5mi = ______ SEC/M³

10mi = ______ SEC/M³

ISSUED

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ATTACHMENT D-1 (Continued)

KEY ISOTOPE DATA RECORD

Circle Appropriate Answers or Units

12. Whole Body Dose Rate

A. Request that Chemistry obtain a Marinelli sample from RM-061 (RM-057 for primary/secondary release) and perform an isotopic analysis.

B. Using Attachment D-2 "Whole Body Rate Calculation Sheet", record the required nuclide concentrations in Column II in Ci/M^3. NOTE: 1 µCi/cc = 1 Ci/m^3.

C. Calculate the radionuclide release (Column III) by using the following formula:

Radionuclide Release Rate (Ci/sec) = (Column II Concentrations) X (Stack Flow Rate or Main Steam Flow Rate Step 8 or 9) X (4.72E-04)

Record the results in Column III.

D. Calculate the whole body dose rate factor (Column V) for each isotope by use of the following formula:

Whole Body Dose Rate Factor = (Release Rates Column III) X (Average Gamma Energy Column IV)

Record the results in Column V.

E. Add all values recorded in Column V
W.B. Dose Rate Factor ____________

F. Calculate the whole body dose rate for a selected location:

1. Whole body dose rate =

(W.B. Dose Rate Factor Step 12.E.) X (X/Q) (Step 10 or 11) X (9.0E+5)

2. Record whole body dose rate for a selected location ____________ MR/HR

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ATTACHMENT D-1 (Continued)

KEY ISOTOPE DATA RECORD

Circle Appropriate Answers or Units

13. Thyroid Dose Rate

A. Request that Chemistry obtain a charcoal cartridge sample from RM-060 and perform an isotopic analysis.

B. Using Attachment D-3 "Thyroid Dose Rate Calculation Sheet", record the required nuclide concentration in Column II in Ci/M^3. NOTE: $1\ \mu Ci/cc = 1\ Ci/m^3$.

C. Calculate the radionuclide release (Column III) by using the following formula:

Radionuclide Release Rate (Ci/sec) = (Column II Concentrations) X (Stack Flow Rate) X (4.72E-4)
(Step 8)

Record the results in Column III.

D. Calculate the thyroid dose rate factor (Column V) for each isotope by use of the following formula:

Thyroid Dose = (Release Rate) X (Dose Conversion Factor Rate Factor)
(Column III) (Column IV)

E. Add all values recorded in Column V
Thyroid Dose Rate Factor ____________________

F. Calculate thyroid dose rate for a selected location:

1. For time intervals between 0 and 8 hours from the time of the accident use the following formula:

Thyroid Dose Rate (mR/Hr) = (Thyroid Dose Rate Factor) X (X/Q) X (1.25E+3)
(Step 13.E.) (Step 8)

2. For time intervals greater than 8 hours from the time of the accident use the following formula:

Thyroid Dose Rate (mR/Hr) = (Thyroid Dose Rate Factor) X (X/Q) X (8.35E+2)
(Step 13.E.) (Step 8)

3. Record thyroid dose rate for a selected location ____________ MR/HR

ISSUED

ATTACHMENT D-1 (Continued)

KEY ISOTOPE DATA RECORD

Circle Appropriate
Answers or Units

14. Lung Dose Rate

A. This calculation should be made if thyroid blocking agents have been issued or a long delay occurs between the time of the accident and the time of release.

B. Request that Chemistry obtain a charcoal cartridge sample from RM-060 and perform an isotopic analysis.

C. Using Attachment D-4 "Lung Dose Rate Calculation Sheet", record the required nuclide concentrations in Column II in Ci/M³. NOTE: 1 μCi/cc = 1 Ci/m³.

D. Calculate the radionuclide release (Column III) by use of the following formula:

Radionuclide Release Rate (Ci/sec) = (Column II Concentrations) X (Stack Flow Rate / Step 8) X (4.72E-4)

Record the results in Column III

E. Calculate the lung dose rate factor (Column V) for each isotope by use of the following formula:

Lung Dose Rate Factor = (Release Rate / Column III) X (Dose Conversion Factor / Column IV)

Record results in Column V

F. Add all values in Column V
Lung Dose Rate Factor ____________________

G. Calculate lung dose rate for a selected location:

1. For time intervals between 0 and 8 hours from the time of the accident use the following formula:

Lung Dose Rate (mR/Hr) = (Lung Dose Rate Factor / Step 14.F.) X (X/Q) (Step 8) X (1.25E+3)

ISSUED

ATTACHMENT D-1 (Continued)

KEY ISOTOPE DATA RECORD

Circle Appropriate Answers or Units

2. For time intervals greater than 8 hours from the time of the accident use the following formula:

Lung Dose Rate (mR/Hr) = (Lung Dose Rate Factor) (Step 14F) X (X/Q) (Step 8) X (8.35E+2)

3. Record lung dose rate for a select location ________ MR/HR

15. Projected Duration of Release (in hours, from Shift Supervisor) ________ HOURS

16. Total Projected Dose to a Selected Location (projected duration of release (Step 15) X actual dose rate (Step 12F, 13F, 14F)

MR	W.B.
	THYROID
R	LUNG

17. Report Results to Shift Supervisor

18. Protective Action Recommendation (Shift Supervisor Circle One)
If the total projected dose to a selected location (Step 16) is:

A. W.B. Dose < 1 REM Thyroid < 5 REM
NO PROTECTIVE ACTION REQUIRED

B. W.B. Dose > 1 REM < 5 REM Thyroid > 5 REM < 25 REM
SEEK SHELTER, CONSIDER EVACUATION

C. W.B. Dose > 5 REM Thyroid > 25 REM
CONDUCT EVACUATION

STABILITY CLASSES

T (°C)	CLASS
< 1.9	A
-1.9 to -1.7	B
-1.7 to -1.5	C
-1.5 to -0.5	D
-0.5 to 1.5	E
1.5 to 4.0	F
> 4.0	G

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ATTACHMENT D-2

WHOLE BODY DOSE RATE CALCULATION SHEET

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V
Radionuclide	Radionuclide Concentration Ci/m³	Radio-nuclide Release Ci/sec	Average Gamma Energy (Mev/dis)	Whole Body Dose Rate Factor
Kr-88			2.03 E+00	
I-131			3.92 E-01	
I-133			6.24 E-01	
I-135			1.56 E+00	
Te-132			2.31 E-01	
Xe-133			4.50 E-02	
Xe-135			2.62 E-01	
Cs-134			1.59 E+00	
Cs-137			5.36 E-01	

Total = ______________________

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ATTACHMENT D-3

THYROID DOSE RATE CALCULATION SHEET

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V
Radionuclide	Radionuclide Concentration Ci/m³	Radio-nuclide Release Ci/sec	Dose Conversion Factor Rem/Ci	Thyroid Dose Factor
I-131			1.4 E+06	
I-132			6.5 E+03	
I-133			1.8 E+05	
I-134			2.5 E+04	
I-135			4.4 E+04	
Te-132			9.7 E+04	

Total = ____________________

ISSUED

ATTACHMENT D-4

LUNG DOSE RATE CALCULATION SHEET

COLUMN I Radionuclide	COLUMN II Radionuclide Concentration Ci/m^3	COLUMN III Radio-nuclide Release Ci/sec	COLUMN IV Dose Conversion Factor Rem/Ci	COLUMN V Lung Dose Factor
I-131			2.4 E+06	
I-132			1.0 E+03	
I-133			3.1 E+03	
I-134			-	
I-135			2.5 E+03	
Ru-106			3.9 E+06	
Te-132			3.0 E+04	
Cs-134			5.1 E+04	
Cs-137			4.0 E+04	
Ce-144			–	

Total = ______________________

ISSUED

IV. PROCEDURE (Continued)

E. Section E - Assessment of Liquid Releases.

1. The Shift Supervisor or his designee, upon receipt of an alert or alarm indication on RM-055/055A, or noting an uncontrolled release of a monitor tank to the river, shall assign an individual to perform dose assessment. This will normally be the Shift Chemist. The Shift HP will be used as his/her alternate.

2. The person assigned to dose assessment will perform dose assessment determinations until relieved or directed to stop by the Shift Supervisor or his designee. Dose assessment will be completed in accordance with the following:

   a. Obtain the "Dose Assessment Forms Booklet" from the Control Room Emergency Gear Locker.

   b. Obtain Attachment E-1 "Liquid Release Data Record" from the Dose Assessment Forms Booklet. Collect and record the following data:

      1. Date and Time

      2. Tank Release Rate - Obtain from operations personnel in the Control Room. This must be in gallons per minute. Record tank release rate.

      3. Missouri River Flow Rate and Speed - Contact the Corps of Engineers (phone 221-3020). Record flow rate in cubic feet per second (CFS) and speed in miles per hour (MPH).

      4. Determine if RM-055/055A are functioning. Collect and record the following data:

         a. If RM-055/055A are functioning collect and record the following data:

            1. RM-055/055A Net Counts Per Minute (NCPM) - Read meter, subtract background listed in the Technical Data Book to obtain NCPM. Record the net counts per minute.

            2. Obtain graph, Attachment E-2 for RM-055 or Attachment E-3 for RM-055A. Locate present release rate on the left side of the graph.

            3. Locate NCPM level at the lower part of the graph. Plot upward until you intersect with the release value from Step 2.

            4. Locate the nearest diagonal line above your point of intersection. Plot up or down that diagonal line until it intersects present river flow rate (shown on right side of graph).

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IV. PROCEDURE (Continued)

5. At that point of intersection, plot straight upward to the indicated total gamma specific activity at the M.U.D. intake. Record this value on the "Liquid Release Data Record" in μCi/ml.

6. Record the activity in the P.A.G. chart at the bottom of the "Liquid Release Data Record".

b. If RM-055/055A are NOT functioning, collect and record the following data:

1. Obtain tank total specific gamma activity from the latest Liquid Release Permit in the Control Room. The chemistry group may have to obtain an isotopic analysis to determine this data. Record this activity.

2. Obtain graph, Attachment E-2 only as it will provide more conservative results. Locate present release rate on the left side of the graph.

3. Locate total tank specific gamma activity on the lower part of the graph, and plot upward until you intersect with the release rate value found above.

4. Locate the nearest diagonal line above your point of intersection. Plot up or down that diagonal line until it intersects present river flow rate (shown on right side of graph).

5. At that point of intersection plot straight upward to the indicated total gamma specific activity at M.U.D. Record this data on the "Liquid Release Data Record" in μc/ml.

6. Record the activity in the P.A.G. chart at the bottom of the "Liquid Release Data Record".

c. Protective actions (Shift Supervisor or his designee) -

1. Using the total activity calculated above, multiply by the isotope distribution factors shown in Column II of the P.A.G. chart for each radionuclide.

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IV. PROCEDURE (Continued)

2. Record results in Column III.

3. Compare the results with the EPA standards liste in Column IV. If any of the calculated values are equal to or greater than these values, notify M.U.D. (phone 554-7946) and the State of Nebraska (phone 1-473-1721) immediately for appropriate protective actions.

d. After completing the "Liquid Release Data Record" standby to repeat the process using new data sheets. Terminate procedure when directed to do so by the Shift Supervisor or his designee.

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RM-055

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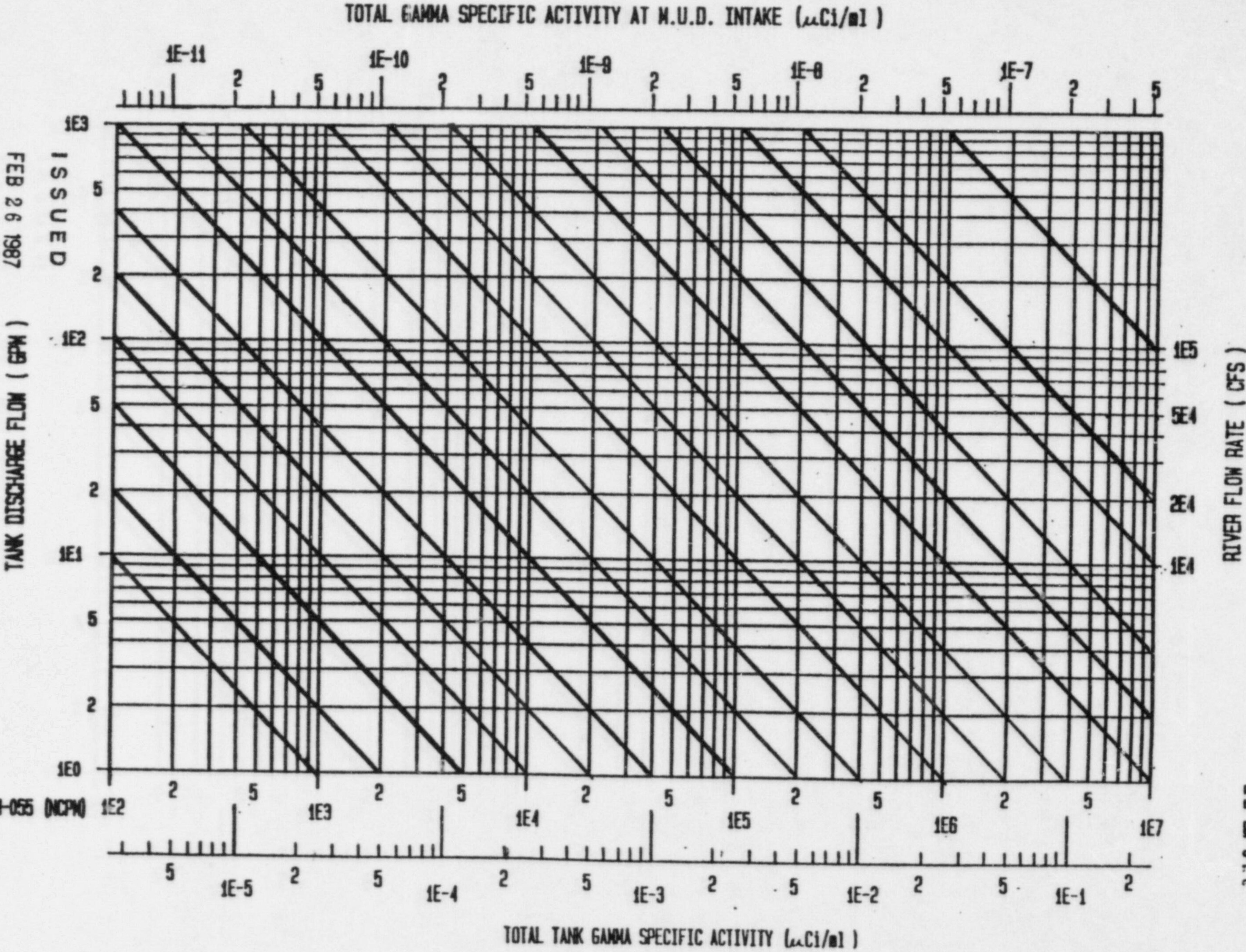

R10 02-26-87

ATTACHMENT #E-2
EPIP-EOF-6

RM-055A

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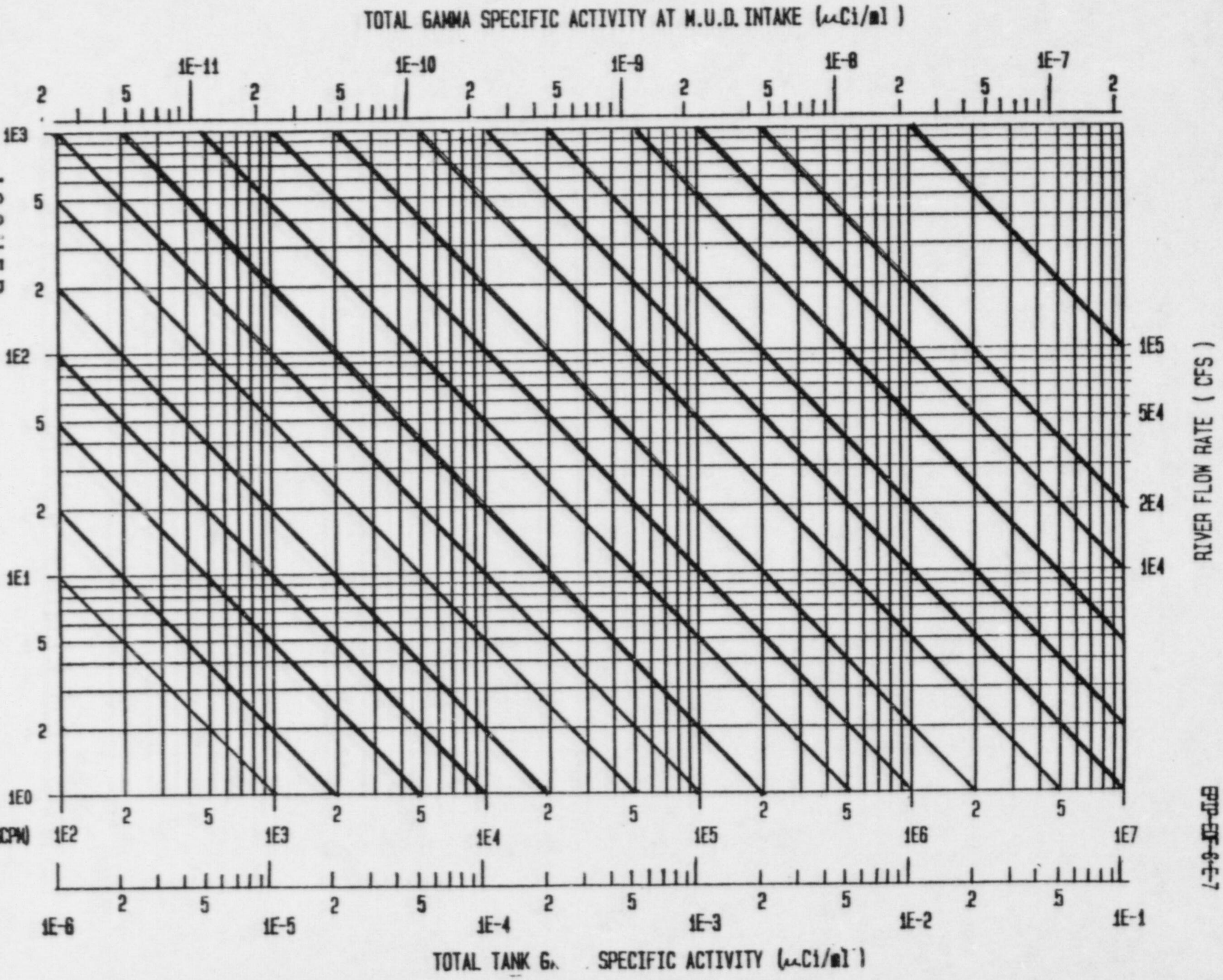

R10 02-26-87

ATTACHMENT #E-3
EPIP-EOF-6-E-7

ATTACHMENT E-1

LIQUID RELEASE DATA RECORD

	Circle Appropriate Answers or Units
1. Date and Time	______ / ______
2. Tank Release Rate (from control room)	______ GPM
3. Missouri River Flow Rate and Speed (from Corps. of Engineers, phone 221-3020)	______ CFS ______ MPH

4. A. RM-055 or RM-055A Functioning:

1. RM-055 or RM-055A NCPM (from control room). (Gross CPM minus background CPM from Technical Data Book). ______ NCPM

2. Using Attachment E-2 for RM-055 or Attachment E-3 for RM-055A, locate the tank release rate on left side of graph.

3. Plot straight over until release rate intersects with monitor reading in NCPM (located on lower part of graph).

4. Follow nearest higher diagonal line either up or down to intersect present river flow rate (shown on right side of graph).

5. At that intersect, plot straight up to indicated activity at M.U.D. intake. ______ μCi/ml

6. Record activity in P.A.G. chart below, Column I.

B. RM-055 or RM-055A Not Functioning:

1. Obtain tank gamma specific activity from the latest Liquid Release Permit in the control room. ______ μCi/ml

2. Using Attachment E-2 only, locate tank release rate on left side of graph.

3. Plot straight over until release rate intersects with tank specific activity (located at lower part of graph).

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ATTACHMENT E-1 (Continued)

LIQUID RELEASE DATA RECORD

Circle Appropriate Answers or Units

4. Follow nearest higher diagonal line either up or down to intersect present river flow rate (shown on right side of graph).

5. At that intersect, plot straight up to indicated activity at M.U.D. intake. ______ μCi/ml

6. Record activity in P.A.G. chart below, Column I.

5. Protective Action Determination

Radionuclide	Column I Total Activity	Column II Isotope Distrib. Factor	Column III Projected Activity at MUD Col. I X Col. II	Column IV E.P.A. Standards (μCi/ml)
I-131		0.15		3.0E-09
CS-134		0.45		2.0E-05
CS-137		0.10		2.0E-07
CO-60		0.30		1.0E-07
H-3		0.70		2.0E-05

A. Multiply Column I value times each Column II value, record in Column III.

B. If Column III value is equal to or greater than Column IV, call M.U.D. [redacted] and State of Nebraska [redacted] and recommend protective actions to be taken. The protective action would be to terminate intake of Missouri River water at the Florence Station.

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[redacted]

IV. PROCEDURE (Continued)

F. Section F - Determination of actual offsite dose rates and verification of activity release rates by utilizing information from the Onsite and/or Offsite Monitor Teams.

1. The HP/Chemistry Supervisor or the Emergency Coordinator shall designate someone to complete the following steps to find the actual offsite dose rates.

2. Obtain the whole body dose rate from the monitor team for direct radiation dose rate measurements and enter in Attachment F-1.

3. Calculate actual thyroid dose rate for selected locations as follows:

$$\text{Actual Thyroid Dose Rate (mRem/Hr)} = 1.55E{+}09 \times \underset{X^*}{\underline{\qquad\qquad}}\ \mu Ci/_{cc}$$

4. Record actual dose rates on Attachment F-1.

5. Report the data recorded on Attachment F-1 to the HP/Chemistry Supervisor or Emergency Coordinator for his review and then update the Status Board.

6. If the actual dose rates are higher than the predicted dose rates, the HP/Chemistry Supervisor or the Emergency Coordinator shall review the current recommended protective actions and revise them as necessary.

7. Protective Action Guidelines

A. W.B. Dose < 1 REM Thyroid < 5 REM

NO PROTECTIVE ACTION REQUIRED

B. W.B. Dose > 1 REM < 5 REM Thyroid > 5 REM < 25 REM

SEEK SHELTER, CONSIDER EVACUATION

C. W.B. Dose > 5 REM Thyroid > 25 REM

CONDUCT EVACUATION

*X = Specific activity supplied by monitor team (in µCi/cc).

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ATTACHMENT F-1

ONSITE/OFFSITE DOSE RATES: PREDICTED-ACTUAL

				DOSE RATES (MR/HR)			
				PREDICTED		ACTUAL	
DATE	TIME	LOCATION	DISTANCE	W.B.	THYROID	W.B.	THYROID

REMARKS: ____

____

____

____

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IV. PROCEDURE (Continued)

G. Section G - Whole Body Dose Determination from Contamination Released Through the Plant Ventilation Stack.

1. The Shift Supervisor or his designee, upon receiving an alert or alarm indication on RM-061, shall assign the Shift Chemist to perform dose assessment. The Shift HP will be used as the alternate.

2. The person assigned to dose assessment will perform dose assessment determinations until relieved or directed to stop by the Shift Supervisor or his designee. Dose assessment will be completed in accordance with the following:

a. Obtain the "Dose Assessment Forms Booklet" from the control room emergency gear locker.

b. Obtain Attachment G-1, "Contamination and Whole Body Dose Rate Data Record", from the Dose Assessment Forms Booklet. Collect and record the following data:

1. Date and Time

2. Selected Location - Using Attachment G-2, find the affected sector and determine the selected downwind location for the calculation being performed.

3. Present Wind Direction - Wind direction meter is located on the north wall of the Control Room above the fire control and alarm panels (AI-184), or obtain wind direction from the Plant Computer by requesting information from operations personnel. Record wind direction; use the estimated average if the reading is unstable.

NOTE: This is the direction that the wind is coming from.

4. Stack Flow Rate - Stack flow rate meter is located behind the control panel on AI-44. The meter number is FR-758. Meter reading is in standard cubic feet per minute (SCFM) times one thousand. Convert this value to M^3/sec using the following conversion:

(Stack Flow Rate) X (4.72E-04) = Stack Flow Rate in M^3/sec

5. Relative Deposition Factor (D/Q) - Determine the relative deposition factor for the selected downwind location (Step 2) by using Attachment G-2, "Relative Deposition Factors", the wind direction (Step 3), and the selected location.

NOTE: If the selected downwind location is between two of the listed distances, use the next SMALLER distance.

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IV. PROCEDURE (Continued)

6. Projected Duration of Release - The Shift Supervisor or his designee must determine the projected duration of release. This information is required to calculate the projected total dose to a given area. Record this number in seconds.

7. Request that Chemistry obtain a particulate air sample from RM-061, RM-060, or RM-063 (if RM-061 and RM-060 are unavailable) and perform an isotopic analysis on the sample, using the applicable procedures.

   A. Record the required radionuclide concentrations (in μc/cc) in Column II.

   B. Calculate the radionuclide release rates by use of the following formula:

Radionuclide Release Rate (Ci/sec) = (Column II Values) X (Stack Flow Rate Step 4)

Record the results in Column III in Ci/sec.

   C. Calculate the contamination deposition by use of the following formula:

Contamination Deposition (Ci/M^2) = (Column III Values) X (D/Q Step 5) X (Release Duration Step 6)

Record the results in Column IV in Ci/M^2.

   D. Calculate the whole body dose rate for each nuclide by use of the following formula:

W.B. Dose Rate For Each Nuclide (R/Hr) = (Column IV Values) X (Dose Conversion Factor Column V Values)

Record the results in Column VI in mR/Hr.

8. Total the values recorded in Column VI and record the total at the bottom of Attachment G-1.

9. Total Projected Dose to a Selected Location - Multiply the total whole body dose rate (Step 12) by the projected duration of release (Step 6). Record the results on the "Contamination and Whole Body Dose Rate Data Record" and circle the appropriate units.

10. Compare the total projected dose to a selected location to the "Protective Action Guidelines" at the top of Attachment G-2.

IV. PROCEDURE (Continued)

c. Report the results to the Shift Supervisor, H.P./Chemistry Supervisor, or the Emergency Coordinator if the EOF is activated.

d. Standby to repeat this procedure as required.

ISSUED

FEB [illegible] 'ᴂ'

ATTACHMENT G-1
CONTAMINATION AND WHOLE BODY DOSE RATE DATA RECORD

Circle Appropriate Answers or Units

1. Date and Time ______ / ______
2. Selected Location ______ / ______
   Sector Distance
3. Present Wind Direction ______ DEGREES
4. Stack Flow Rate (Stack Flow Rate SCFM) X (4.72E-04) = ______ M^3/Sec
5. Relative Deposition Factor (D/Q) ______ M^{-2}
   (Use Attachment G-2, Wind Direction, and Selected Location)
6. Projected Duration of Release (from Shift Supervisor) ______ SEC
7. Request that Chemistry obtain particulate air sample from RM-061, RM-060, or RM-063.

I	(Step A) II	(Step B) III	(Step C) IV	V	(Step D) VI
Radionuclide	Isotopic Analysis (µc/cc)	Release Rate (Ci/sec)	Contamination Deposition (Ci/M^2)	Dose Conversion Factor	Whole Body Dose Rate (R/Hr)
	RM-061/RM-060 RM-063*	(Column II)X (Stack Flow Rate)	(Column III)X(D/Q)X (Release Duration)		(Column IV)X (Column V)
Mn-54				5.8	
Co-60				1.7E+01	
Sr-89				5.6E-04	
I-131				2.8	
I-133				3.7	
I-135				1.2E+01	
Cs-134				1.2E+01	
Cs-137				4.2	
Ba-140				2.1	
La-140				1.5E+01	

8. Total W.B. Dose Rate (Total of Column VI) ______ R/HR
9. Total Projected Dose to a Selected Location
   (Step 8 Result)(Projected duration of release-Step 6) ÷ 3600 ______ REM
10. Compare the total projected dose to a selected location to the Protective Action Guidelines at the top of Attachment G-2. Report to Shift Supervisor.

*Use only if RM-060 and RM-061 are not available.

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ATTACHMENT #G-2

RELATIVE DEPOSITION FACTORS

and

PROTECTIVE ACTION RECOMMENDATIONS

PROTECTIVE ACTION RECOMMENDATIONS

< 1Rem Whole Body Dose
No Protective Action Required

> 1Rem But < 5Rem Whole Body Dose
Seek Shelter, Consider Evacuation

> 5Rem Whole Body Dose
Conduct Evacuation

Relative Deposition Factors (m^{-2})

Wind Direction (Degrees)	Affected Sector	0.50 Mile	1.50 Mile	2.50 Mile	3.50 Mile	4.50 Mile	7.50 Mile	15.0 Mile	25.0 Mile	35.0 Mile	45.0 Mile
169 - 191	A	6.7E-08	5.9E-09	1.7E-09	7.6E-10	4.5E-10	1.6E-10	5.3E-11	1.9E-11	1.1E-11	6.6E-12
191 - 214	B	5.2E-08	4.6E-09	1.3E-09	5.9E-10	3.5E-10	1.2E-10	4.1E-11	1.5E-11	8.2E-12	5.1E-12
214 - 236	C	3.3E-08	2.9E-09	8.4E-10	3.8E-10	2.2E-10	7.9E-11	2.6E-11	9.5E-12	5.2E-12	3.[illegible]E-12
236 - 259	D	2.5E-08	2.2E-08	6.2E-10	2.8E-10	1.6E-10	5.8E-11	1.9E-11	7.0E-12	[illegible]	2.4E-12
259 - 281	E	2.9E-08	2.6E-09	7.4E-10	3.3E-10	2.0E-10	6.9E-11	2.3E-11	8.3E-12	4.6E-12	2.9E-12
281 - 304	F	5.9E-08	5.2E-09	1.5E-09	6.7E-10	3.9E-10	1.4E-10	4.6E-11	1.7E-11	9.2E-12	5.6E-12
304 - 326	G	8.8E-08	7.7E-09	2.2E-09	1.0E-9	5.9E-10	2.1E-10	6.9E-11	2.5E-11	1.4E-11	8.6E-12
326 - 349	H	7.5E-08	6.6E-09	1.9E-09	8.5E-10	5.0E-10	1.8E-10	5.9E-11	2.2E-11	1.2E-11	7.4E-12
349 - 11	J	7.1E-08	6.3E-09	1.8E-09	8.1E-10	4.8E-10	1.7E-10	5.6E-11	2.0E-11	1.1E-11	7.0E-12
11 - 34	K	3.7E-08	3.3E-09	9.4E-10	4.2E-10	2.5E-10	8.8E-11	2.9E-11	1.1E-11	5.8E-12	3.6E-12
34 - 56	L	1.9E-08	1.7E-09	4.8E-10	2.2E-10	1.3E-10	4.5E-11	1.5E-11	5.5E-12	3.0E-12	1.9E-12
56 - 79	M	1.8E-08	1.6E-09	4.5E-10	2.0E-10	1.2E-10	4.2-11	1.4E-11	5.1E-12	2.8E-12	1.7E-12
79 - 101	N	2.1E-08	1.9E-09	5.4E-10	2.4E-10	1.4E-10	5.1E-11	1.7E-11	6.2E-12	3.4E-12	2.1E-12
101 - 124	P	4.0E-08	3.5E-09	1.0E-09	4.5E-10	2.7E-10	9.5E-11	3.1E-11	1.1E-11	6.3E-12	3.9E-12
124 - 146	Q	7.0E-08	6.1E-09	1.8E-09	7.9E-10	4.7E-10	1.7E-10	5.5E-11	2.0E-11	1.1E-11	6.9E-12
146 - 169	R	6.6E-08	5.8E-09	1.7E-09	7.5E-10	4.5E-10	1.6E-10	5.2E-11	1.9E-11	1.0E-11	6.5E-12

IV. PROCEDURE (Continued)

H. Section H - Onsite and Offsite Dose Assessment Using the Computerized Program.

1. Purpose

This procedure establishes step by step instructions for the operation of the Tektronix-CX-4107A computer terminal and the GE-TermiNet printers. The Tektronix is used to execute the Emergency Assessment of Gaseous and Liquid Effluents (EAGLE) computer program while the TermiNets are used to make hardcopies of EAGLE's results. The computer program is the preferred method for performing dose assessment, with other methods intended as alternate and backup methods.

2. Prerequisites

a. Emergency classification has been initiated per EPIP-OSC-1.

b. The Emergency Plan has been activated per EPIP-OSC-2.

c. Post Accident Procedure OI-PAP-7 is available.

d. The Technical Data Book is available.

e. The Tektronix terminal, GE TermiNet printer, and all associated equipment are available in the TSC and EOF dose assessment areas and hooked up as diagrammed in Figure H-1.

f. The appropriate form must be filled out for each plume with meteorological data and appropriate radiological data.

3. Precautions

a. Always use the lowest level winds and differential temperature data as input to the program.

b. Use the 10 meter temperature value as ambient temperature. Effluents exit temperatures should remain at their default values.

c. Update and perform the dose assessments every fifteen (15) minutes.

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IV. PROCEDURE (Continued)

4. Limitations and Actions

a. If the VM/CMS is down or communication with the computer via the Tektronix terminal cannot be established, the "Onsite and Offsite Dose Assessment" can be performed by using other sections of EPIP-EOF-6.

b. Dose calculations cannot be performed on both terminals (one in the TSC and one in the EOF) concurrently. The program must be ended by one party (TSC or EOF) on a given plume before the next party (TSC or EOF) can start calculation on the next plume.

Tabular and Graphics displays for previous plumes can, however, be executed by a second party while the first party is performing calculations on the current 15 minute plume.

c. The dose calculations have to be ended on the current 15 minute plume before switching to the tabular and/or graphics displays menu for additional data on the current plume.

5. Procedure

A. Running EAGLE on VM/CMS (Preferred Method)

1. Entering the Computer System

The accessibility between the VM/CMS and the Tektronix terminal is provided via 3274 61-C controllers. The log-on and program calculations consist of the following steps:

a. Turn Tektronix terminal on, you will be on MVS.

b. Enter the following command and hit <ENTER> to access VM/CMS: "VMg"

c. Press the <ENTER> key to clear the screen then log-on to VM/CMS as follows:

At TSC: "L TSC TSC"

At EOF: "L EOF EOF"

NOTE: Screens providing system user's information will show up. Page through these screens by pressing the <CLEAR> key until the screen asking "Is this an emergency?" appears.

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IV. PROCEDURE (Continued)

d. Enter in "YES" and press the <ENTER> key when asked if this is an Emergency.

e. Enter in "EAGLE" after the prompt (R;) and press <ENTER>.

f. The program will prompt you to the following menu indices on the screen:

MENU

EMERGENCY ASSESSMENT OF GASEOUS AND LIQUID EFFLUENTS
EAGLE

1. ATMOSPHERIC DIFFUSION AND DOSE CALCULATIONS
2. TABULAR DISPLAYS OF MODEL RESULTS
3. EXIT

---

g. Enter in "1" and press the <ENTER> key to start the program. The menus within the program will guide you to various options that are available for diffusion and dos calculations.

NOTE 1: If you incorrectly make an entry but have not pressed the <ENTER> key, you can use the < <--------> key to go back and make the correct entry.

NOTE 2: If you incorrectly make an entry and have pressed the <ENTER> key, then continue to make entries. The next page displayed will be a summary of the entries you made on the previous page. By entering "NO" and hitting <ENTER> EAGLE will re-ask for those entries.

NOTE 3: If you should accept a summary page that does contain a wrong entry, then continue to make entries, enter "N" and hit <ENTER> when EAGLE asks if you wish to distribute a page of output and then end calculation as stated in Step i. You can now go back to Step g and re-run that plume.

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IV. PROCEDURE (Continued)

h. When a page of output is completed, EAGLE will ask if you wish to distribute that page. By entering a "Y" and pressing <ENTER> (or by just hitting <ENTER>) that page of output will be printed out at each of the TermiNet locations.

i. After completing your entries for Recommended Offsite Protective Actions, the following message will appear:

COMMENTS

If you do not wish to send any additional comments, hit <ENTER>. If, however, you do wish to send out some additional comments, skip a space (you may not use the first column) and type in those comments. When you are ready to type on the next line, hit <ENTER>, skip a space, and continue. After you complete your last line of comments, hit <ENTER> twice to continue with EAGLE.

j. End the program for "Atmospheric Diffusion and Dose Calculations" by entering "END" and hitting <ENTER> at the end of a given plume. This will prompt you to the menu indices shown in Step f. Enter a "2" and hit <ENTER> to see the tabular displays.

NOTE: Tabular displays can be exited by following instructions on the screen for Tabular Display Menu.

2. Leaving the Computer System (VM/CMS)

It is important to log-off the system when you are finished. When you get to the menu indices shown in step f, enter a "3" and hit <ENTER>. When the prompt (R;) appears, enter "LOGOFF" and hit <ENTER>.

IMPORTANT NOTE: Should problems occur which are not covered in this procedure, go to the trouble shooting section at the end of this procedure for further assistance.

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IV. PROCEDURE (Continued)

B. Terminet Printers

The Terminet printers are used to produce a hardcopy of EAGLE's results. There are Terminet printers located at the TSC, EOF, and three state locations (one in Nebr. and two in Iowa). When EAGLE is prompted to distribute a page of output, all printers will simultaneously print that page within a matter of seconds.

1. Initial Setup of G.E. TermiNet Printer

a. On the left keypad the only key that should be pressed in is the <ALL CAPS> button.

b. Set the right-hand upper switch to FULL.

c. Set the right-hand lower switch to 120.

d. Make sure that the wiring setup is in accordance with Figure 1.

e. The modem buttons should be in the following positions:

AL-out, ST-out, RDL-out, HS-in, TK/DT-in

2. Operation of G.E. TermiNet Printer

a. Turn on TermiNet printer; power switch located on back of machine.

NOTE: If INTERRUPT light goes on it usually indicates that you're out of paper or print head is pulled away from the paper.

b. Dial the appropriate phone number for the following Terminet locations:

TSC-4049

EOF-4050

c. Upon hearing data tone:

1. Press modem TK/DT button to "out" position.

2. Hang up phone.

d. When you get connected to the system, an OPPD banner will be displayed. If the banner does not appear, press <RETURN>.

IV. PROCEDURE (Continued)

e. Press <ESC> key. Press <CTL> button, hold it down, and press the <E> key. The following message should appear.

< <LINE NUMBER SUPPRESSED> >

NOTE: If a < <LINE NUMBER PRINTED> > appears instead or if at some time when using the TermiNet lines of arrows (<- <- <- <- <-) should start appearing, then try Step e again.

f. Press <ESC> key. Press the <CTL> button, hold it down, and press the <D> key. The following message should appear:

<< TIME OUT FACTOR IS 3 MIN, ENTER MULTIPLIER X 3 MIN>>
<< X=Ø - NO TIME OUT, X=D - DISCONNECT IMMEDIATELY >>

g. Enter a "0" (zero) and press <RETURN>.

You should now get the following message:

"ENTER ONE OF THE FOLLOWING COMMANDS"

followed by some command examples.

h. Enter the following log-on and then press <RETURN>:

At TSC - "L EAGLE5 TSCPRT"

At EOF - "L EAGLE6 EOFPRT"

Some messages will now appear which are intended for OPPD computer users. After a few lines of messages, a "MORE..." message will appear on the right side. Anytime a "MORE..." appears, do the following:

1. Press the <ESC> key and then the <X> key.

NOTE: Should you hit <RETURN> instead of performing 1. (above), you will get a "HOLDING" message. Anytime you get a "HOLDING" message, hit <RETURN>, which will give you back a "MORE..." message, and then perform 1. (above).

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IV. PROCEDURE (Continued)

i. After the messages to the computer users are completed, the following message should appear which indicates you're logged-on and in "monitor" mode:

<<<WAITING FOR DATA EAGLE.>>>

-PRESS THE 'RETURN' KEY, TWICE, TO LOGOFF.

-TYPE 'REPRINT' AND PRESS THE 'RETURN'

KEY TO REPRINT THE LAST TABLE

RECEIVED, IF ANY.

NOTE: If you do not get this message but get a RECONNECTED message instead, erter a "B" and hit <RETURN>. You will receive a

RUNNING
VM READ   or   RUNNING

over on the right-hand side of the paper. Press <RETURN> and either a page of output will print out or another VM READ message will appear. If you get the VM READ message, enter REPRINT, hit <RETURN>, and the last page of output you received will be printed as well as the WAITING FOR DATA" message.

j. When a page of output from EAGLE is sent out, the following message will appear:

RUNNING

POSITION THE RIBBON OF THE PAPER CRT AT THE TOP OF A NEW PAGE. PRESS THE RETURN KEY TO PRINT OUT A PAGE.

Position paper and hit <RETURN>. The page of output will be printed followed by the "WAITING FOR DATA" message (Step i). The printer will wait in a "sleep" mode until another page of output is sent out indicated by the "POSITION THE RIBBON" message.

NOTE: If you should press <RETURN> after the "WAITING FOR DATA" message appears but there is no output ready to be printed, a "VM READ" or "CP READ" will appear. Enter "REPRINT", hit <RETURN>, and the "WAITING FOR DATA" message will appear. Wait until "POSITION THE RIBBON" message appears.

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IV. PROCEDURE (Continued)

k. To logoff system, press <RETURN> a few times until the OPPD banner again appears.

l. Press modem TK/DT button to "in" position.

m. Turn TermiNet printer off.

Additional Notes

1. Should problems occur, hit the <RETURN> key 2 or 3 times to log-off and then one more time to get the OPPD banner. Go back and start again at Step 2.e. If you cannot log-off by hitting <RETURN> 2 or 3 times, turn off the power and start over at step 1.

NOTE: If you turn off the power and start again you will get a "RECONNECTED" message.

2. To advance paper a single space at a time, depress <LF> key. To advance fast forward, set right hand upper switch to "Inhibit Send" (or "Local") and depress <RPT> and <LF> keys simultaneously. Return right-hand upper switch to "FULL" for normal operation.

3. If the upper right-hand switch is set at "Inhibit Send" (or "Local") or if the TermiNet is not in "monitor" mode, the pages of output from EAGLE will not be printed. However, when the upper right-hand switch is set to FULL or the TermiNet put into "monitor" mode, all those pages of output will then be printed out.

4. If any problems come up which are not covered in this section proceed to next section.

C. Troubleshooting Dose Assessment Computer Hardware/Software

1. Checkout of G.E. TermiNet Printers

a. Setup

1) Go back to Section 1 and make sure setup is correct.

b. Network Problems

1) If any problems are encountered when dialing-up to get the printer online (i.e., busy signal, ring but no answer, or an answer but no carrier signal [tone]) proceed to Part 2 of this procedure and report the problem.

ISSUED

IV. PROCEDURE (Continued)

c. Printer Problems

1) If you do get a carrier signal but still experience problems:

a. Turn off printer.

b. Lift cover and move print head to center of page.

c. Turn on printer. If the printhead does not move and position itself to the left hand side of the printer, proceed to Part 2 of this procedure and report the problem.

NOTE: When you turn the printer on, the power and motor lights should be the only ones on.

If the interrupt alarm light is on:

1. Lift cover and check that:

a) Run/Load lever is forward.

b) Paper is properly feeding through printer.

2. If interrupt light is still on, proceed to Part 2 of this procedure and report problem. If light is not on:

a) Press in the [LOCAL] button located on the left of the printer.

b) Type on keyboard.

c) If printer fails to print what you are typing, proceed to Part 2 of this procedure and report the problem.

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IV. PROCEDURE (Continued)

d. Modem Problems

If after performing all the previous steps you still have problems, perform the following:

1) Call Rixon at (301) 622-1333 and ask the modem coordinator to call back into the data phone (the phone connected to the Rixon modem) for related checkout.

NOTE: Rixon checkout service is available 8:00 a.m.-5:00 p.m. Monday-Friday.

2) If there is a modem problem or there is no modem problem but the printer still isn't working properly, proceed to Part 2 of this procedure and report the problem.

2. Reporting of Problems

a. When any problems with the dose assessment computer hardware/software occur, do the following:

1) Call the Information Center at 4224 or 4324 and inform the person answering that you are having problems with EAGLE. Then proceed to state your name, location and the nature of the problem.

NOTE: Be sure to use the word "EAGLE" which will help the person answering in identifying the problem area.

METEOROLOGICAL AND RADIOLOGICAL DATA WORKSHEET

TIME ______ : ______ DATE: ______________ , 19 ______
(HR:MIN)

PLUME NO. __________

I METEOROLOGICAL DATA

1. Stack flow rate________cfm
2. Condenser off gas flow rate *________cfm*
   RMO-057 ONLY
3. Set.Steam Flow ________ lbm/hr
   RMO-064 ONLY
4. Wind speed at 10 meters_______MPH
5. Wind direction from__________°
6. Ambient temperature at 10 meters______(°C/°F)
7. Temperature difference (ΔT)_______(°C @ 100m)

* 1. 1585 cfm X No. of vacuum pumps(in hogging mode).
2. 15 cfm X No. of vacuum pumps (in Normal operations).

II RADIOLOGICAL DATA

1. RM-062______________gcpm
2. RM-060______________gcpm
3. RM-061______________gcpm
4. RM-063______________ gcpm
   (Circle: L, M, or H)
5. RM-063 FILTER______________ mr/hr__________mr/hr Bkg
6. RM-057______________gcpm
7. RM-064______________cpm
8. Containment Monitor Reading______R/hr

III STABILITY CLASSES

ΔT (°C)	CLASS
ΔT≤-1.9	A
-1.9<ΔT≤-1.7	B
-1.7<ΔT≤-1.5	C
-1.5<ΔT≤-0.5	D
-0.5<ΔT≤ 1.5	E
1.5<ΔT≤ 4.0	F
4.0<ΔT	G

IV RADIOLOGICAL RELEASE DATA

SAMPLE

RM-062 - NOBLE GAS (STACK)

Q = ____________cfm × (ncpm) / (Sensitivity Factor*) X 4.72E-04
STACK FLOW RATE

RELEASE RATE (Q) = ________________Ci/sec

* cpm / μCi/cc

RM-060 - IODINE (STACK)

Sample Volume (cc) = [RM-060 flow rate (cfm)*] × [Time cartridge in service (min)] × [28,317 (cc/ft3)]

= ________________cc

* The average flow rate for RM-060 is approximately 2.3 cfm.

Q = ____________cfm × (ncpm) / (Sensitivity Factor* X__________cc) X 4.72E-04
STACK FLOW RATE — Sampl.Vol.

RELEASE RATE (Q) = ________________Ci/sec

* cpm/μCi

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RM-061 - PARTICULATE

Sample Volume (cc) = [RM-061 flow rate (cfm)*] x [(Sample collection time (min)] x [28,317 (cc/ft3)]

= ____________ cc

* The average flow rate for RM-061 is approximately 7 cfm.

Q = ________ cfm x [________ ________ ncpm] x 4.72E-04
STACK FLOW RATE   [4.56E + 05 cpm/µCi (1) x ________ cc (SAMPLE VOLUME)]

RELEASE RATE (Q) = ____________ Ci/sec

RM-063 - (L,M, OR H) - Noble Gas(STACK)

Q = ________ cfm x (ncpm) / (Sensitivity Factor*) X 4.72E-04 X 2.31
STACK FLOW RATE

RELEASE RATE (Q) = ____________ Ci/sec

* cpm / µCi/cc

RM-063 ACCIDENT FILTER DOSE RATE

1. Sampling Vol.(cc)=(RM-063 or H flow rate 500 cc/min) X (Sampl.Time Min.) = ________ cc
2. Net Filter Activity = 0.7027 uCi/mr/hr X Net Filter Dose Rate (mr/hr) = ________ µCi

Q = ________ cfm x [Net Filter Activity (uCi)] / [Sampling Volume (cc)] X 4.72E-04
STACK FLOW RATE

RELEASE RATE (Q) = ____________ Ci/sec

SAMPLE

RM-057 - Noble Gas (Cdsr Off-gas)

Q = ________ cfm x (ncpm) / (Sensitivity Factor*) X 4.72E-04
CONDENSER OFF GAS FLOW RATE

RELEASE RATE (Q) = ____________ Ci/sec

* cpm / µCi/cc

RM-064 - Noble Gas (Main Steam)

Steam Flow Rate = ________ lbm/hr (From OI-PAP-8)

Q = ________ blm/hr x (cpm) / (Sensitivity Factor*) X 2.11e-04
STEAM FLOW RATE

RELEASE RATE (Q) = ____________ Ci/sec

* cpm / µCi/cc

---

(1) OBTAIN THE MONITOR SENSITIVITY FACTOR FROM THE TECHNICAL DATA BOOK

(2) SENSITIVITY FACTOR FOR RM-063M = 2.9E+03 cpm/µCi/cc
SENSITIVITY FACTOR FOR RM-063H = 1.33+01 cpm/µCi/cc

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DOSE ASSESSMENT COMPUTER SETUP

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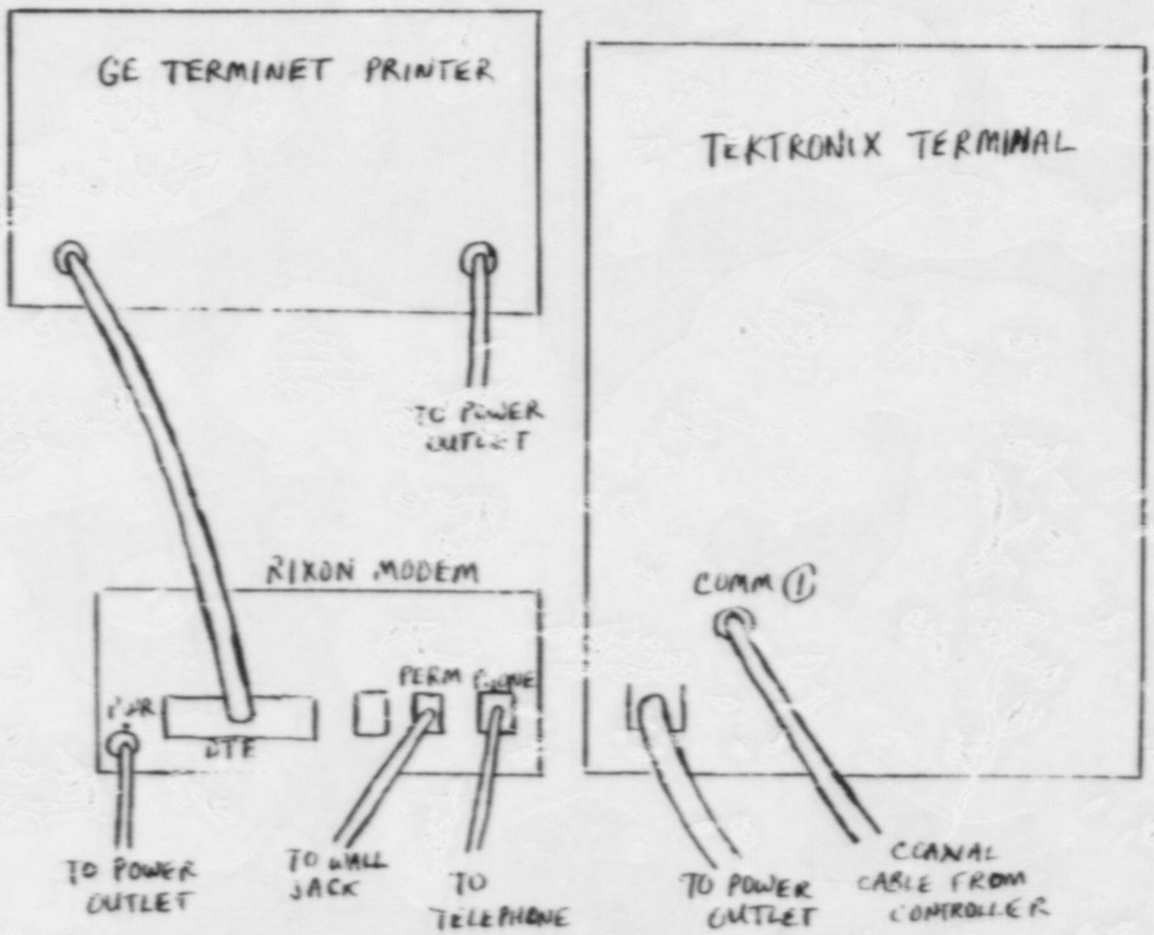

FIGURE H-1

R10 2-26-87

Fort Calhoun Station Unit No. 1
EMERGENCY PLAN IMPLEMENTING PROCEDURE
EPIP-TSC-8
TECHNICAL SUPPORT CENTER

Estimate of Core Damage

I. PURPOSE

A. This procedure contains four sections to provide independent and redundant estimates of the type and degree of core damage which may have occurred during an accident situation. Use the sections that will yield the quickest and/or most accurate assessment of damage first, as determined from the guidance below and the attached flow chart.

FAST TRANSIENT: Obtain samples using the Post Accident Sampling System (PASS) and estimate core damage by using containment hydrogen measurement (EPIP-TSC-8-C) and isotopic data analysis (EPIP-TSC-8-B) followed by containment radiation dose rate analysis (EPIP-TSC-8-A). Core damage can be estimated using Core Exit Thermocouple (CET) temperatures, but results are not expected to be very accurate for fast acting transients.

SLOW TRANSIENT: Use core exit thermocouple temperatures (EPIP-TSC-8-D) and containment radiation dose rate analysis (EPIP-TSC-8-A) for an early estimate of core damage. When conditions permit, the Post Accident Sampling System (PASS) should be used to obtain samples for containment hydrogen measurement (EPIP-TSC-8-C) and isotopic data analysis (EPIP-TSC-8-B) to enhance earlier damage indications.

B. This procedure is divided into the following four sections:

1. Section A - Containment Dose Rate Analysis uses radiation readings from RM-091A and RM-091B to estimate the type and degree of core damage.

2. Section B - Isotopic Data Analysis uses post accident sample isotopic data to determine the type and degree of core damage.

3. Section C - Containment Hydrogen Measurement determines the sources of hydrogen generated in containment and relates them to the type and degree of core damage.

4. Section D - Core Exit Thermocouple (CET) Temperatures are trended to relate temperature changes in the CET's to the type and degree of core damage.

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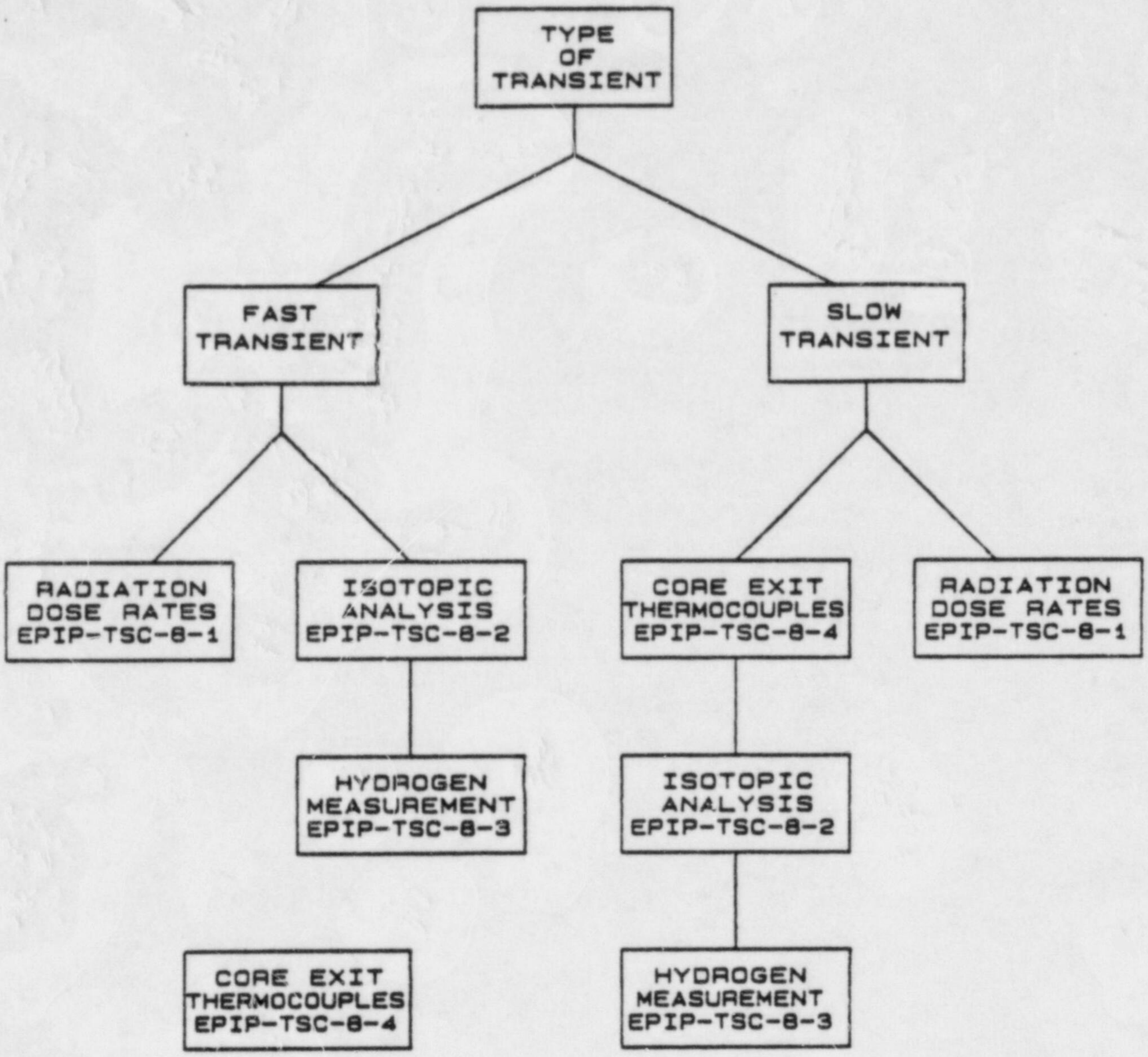

EPIP-TSC-8

CORE DAMAGE ASSESSMENT PROCEDURE FLOW CHART

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SECTION A

Estimate of Core Damage Using Containment Radiation Dose Rates

I. PREREQUISITES

A. A plant accident with the potential for core damage has occurred.

B. Wide Range Radiation Dose Monitors RM-091A and RM-091B are operable and able to measure area dose rates in containment resulting from fission products dispursed in the building atmosphere and plated out on the building surfaces.

II. PRECAUTIONS AND LIMITATIONS

A. The total quantity of fission products measured at monitor locations in containment may be changing rapidly due to transient plant conditions. Therefore, multiple measurements should be obtained within a minimum time period and under stabilized plant conditions when possible. Samples obtained during rapidly changing plant conditions should not be weighed heavily into the assessment of core damage. RM-091A and RM-091B have an upper radiation reading limit of 1E7 R/HR

B. This procedure only provides an upper limit estimate of the progressive core damage and cannot accurately distinguish between the conditions of fuel cladding failure and fuel overheat when the resulting dose rates are the same. This procedure does not attempt to identify the extent of any potential fuel melting.

C. This procedure is intended for use when the fission product inventory in the core has had sufficient time to reach equilibrium. Based upon the fission products of concern, equilibrium conditions are achieved after 30 days of operations at constant power. Reactor power is considered to be constant if it has not changed by more than ±10%. This procedure can be applied following non-constant periods of operation and when the reactor has produced power for less than 30 days. The assessment of core damage for less than 30 days of operation will underpredict the actual conditions.

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III. PROCEDURE

A. Record the following plant indications.

CONTAINMENT BUILDING

Radiation Dose Rate ____________________ Rads/hr.

Time of Measurement Date ____________ Time ______

Prior 30 days power history:

Power, Percent	Duration, Days

B. Time of reactor shutdown Date __________ Time __________

C. Plant Power Correction

The measured radiation dose rate inside the containment building is to be corrected for the plant power history. To correct the measured dose rate to the corresponding value had the plant been operating at 100 percent power, follow the guidelines below.

For operation at constant power for more than 30 days, apply a simple ratio of power. Reactor power is considered to be constant if it has not changed by more than ±10%.

To correct the radiation dose rate for the case in which reactor power level has not remained constant during the 30 days prior to the reactor shutdown, engineering judgement is used to determine the most representative power level. The guidelines below should be used in making this determination.

The average power during the 30 day period is not necessarily the most representative value to be used for the correction to equilibrium conditions.

The power levels at which the reactor last operated should weigh more heavily in the determination than the earlier power levels.

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III. PROCEDURE (Continued)

C. Plant Power Correction (Continued)

Continued operation for an extended period should weigh more heavily than brief transient periods.

For operation less than 30 days this procedure can still be employed, however, the estimate of core damage is expected to be an under-prediction of actual conditions.

D. Apply the following equation to determine the radiation dose rate corresponding to equilibrium full power source inventory conditions.

$$\text{Equilibrium Dose Rate} = \text{Measured Dose Rate} \times \frac{100}{\text{\% Reactor Power Level}}^{*}$$

* dose rate correction factor

E. To determine the decay correction for the radiation dose rate, record the time between measurement of the dose rate and reactor shutdown, recorded in Step B.

Time duration for this measurement = ____________ hours

F. Estimate the extent of core damage using the equilibrium dose rate (step III.D), the duration of reactor shutdown, and the analytically determined dose rates provided in Enclosure 2. Use engineering judgement to determine which category of core damage shown on Enclosure 2 is more representative of the plotted value. Consider the following criteria when making this determination:

Some dose rate measurements could have been recorded during periods of transient conditions within the plant. Measurements made during stable plant conditions should weigh more heavily in the assessment of core damage.

Dose rates significantly above the lower bound in the category of major fuel overheat may indicate concurrent fuel pellet melting. This procedure can not be employed to estimate the degree of fuel pellet melting.

Fuel cladding failure should be anticipated for dose rates within any category of fuel overheating. This procedure can not distinguish the relative contributions of the two categories to the total dose rate, but does give an estimate of the highest category of damage.

Dose rates corresponding to the two categories of major cladding failure and initial fuel overheat are observed to overlap on Enclosure 2. The evaluation of other plant parameters may be required to distinguish between them. However, concurrent conditions may be anticipated.

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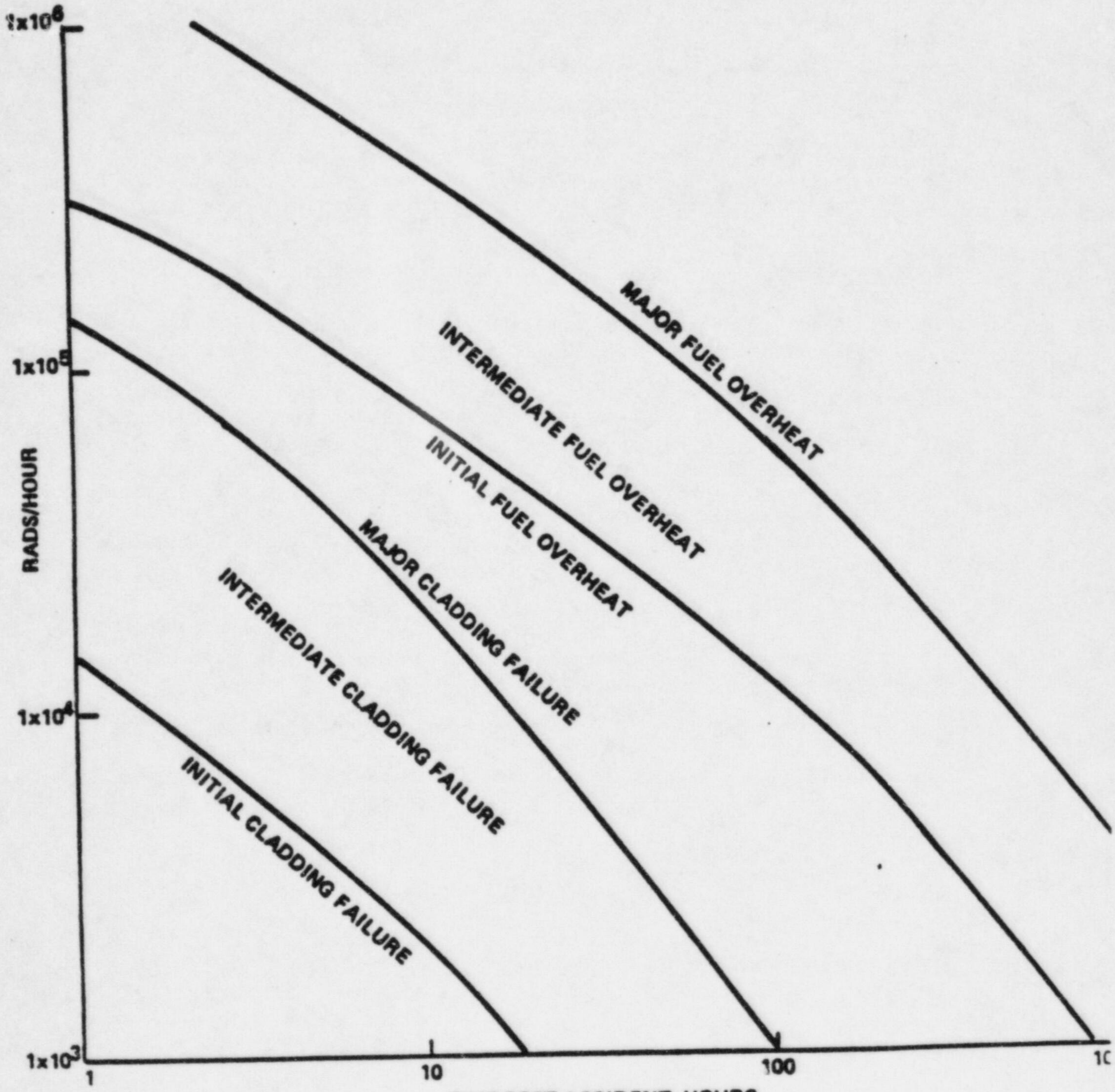
Enclosure 1

Radiological Characteristics of NRC Categories of Fuel Damage

NRC Category of Fuel Damage	Mechanism of Release	Source of Release	Characteristic Isotope	Release of Characteristic Isotope Expressed as a Percent of Source Inventory
No Fuel Damage	Halogen Spiking Tramp Uranium	Gas Gap	I 131, Cs 137 Rb 88	Less than 1
Initial Cladding Failure		Gas Gap		Less than 10
Intermediate Cladding Failure	Clad Burst and Gas Gap Diffusion Release	Gas Gap	Xe 131m, Xe 133 I 131, I 133	10 to 50
Major Cladding Failure		Gas Gap		Greater than 50
Initial Fuel Pellet Overheating	Grain Boundary Diffusion	Fuel Pellet	Cs 134, Rb 88, Te 129, Te 132	Less than 10
Intermediate Fuel Pellet Overheating		Fuel Pellet		10 to 50
Major Fuel Pellet Overheating	Diffusional Release From UO_2 Grains	Fuel Pellet		Greater than 50
Fuel Pellet Melt		Fuel Pellet		Less than 10
Intermediate Fuel Pellet Melt	Escape from Molten Fuel	Fuel Pellet	Ba 140, La 140 La 142, Pr 144	10 to 50
Major Fuel Pellet Melt		Fuel Pellet		Greater than 50

ENCLOSURE 2
TYPICAL ANALYSIS FOR POST ACCIDENT DOSE RATE INSIDE A CYLINDRICAL CONTAINMENT



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SECTION B

Estimate of Core Damage Using Isotopic Data

I. PREREQUISITES

A. A plant accident with the potential for core damage has occurred.

B. Isotopic activities are available per OI-SL-2 or OI-PAP-2.

C. Computer program UTYPASS is available for execution.

D. The Post Accident Sampling System (PASS) is operable and has the capability to obtain and analyze the identity and concentration of fission product isotopes in fluid samples which have the potential to be highly radioactive.

II. PRECAUTIONS AND LIMITATIONS

The assessments of core damage obtained by using this procedure are only estimates and represent lower limit estimates of clad damage.

The total quantity of fission products measured at monitor locations in containment may be changing rapidly due to transient plant conditions. Therefore, multiple measurements should be obtained within a minimum time period and under stabilized plant conditions when possible. Samples obtained during rapidly changing plant conditions should not be weighed heavily into the assessment of core damage.

III. PROCEDURE

Estimation of Core Damage Using Isotopic Analysis

A. Perform an isotopic specific activity analysis by obtaining samples based on the following criteria:

TYPE TRANSIENT	SAMPLE LOCATIONS
a) Rapid Depressurization of Primary System.................	Reactor Coolant, Containment Atmosphere, Containment Sump
b) Slow Depressurization of Primary System	
EARLY.......................	Reactor Coolant
LATER.......................	Reactor Coolant, Containment Atmosphere, Containment Sump

III. PROCEDURE (Continued)

NOTE: If the core damage estimate is performed after purging containment, the noble gas concentrations should be adjusted to reflect the initial concentrations prior to the purge operation.

B. Using OI-SL-2 or OI-PAP-2, obtain and analyze the selected samples for fission product specific activity and record in Table 1. All of the isotopes listed in the table may not be observed in the sample.

C. Record the time of reactor trip. Date__________/ Time__________.

D. If the Safety Injection Tanks (SIT's) and/or Safety Injection Refueling Water Tank (SIRWT) have been used during the transient, complete Table 2.

E. Determine the elapsed time between reactor trip and sample measurement:

____________hours

F. Complete Table 3 on Power History.

G. This step uses the computer program UTYPASS on the IBM PC to provide an estimate of core damage using isotopic analysis. If access to the IBM PC is not available, proceed to Step I to access the program on the terminet.

1. Insert the UTYPASS floppy disk, found in the Core Physics Supervisor emergency packet, into the "A" floppy drive.

2. Enter the following statements, in order:

CD\EPIP	CR	(Carriage Return)
COPY A: *.*	CR	
PE	CR	CR
EDIT USERI.PRG	CR	

3. Input the information from Tables 1, 2 and 3 by using the arrow, PgDn and PgUp keys on the right side of the keyboard to modify the input data file as outlined in Appendix A.

4. Enter the following statements, in order:

FILE USERI.PRG NOTABS	CR
QUIT	CR
PRGPASS	CR

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III. PROCEDURE (Continued)

G. 5. When "Stop - Program Terminated." appears on the screen, enter the following statements:

PE	CR
EDIT USERO.PRG	CR

6. Use the arrow, PgDn and PgUp keys to view the output, or use the F7 function key on the left side of the keyboard to print the output file.

7. When finished, return the floppy disk to the Core Physics Supervisor emergency packet and type the following:

QUIT	CR
QUIT	CR
CD\	CR

H. CORE DAMAGE ASSESSMENT

The conclusion on core damage is made using the three parameters developed above. These are:

1. Identification of the fission product isotopes which most characterize a given sample, step B, Table 1.

2. Identification of the source of the release from program output or step L, if manual calculation was used.

3. Quantity of the fission product available for release to the environment expressed as a percent of source inventory from program output or step O if manual calculation was used.

Compare the three parameters above to the definitions of the 10 NRC categories of fuel damage found in Enclosure 1. Core damage is not anticipated to take place uniformly. Therefore when evaluating the three parameters listed above, the procedure is anticipated to yield a combination of one or more of the 10 categories defined in Enclosure 1. These categories will exist simultaneously.

CONCLUSIONS:

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III. PROCEDURE (Continued)

I. This step uses the computer program UTYPASS on the terminet to provide an estimate of core damage using isotopic analysis. If access to UTYPASS or the terminet is not available, continue with procedure Step J for manual calculation toward an isotopic core damage estimate.

1. To use the Combustion Engineering computer system upon which UTYPASS resides,

   SET TERMINET TO HALF DUPLEX
   Dial 1-800-243-3202
   or 1-203-683-0411
   or 1-203-683-2734

2. Once the computer has been accessed, use the following sequence to log on and access UTYPASS.

   USER NAME, PASSWORD:

   OMAHA, Ø CR

   XEDIT,UTYPASS,P CR

   Perform input changes as outlined in Appendix A

   Q,,RL CR

3. To submit the computer job, type:

   SUBMIT, UTYPASS,T CR

4. When the job is complete, use the following command to identify the job name.

   ENQUIRE,UJN CR

5. To print the results, input the following sequence:

   TRMDEF,PW=136. CR

   QGET,LfN CR

   COPY,LfN CR

6. Summarize the core damage results as directed in procedure Step H.

III. PROCEDURE (Continued)

J. Complete the Enclosure 3 worksheet to correct the measured sample specific activity to standard temperature and pressure as follows.

NOTE: This portion of the procedure is only to be used when access to UTYPASS is not available.

1. Reactor coolant liquid samples are corrected for system temperature and pressure using the factor for water density provided in Enclosure 2. The correction factor obtained from the enclosure is divided into the measured value to obtain the density corrected value.

2. Containment building sump samples do not require correction for temperature and pressure within the accuracy of this procedure.

3. Containment building atmosphere gas samples are corrected using the following equation.

$$\text{Specific Activity(STP)} = \text{Specific Activity} \times \left(\frac{14.7}{P_1 + 14.7}\right) \times \frac{(T_1 + 460)}{492}$$

Where:

T_1, P_1 = Measured Sample temperature and pressure recorded in step B.

K. Correct the sample specific activity at STP for decay back to the time of reactor shutdown, as recorded in step C, using the following equation. Enclosure 4 is provided as a worksheet.

$$A_0 = \frac{A}{e^{-\lambda\tau}}$$

Where:

A_0 = the specific activity of the sample corrected back to the time of reactor shutdown, μci/cc.

A = the measured specific activity, μci/cc.

λ = the radioactive decay constant, 1/sec.

τ = the time period from reactor shutdown to sample analysis, sec.

III. PROCEDURE (Continued)

L. Identification of the Fission Product Release Source.

1. Calculate the following ratios for each noble gas and iodine isotope only using the specific activities obtained in step L. Enclosure 5 is provided as a worksheet.

$$\text{Noble Gas Ratio} = \frac{\text{Noble Gas Isotope Specific Activity}}{\text{Xe133 Specific Activity}}$$

$$\text{Iodine Ratio} = \frac{\text{Iodine Isotope Specific Activity}}{\text{I-131 Specific Activity}}$$

2. Determine the source of release by comparing the results obtained to the predicted ratios provided in Enclosure 5. An accurate comparison is not anticipated. Within the accuracy of this procedure it is appropriate to select as the source that ratio which is closest to the value obtained in step L.1.

M. Calculate the total quantity of fission products available for release to the environment. Enclosure 6 is provided as a worksheet.

1. The quantity of fission products found in the reactor coolant is calculated as follows.

a. If the water level in the reactor vessel recorded in step B indicates that the vessel is full, the quantity of fission products found in the reactor coolant is calculated by the following equation.

Total Activity(Ci) = A_0 (µci/cc) x RCS Volume

Where:

A_0 = the specific activity of the reactor coolant sample corrected to time of reactor shutdown obtained in step K, µci/cc.

RCS Volume = the full reactor coolant system water volume corrected to standard temperature and pressure using Enclosure 2.

b. If the water levels in the reactor vessel and pressurizer recorded in step B, Table 1 indicates that a steam void is present in the reactor vessel, the quantity of fission products found in the reactor coolant is calculated using the equation from step M.1.a.

c. If the water level in the reactor vessel recorded in step B is below the low end capability of the indicator, it is not possible to determine the quantity of fission products from this sample because the volume of water in the reactor coolant system is unknown. Under this condition, assessment of core damage is obtained by using the containment sump sample.

III. PROCEDURE (Continued)

M. 2. The quantity of fission products found in the containment building sump is determined as follows.

a. The water volume in the containment building sump is determined from the sump level recorded in step B, Table 1 and the curve provided in Enclosure 7.

b. The quantity of fission products in the sump is calculated by the following equation.

$$\text{Total Activity, Ci} = A_0\ (\mu ci/cc) \times \text{Sump Volume}$$

Where:

A_0 = the specific activity of the containment sump sample corrected to the time of reactor shutdown obtained in step K, μci/cc.

3. The quantity of fission products found in the containment building atmosphere is determined as follows.

a. The volume of gas in the containment building at the time of the accident, is corrected to standard temperature and pressure using the following equation.

$$\text{Gas Volume(STP)} = \text{Gas Volume} \times \frac{(14.7 + P_1)}{14.7} \times \frac{492}{(T_1 + 460)}$$

Where:

T_1, P_1 = Containment Atmosphere temperature and pressure recorded in step B, Table 1.

4. The total quantity of fission products available for release to the environment is equal to the sum of the values obtained from each sample location.

III. PROCEDURE (Continued)

N. PLANT POWER CORRECTION

The quantitative release of the fission products is expressed as the percent of the source inventory at the time of the accident. The equilibrium source inventories are to be corrected for plant power history. Use information from step F, Table 3.

1. To correct the source inventory for the case in which plant power level has remained constant for a period greater than four radioactive half lives the following procedure is employed. Enclosure 8 is provided as a worksheet.

   a. The fission products are divided into two groups based upon the radioactive half lives. Group 1 isotopes are to be employed in the case where core power had not changed greater than ± 10 percent within the last 30 days prior to the reactor shutdown. Group 2 isotopes are to be employed in the case where core power had not changed greater than ± 10 percent within the last 4 days prior to the reactor shutdown.

   b. The following equation may be applied to the fission product Group which meets the criteria stated in N.1.a only.

$$\text{Group 1 Power Correction Factor} = \frac{\text{Steady State Power Level for Prior 30 days}}{100}$$

$$\text{Group 2 Power Correction Factor} = \frac{\text{Steady State Power Level for Prior 4 Days}}{100}$$

2. To correct the source inventory for the case in which plant power level has not remained constant prior to reactor shutdown, the following equation is employed. The entire 30 days power history should be employed. Enclosure 9 is provided as a worksheet.

$$\text{Power Correction Factor} = \frac{\Sigma_j P_j \left(1-e^{-\lambda\tau_j}\right) e^{-\lambda\tau_j^0}}{100}$$

Where:

P_j = steady reactor power in period j

τ_j = duration of period j

τ_j^0 = time from end of period j to reactor shutdown

III. PROCEDURE (Continued)

O. Comparison of Measured Data with Source Inventory

The total quantity of fission products available for release to the environment obtained in step M.4 is compared to the source inventory corrected for plant power history obtained in step N.2. This comparison is made by dividing the two values for each isotope and calculating the percent of the corrected source inventory that is now in the sampled fluid and therefore available for release to the environment. Enclosure 10 is provided as worksheet.

P. CORE DAMAGE ASSESSMENT

Summarize the core damage results as directed in procedure step H.

TABLE 1

	Temperature °F	Pressure psia
Containment		
Gas Loop		
RCS (T_{ave})		

Reactor Vessel Level ________%

Pressurizer Level ________%

Containment Sump Level ________%

Isotope	Specific Activity (microcuries/cc) RC	CA	CS
Xe-131M			
Xe-133			
Kr-88			
Kr-85			
Kr-87			
I-132			
I-133			
I-135			
I-131			
Cs-134			
Te-132			
Ba-140			
Ru-103			

Time of Sample Measurement ____________________

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TABLE 2

Safety Injection Tank Level, %

	Before	After
SI-6A		
SI-6B		
SI-6C		
SI-6D		

SIRWT Level (Inches)

	Before	After
SIRWT		

TABLE 3

30 DAY POWER HISTORY

P_j	T_j	T_j^o

Up to 8 Intervals May be Revised

P_j = Steady reactor power operated in period j % full power

NOTE: In each period, the variation of steady power should be limited to ±10%.

T_j = Duration of operating period j (days)

T_j^o = Time between the end of operating period j and time of reactor shutdown (days)

APPENDIX A

User input guide for core damage estimate computer program

PRGPASS.

CARD 1

5	10	15	20	25	30	35	40
		HOURS					
TIME=	HOURS						

Hours is in F5.1 format starting in Card Column 12

Hours is the time from reactor trip until the primary sample is read.

CARDS 2 through 5 - SI Tank Levels

5	10	15	20	25	30	35	40
SI-6X		0.00	0E+00	0.00	0E+00		

Cards 2 through 5 are for SI, 6A, 6B, 6C, 6D tank levels before use and after use. The levels are in percent. Format is E9.3, 1X, E9.3 starting in Card Column 12.

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CARD 6 - SIWRT Level

5	10	15	20	25	30	35	40
			INITIAL	FINAL			
SIRWT							

Card 6 is for SIWRT level before and after use, if any. Level is input in inches. Format is E9.3, 1X, E9.3 starting in Card Column 12.

CARD 7 - Containment Temperature and Pressure

5	10	15	20	25	30	35	40
			TEMP.	PRESS.			
CONTA	INMT						

Card 7 is for input of containment temperature (°F) and containment pressure (PSIA). These values should correspond to the time the containment atmospheric sample was taken. Format starting in Card Column 12 is E9.3, 1X, E9.3.

CARD 8 - Gas Sample Temperature and Pressure

5	10	15	20	25	30	35	40
			TEMP	PRESS.			
GAS L	LOOP						

Card 8 is for input of the gas sample temperature (°F) and pressure (PSIA). The format starting in Card Column 12 is E9.3, 1X, E9.3.

CARD 9 - Core Average Reactor Coolant System Temperature

5	10	15	20	25	30	35	40
		TEMP.					
R C S	T E M P						

Card 9 is for input of the core average RCS temperatures (°F) corresponding to the time when the primary sample was taken. Format starting in Card Column 12 is E9.3.

CARDS 10 through 21 - Isotopic Information

5	10	15	20	25	30	35	40
		RC		CA		CS	
I S O T	O P E						

Cards 10 through 21 are for input of isotopic information.

The activities input are in microcuries/cc.

The reactor coolant values start in Card Column 12.

The containment atmospheric values start in Card Column 22.

The containment sump values start in Card Column 32.

If a sample is not read for a particular isotope or a region is not sampled, input zero's.

The format for each card is A10, 1X, E9.3, 1X, E9.3, 1X, E9.3.

The isotope cards must be in the following order.

CARD #	ISOTOPE
10	XE-133M
11	XE-133
12	KR-88
13	KR-85
14	KR-87
15	I-132
16	I-133
17	I-131
18	CS-134
19	TE-132
20	BA-140
21	RU-103

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CARD 22 - Choice to use Noble Gases or Cs-134/I-131 for Overheating Calculations.

5	10	15	20	25	30	35	40
		N1					
CHOICE							

N1 = 0 Use I-131 and Cs-134.
= 1* Use Nobel Gases

*Use the data for Iodine or Cesium only when the data for noble gases is not available.

CARD 23 - Number of Values in History File (Cards 24 through 31)

5	10	15	20	25	30	35	40
		N					
PWRS							

N = Number of power changes for 30 Days prior to trip. N = 1 to 8.

Integer format in Card Column 12.

CARDS 24 through 31 - Power History

5	10	15	20	25	30	35	40
			POWER		DAYAT		DAYTIL

The power history is for the 30 days prior to shutdown. Up to 8 power changes may be modeled.

POWER = Power level in percent of full power. Note 10% levels are sufficient modeling changes.

DAYAT = Duration of operating period (Days).

DAYTIL = Time between the end of the operating period and the time of reactor shutdown (Days).

FORMAT = 15X, F5.1, 5X, F5.1, 5X, F5.1.

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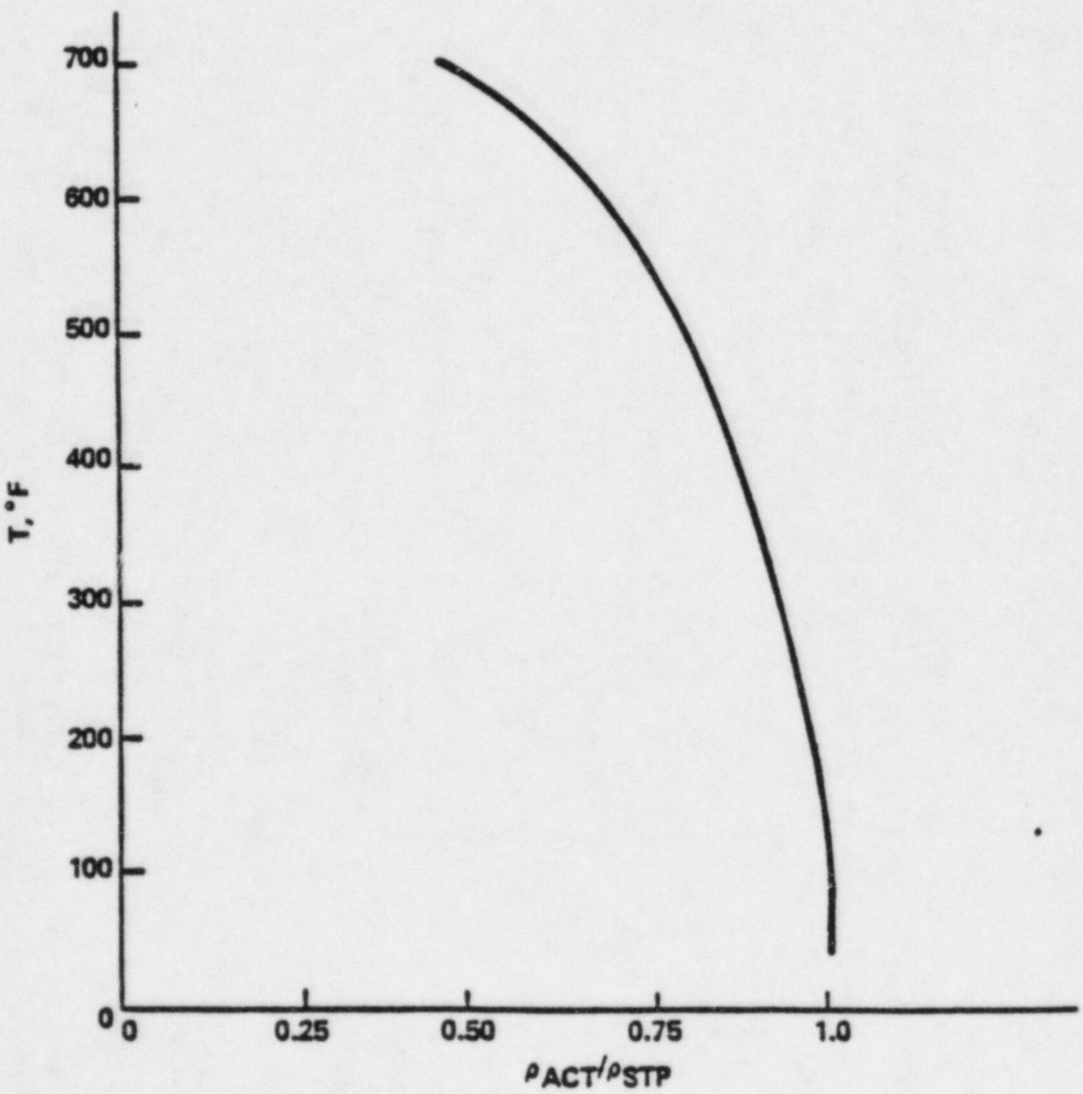
Enclosure 1

Radiological Characteristics of NRC Categories of Fuel Damage

NRC Category of Fuel Damage	Mechanism of Release	Source of Release	Characteristic Isotope	Release of Characteristic Isotope Expressed as a Percent of Source Inventory
No Fuel Damage	Halogen Spiking Tramp Uranium	Gas Gap	I 131, Cs 137 Rb 88	Less than 1
Initial Cladding Failure		Gas Gap		Less than 10
Intermediate Cladding Failure	Clad Burst and Gas Gap Diffusion Release	Gas Gap	Xe 131m, Xe 133 I 131, I 133	10 to 50
Major Cladding Failure		Gas Gap		Greater than 50
Initial Fuel Pellet Overheating	Grain Boundary Diffusion	Fuel Pellet	Cs 134, Rb 88, Te 129, Te 132	Less than 10
Intermediate Fuel Pellet Overheating		Fuel Pellet		10 to 50
Major Fuel Pellet Overheating	Diffusional Release From UO_2 Grains	Fuel Pellet		Greater than 50
Fuel Pellet Melt		Fuel Pellet		Less than 10
Intermediate Fuel Pellet Melt	Escape from Molten Fuel	Fuel Pellet	Ba 140, La 140 La 142, Pr 144	10 to 50
Major Fuel Pellet Melt		Fuel Pellet		Greater than 50

ENCLOSURE 2

RATIO OF H_2O DENSITY TO H_2O DENSITY AT STP vs TEMPERATURE



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ENCLOSURE 3

RECORD OF SAMPLE TEMPERATURE CORRECTION

Sample Number:

Location:

Time of Analysis:

Temperature, °F:

Pressure, PSIG:

Isotope	Measured Specific Activity (Table 1), µci/cc	Correction Factor	Specific Activity @ STP, µci/cc
Kr 87			
Xe 131m			
Xe 133			
I 131			
I 132			
I 133			
I 135			
Cs 134			
Rb 88			
Te 129			
Te 132			
Sr 89			
Ba 140			
La 140			
La 142			
Pr 144			

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ENCLOSURE 4

RECORD OF DECAY CORRECTION

Time of Reactor Shutdown, Step IV.C.

Sample Number:

Location:

Time of Analysis:

Isotope	Decay Constant, 1/sec	Specific Activity @ STP (Enclosure 3), uci/cc	Decay Corrected Specific Activity uci/cc
Kr 87	1.5 (-4)		
Xe 131m	6.7 (-7)		
Xe 133	1.5 (-6)		
I 131	9.9 (-7)		
I 132	8.4 (-5)		
I 133	9.3 (-6)		
I 135	2.9 (-5)		
Cs 134	1.1 (-8)		
Rb 88	6.5 (-4)		
Te 129	1.7 (-4)		
Te 132	2.5 (-6)		
Sr 89	1.6 (-7)		
Ba 140	6.3 (-7)		
La 140	4.8 (-6)		
La 142	1.2 (-4)		
Pr 144	6.7 (-4)		

ENCLOSURE 5

RECORD OF FISSION PRODUCT RELEASE SOURCE IDENTIFICATION

Sample Number:

Location:

Isotope	Decay Corrected Specific Activity (Enclosure 4), $\mu ci/cc$	Calculated Isotope Ratio*	Fuel Pellet Inventory	Activity Ratio In Gas Gap	Identified Source
Kr 87			0.2	0.001	
Xe 131m			0.003	0.001-0.003	
Xe 133			1.0	1.0	
I 131			1.0	1.0	
I 132			1.4	0.01-0.05	
I 133			2.0	0.5-1.0	
I 135			1.8	0.1-0.5	

* Noble Gas Ratio = $\frac{\text{Decay Corrected Noble Gas Specific Activity}}{\text{Decay Corrected Xe 133 Specific Activity}}$

Iodine Ratio = $\frac{\text{Decay Corrected Iodine Isotope Specific Activity}}{\text{Decay Corrected I-131 Specific Activity}}$

ENCLOSURE 6

RECORD OF RELEASE QUANTITY

Isotope	Reactor Coolant Sample Number, Ci	Containment Sump Sample Number, Ci	Containment Atmosphere Sample Number , Ci	Total Quantity Ci
Kr 87				
Xe 131m				
Xe 133				
I 131				
I 132				
I 133				
I 135				
Cs 134				
Rb 88				
Te 129				
Te 132				
Sr 89				
Ba 140				
La 140				
La 142				
Pr 144				

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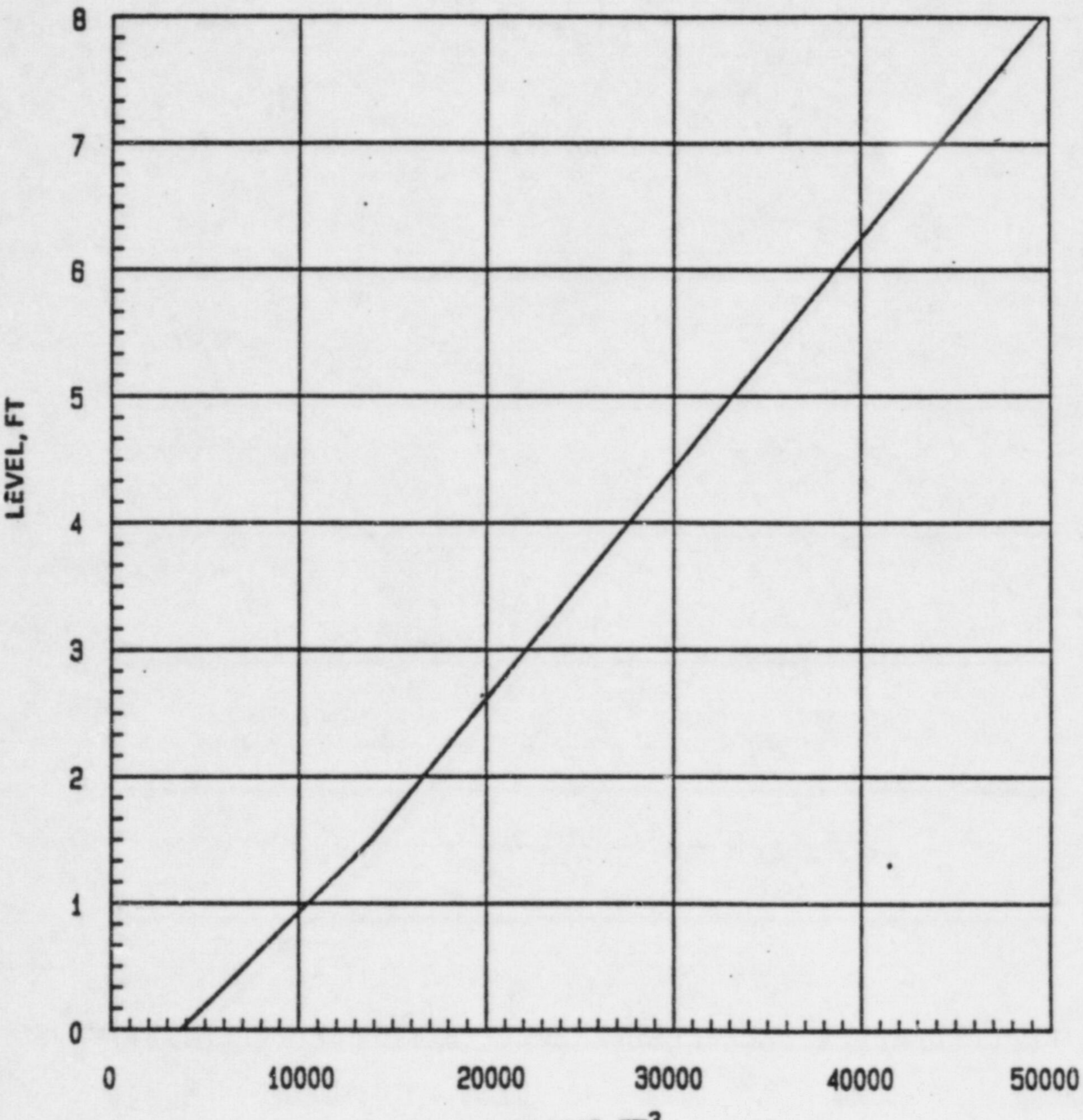
ENCLOSURE 7

CONTAINMENT BUILDING WATER LEVEL vs VOLUME



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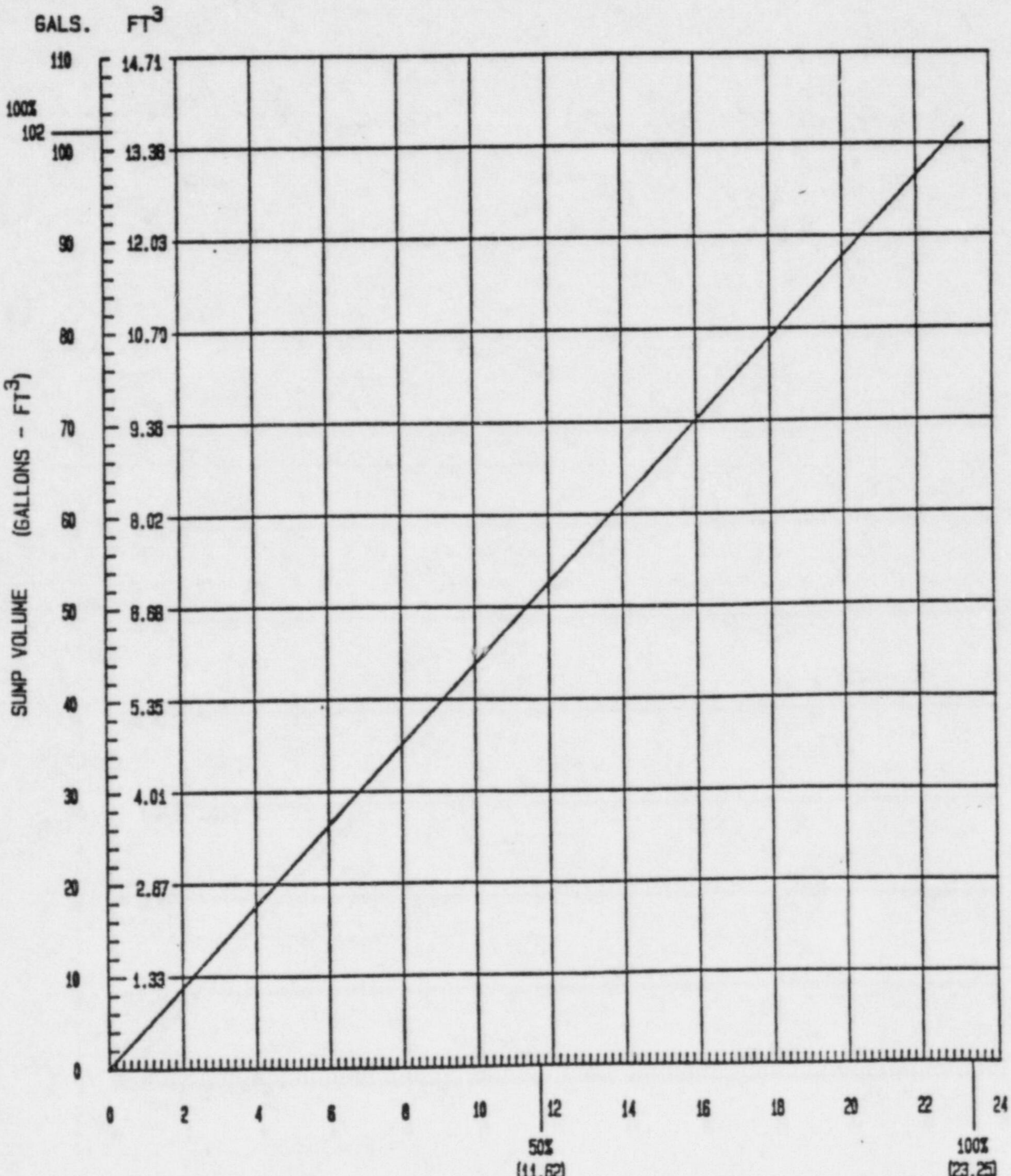
ENCLOSURE 7A

CONTAINMENT SUMP CURVE

LEVEL VS. VOLUME



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ENCLOSURE 8

RECORD OF STEADY STATE POWER CORRECTION

Sample Number:
Location:
Steady State 30 Days Power Level:
Steady State 4 Day Power Level:

Isotope	Fuel History Grouping	Power Correction Factor	x	Equilibrium Source Inventory	=	Corrected Source Inventory
Gas Gap Inventory						
Kr 87	2			3.6(0)		
Xe 131m	1			2.7(4)		
Xe 133	1			1.3(7)		
I 131	1			4.4(6)		
I 132	2			4.9(3)		
I 133	2			4.4(6)		
I 135	2			7.0(5)		
Fuel Pellet Inventory						
Kr 87	2			1.8(7)		
Xe 131m	1			2.9(5)		
Xe 133	1			1.5(8)		
I 131	1			4.8(7)		
I 132	2			7.0(7)		
I 133	2			1.5(8)		
I 135	2			8.6(7)		
Cs 134	1			6.1(6)		
Rb 88	2			2.9(7)		
Te 129	2			1.6(7)		
Te 132	1			7.0(7)		
Sr 89	1			3.9(7)		
Ba 140	1			8.0(7)		
La 140	1			8.4(7)		
La 142	2			1.0(8)		
Pr 144	2			6.5(7)		

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ENCLOSURE 9

RECORD OF TRANSIENT POWER CORRECTION

Sample Number:
Location:
Prior 30 Day Power History:

Power %	Duration, Days
______	______
______	______
______	______

Isotope	Power Correction Factor	x	Equilibrium Source Inventory	=	Corrected Source Inventory
Gas Gap Inventory					
Kr 87			3.6(0)		
Xe 131m			2.7(4)		
Xe 133			1.3(7)		
I 131			4.4(6)		
I 132			4.9(3)		
I 133			4.4(6)		
I 135			7.0(5)		
Fuel Pellet Inventory					
Kr 87			1.8(7)		
Xe 131m			2.9(5)		
Xe 133			1.5(8)		
I 131			4.8(7)		
I 132			7.0(7)		
I 133			1.5(8)		
I 135			8.6(7)		
Cs 134			6.1(6)		
Rb 88			2.9(7)		
Te 129			1.6(7)		
Te 132			7.0(7)		
Sr 89			3.9(7)		
Ba 140			8.0(7)		
La 140			8.4(7)		
La 142			1.0(8)		
Pr 144			6.5(7)		

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ENCLOSURE 10

RECORD OF PERCENT RELEASE

Isotope	Total Quantity Available For Release ÷ (Enclosure 6), Ci	Power Corrected Source Inventory, x 100 = Ci (Enclosure 8 or 9)	Percent
Gas Gap Inventory			
Kr 87			
Xe 131			
Xe 133			
I 131			
I 132			
I 133			
I 135			
Fuel Pellet Inventory			
Kr 87			
Xe 131m			
Xe 133			
I 131			
I 132			
I 133			
I 135			
Cs 134			
Rb 88			
Te 129			
Te 132			
Sr 89			
Ba 140			
La 140			
La 142			
Pr 144			

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SECTION C

Estimate of Core Damage Using Hydrogen In Containment

I. PREREQUISITES

A. A plant accident with the potential for core damage has occurred.

B. The Post Accident Sampling System (PASS) is operable and has the capability to obtain and analyze the identity and concentration of fission product isotopes in fluid samples which have the potential to be highly radioactive.

II. PRECAUTIONS AND LIMITATIONS

The assessments of core damage obtained by using this procedure are only estimates and represent lower limit estimates of clad damage.

This procedure only estimates the percentage of rods which have progressed to at least clad rupture or clad embrittlement, and does not attempt to predict the physical configuration of those rods which have progressed beyond local clad fragmentation.

This procedure assumes there are no voids measurable by the Reactor Vessel Level Monitoring System. However, if the hydrogen samples are taken under conditions in which a measurable void does exist, the attached addendum contains guidelines to estimate the added contribution of hydrogen, by that source, to the total hydrogen measured.

This procedure provides an estimate of only the percentage of rods which have progressed to at least clad rupture or clad embrittlement, and does not attempt to predict the physical configuration of those rods which have progressed beyond local clad fragmentation.

III. PROCEDURE

Estimation of Core Damage Using Hydrogen Measurement

a. Record the estimates for core uncovery and recovery times using instrument records from the Reactor Vessel Level Monitoring System, Core Exit Thermocouple Temperature and Core Exit Thermocouple Saturation Margin.

Instrument	Estimated Core Uncovery Time	Estimated Core Recovery Time
Reactor Vessel Level Monitoring System	Lower Limit Elevation Uncovers. Time ______________	Lower Limit Elevation Recovers. Time ______________
Core Exit Thermocouple Temperature	Start of Continuous Rise or Exceed of 600F. Time ______________ Temperature ________	Rapid Temperature Drop to Saturation. Time ______________ Temperature ________
Core Exit Thermocouple Saturation Margin	Start of Superheat. Time ______________	Return to Saturation or Subcooling. Time ______________

b. Interpret the data from step a to determine the best estimate for the time period of core uncovery and obtain the range of RCS pressure (pressurizer pressure) indicated for this time period. The superheat derived from the thermocouple temperature and corresponding system pressure is considered as the best indicator for core uncovery during core boiloff and should be used but should be compared with other indicators to help identify possible anomolies. Record these values below.

	Core Uncovery	Core Recovery
Time	____________	____________
Pressure	____________	____________

c. Observe available instrument records to determine if there was some reactor vessel inlet flow during the rising temperature portion of the core uncovery period up to approximately the time of peak core exit thermocouple temperature.

Charging Flow Rate ______ GPM   Letdown Flow Rate ______ GPM

HPSI Flow Rate ______ GPM   LPSI Flow Rate ______ GPM

Other Flow Rate ______ GPM

NOTE: Net inlet flow indicates that this procedure may have additional bias which underpredicts clad damage.

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III. PROCEDURE (Continued)

d. Obtain a liquid sample from the RCS hot leg and a gas sample from the containment atmosphere and record the conditions in the containment at the time these samples are obtained, below. Analyze the samples for hydrogen concentration using the PASS procedure and record these results below. Estimate the total cubic feet of hydrogen at standard temperature and pressure as outlined.

Reactor Coolant System	Containment
Sampling Time ________	Atmosphere Pressure ________ psig
Pressure ________ psig	Atmosphere Temperature ________ F
Temperature ________ F	Has Hydrogen Recombiner Operated Yes/No
Reactor Vessel Coolant Level ________ %	Does Pressure or Temperature History Indicate a Hydrogen Burn Yes/No
Pressurizer Level ____ %	

$$\frac{\text{Cont. Sample (Vol. \%/100)} \times \text{Cont. Vol. (Ft}^3) \times (32 + 460)}{\text{Normal Temp. + 460}} = \text{Ft}^3 \text{ Hydrogen at STP}$$

________ X 1.05 x 10 X 492 / ________ = ________

$$\frac{\text{Hot Leg Sample (cc/kg @ STP)} \times \text{RCS Vol. (Ft}^3) \times \text{Density Ratio (Enclosure 2)}}{1000} = \text{Ft}^3 \text{ Hydrogen at STP}$$

________ X 6395 X ________ / 1000 = ________

Total = ________

Record total hydrogen measured in step g, also.

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III. PROCEDURE (Continued)

e. Record the containment temperature at selected time intervals and calculate the hydrogen generated by oxidation of containment materials utilizing the typical plant production rate from Enclosure 3.

1	2	3	4	5
Time at Start of Intervals	Interval Duration (hr)	Avg. Containment Temp. During Interval (°F)	H_2 Prod. Rate (ft^3/hr) (Enclosure 3)	H_2 Produced = 2 X 4
Accident Starts				

Sampling Time

Long Term Hydrogen Production in Containment, Total = ________ ft^3 @STP

Typical Short term rapid hydrogen production by containment aluminum 1000 SCF

Total Hydrogen Production In Containment ________ SCF

Record total in step g also.

III. PROCEDURE (Continued)

f. Record the data requested below and utilize the curve of Enclosure 4 to obtain the cubic feet of hydrogen at STP generated by radiolysis. Determine the approximate power to be used as follows:

For the case in which the operating power is constant or has not changed by more than ±10 percent for a period greater than 30 days, that power is used.

For the case in which the power has not remained constant during the 30 days prior to the reactor shutdown, engineering judgement is required to determine the most representative power level. The last power levels at which the reactor operated should weigh more heavily in the judgement than the earlier levels. Continued operation for an extended period should weigh more heavily in the judgement than brief transient levels.

For the case in which the reactor has produced power for less than 30 days, the procedure may still be employed. However, the estimate of hydrogen from radiolysis will be too high and therefore the calculated hydrogen by core oxidation will be too low. Hence an underprediction of core damage may result.

Prior 30 day power history	Power, percent	Duration, Days
	________	________
	________	________
	________	________
	________	________

Power to use in evaluating long term hydrogen production by radiolysis = (1500, Mwt) X ________________.

Reactor Trip Time	________	hrs
Sampling Time (see step d)	________	hrs
Decay Time (Sampling Time - Trip Time)	________	hrs

Enter abscissa on Enclosure 4 with above decay time and read two values for hydrogen produced by radiolysis, one from each curve, in cubic feet of hydrogen at STP per Mwt operating power. Multiply by above power and record as follows:

Limit Curve	Hydrogen Produced (SCF/Mwt, Enclosure 4)	Operating Power	Total Hydrogen Produced (SCF)
Upper	________	________	________
Lower	________	________	________

Using results from Radiological Damage Assessment Procedure, estimate which results should be used; upper limit for major fuel overheat, lower limit for initial fuel overheat or appropriate estimate between the two curves for intermediate fuel overheat. Circle corresponding value of hydrogen above and also record in step g.

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III. PROCEDURE (Continued)

g. Enter the amounts of hydrogen from steps d, e, and f below.

Hydrogen Measured, Step d.	________	SCF
Hydrogen Produced in Containment, Step e.	________	SCF
Hydrogen Produced by Radiolysis, Step f.	________	SCF
Subtract Step e and f from d to get Hydrogen Produced by Core Clad Oxidation	________	SCF

Divide by (2570 SCF/1% Clad Oxidized) = ________%
= % Core Oxidated

h. Enter the abscissa of the curve on Enclosure 5 with the "% Core Oxidized" from step g. Use the curve labeled with the pressure closes to but greater than the RCS pressure during the core uncovery period as obtained and recorded in Step b. Read on the ordinate of Enclosure 5, the percent of fuel rods with ruptured clad and record below. Note that the sensitivity of measurement of hydrogen is comparable to the range of oxidation on Enclosure 5. Hence, small amounts of clad rupture are not reliably predicted by this procedure.

% of Fuel Rods with Ruptured Clad = ____________ %

i. Enter the abscissa of the curve on Enclosure 6 with th "% Core Oxidized" from step g. Read on the ordinate the lower and upper values of the range indicated by the curve for the percent of fuel rods which have embrittled clad and record below.

Percent of Fuel Rods with Local Oxidation Embrittlement

Range - Upper ____________ %

- Lower ____________ %

j. For a given percent oxidation of the core clad, the lower limit estimate of embrittled clad in step i is, for most accident scenarios, the least amount of potential fuel structural failure. Step g may be interpreted as follows:

When the pressure during uncovery from step b is less than about 100 psia, a rapid core uncovery by blowdown is concluded. Heatup with minimum clad oxidation occurs. The extent of potential clad structural failures by melting may be greater than the upper limit of embrittlement from step i as determined by oxidation. Hence, use the upper limit from step i.

When there is inlet flow while the core is uncovering, the rate of uncovery is slower than assumed in the derivation of the curves on Enclosure 5 and 6. For a measured total amount of oxidation, the local percentage oxidation is probably greater along a shorter length of the upper portion of the fuel. Hence, favor the upper limit from step i.

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III. PROCEDURE (Continued)

k. CORE DAMAGE ASSESSMENT

The conclusion on core damage is made using the two results from above. These are:

1. Percentage of fuel rods with ruptured clad, step h.

2. Percentage of fuel rods with embrittled or structurally damage clad, step i.

Knowledgeable judgement is used to compare the above two results to the definitions of the 10 NRC categories of fuel damage found in Enclosure 1. Core damage does not take place uniformly. Therefore when evaluating damage using these results, Enclosure 1 may yield a combination of categories of damage which exist simultaneously.

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Enclosure 1

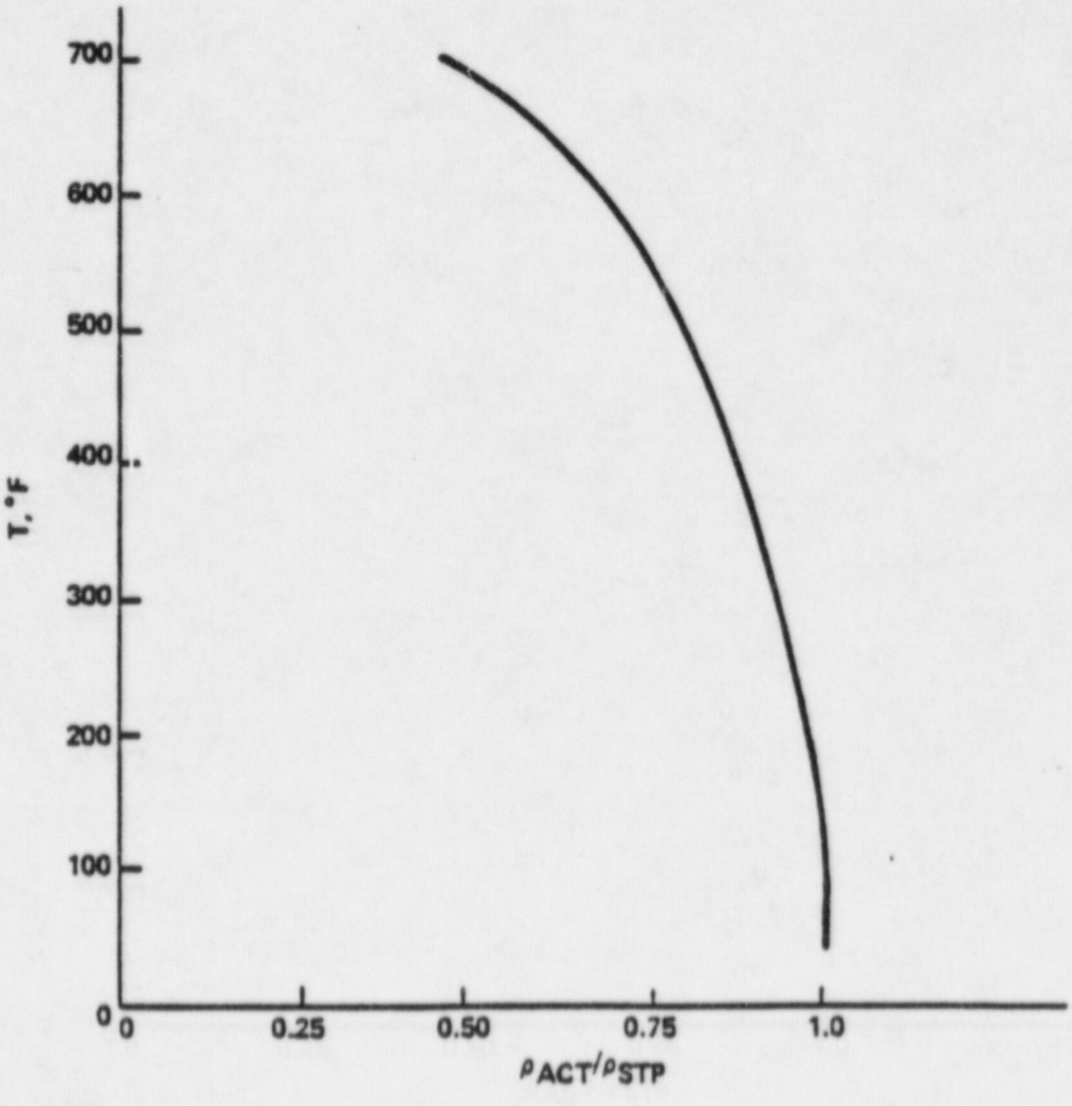
Clad Damage Characteristics of NRC Categories of Fuel Damage

NRC Category of Fuel Damage	Temperature Range (°F)	Mechanism of Damage	Characteristic Measurement	Measurement Range	Percent of Damage Rods
No Fuel Damage	~750	None	--	--	Less Than 1
Initial Cladding Failure	1200-1800	Rupture Due to Gas Gap Overpressurization	Maximum Core Exit Thermocouple Temperature	<1550°F*	Less Than 10
Intermediate Cladding Failure				<1700°F*	10 to 50
Major Cladding Failure				$\lesssim$2300°F $\lesssim$2% Oxidation	Greater Than 50
Initial Fuel Pellet Overheating	1800-3350	Loss of Structural Integrity Due to Fuel Clad Oxidation	Amount of Hydrogen Gas Produced (Equivalent to % Oxidation of Core)	Equivalent Core Oxidation <3%	Less Than 10
Intermediate Fuel Pellet Overheating				<18%	
Major Fuel Pellet Overheating				$\lesssim$65%	Greater Than 50

* Depends on Reactor Pressure and Fuel Burnup. Values Given for Pressure $\leq$1200 psia and Burnup $\geq$0.

ENCLOSURE 2

RATIO OF H_2O TO H_2O DENSITY AT
STP vs TEMPERATURE



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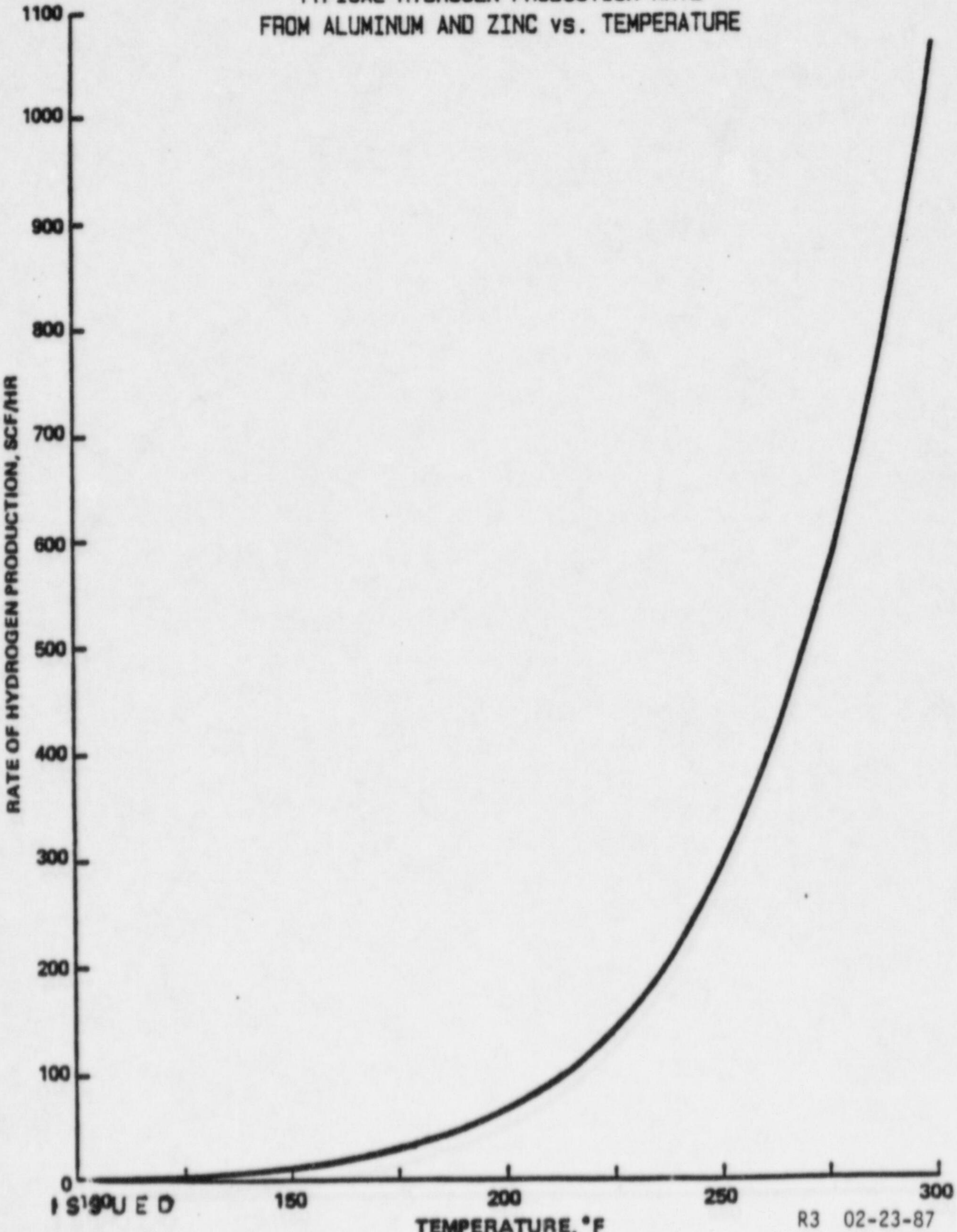
ENCLOSURE 3

TYPICAL HYDROGEN PRODUCTION RATE
FROM ALUMINUM AND ZINC vs. TEMPERATURE



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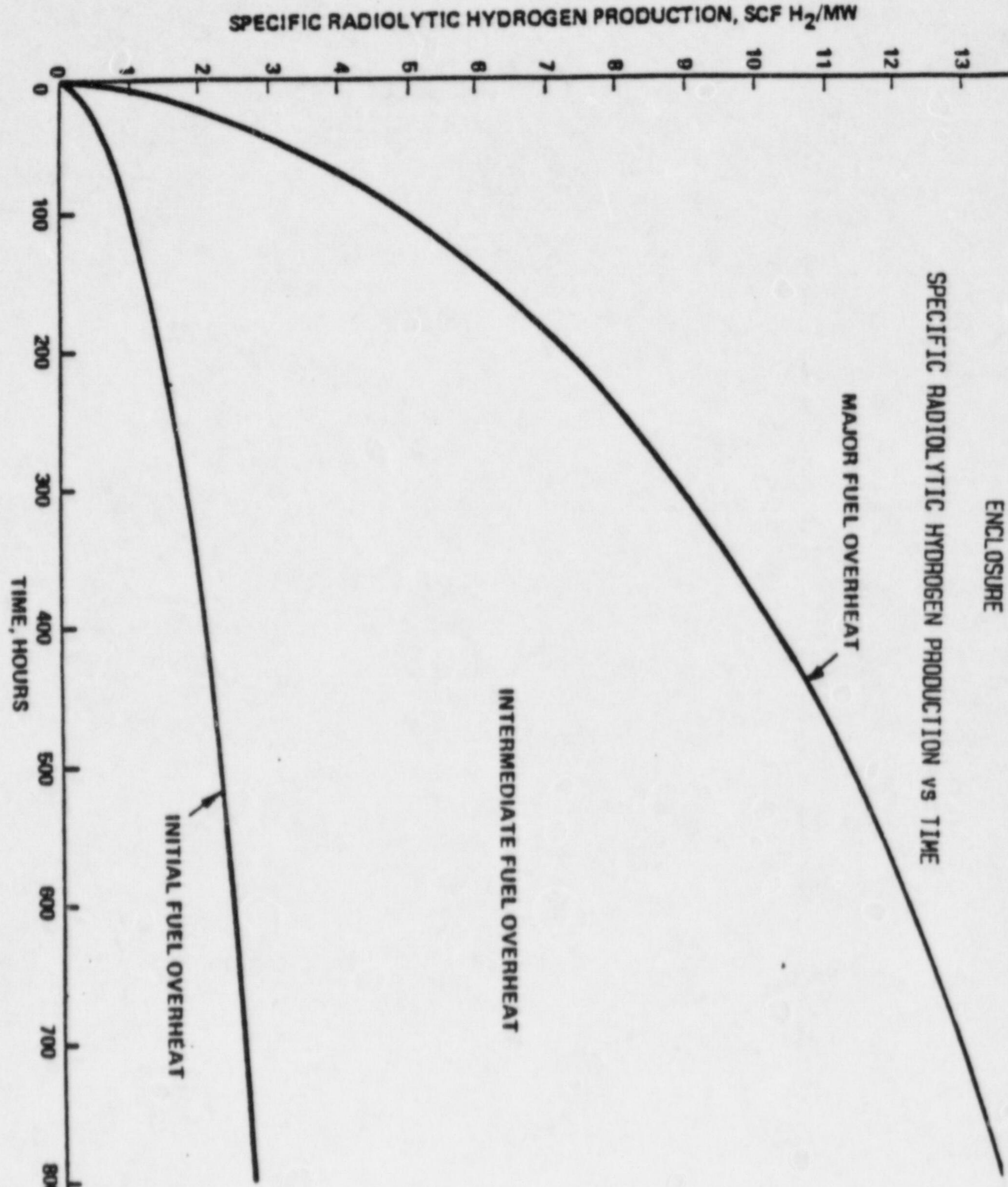
ENCLOSURE

SPECIFIC RADIOLYTIC HYDROGEN PRODUCTION vs TIME



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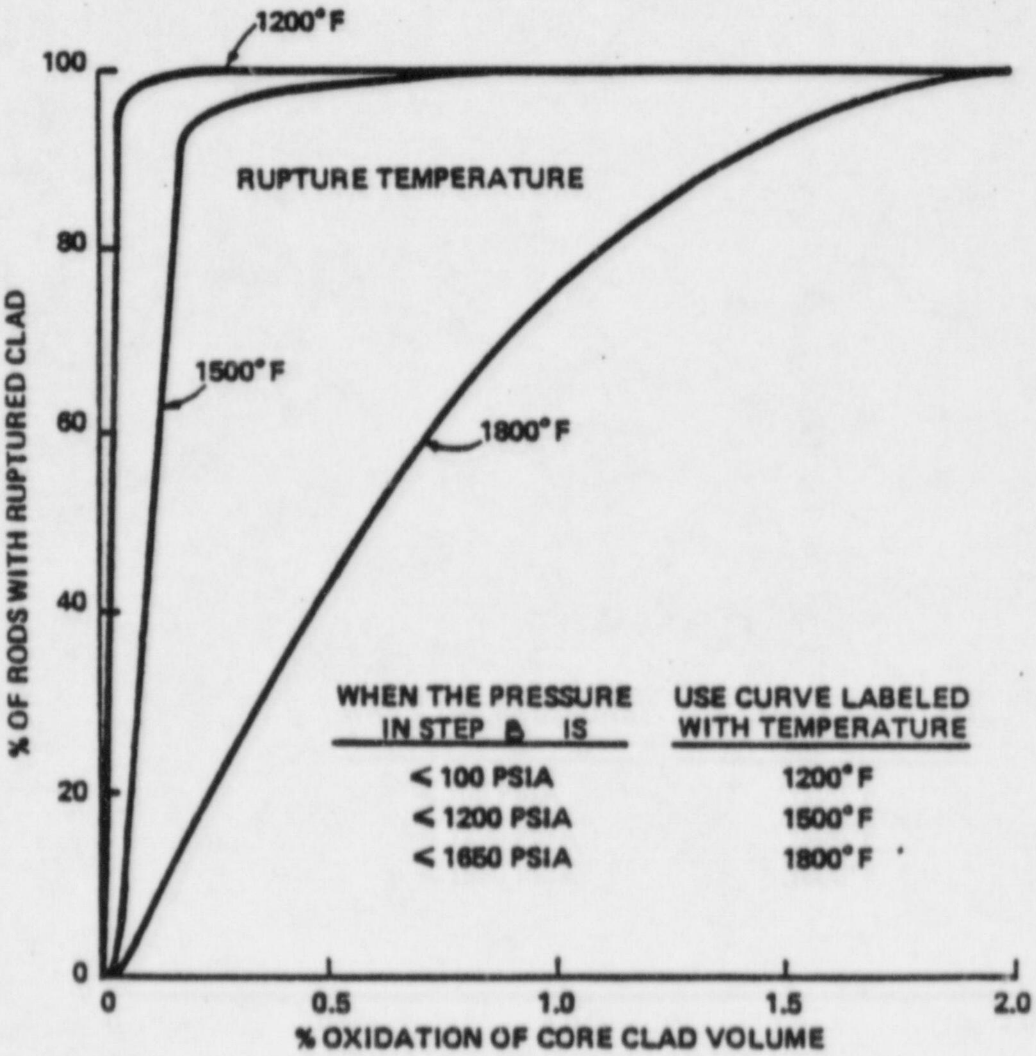
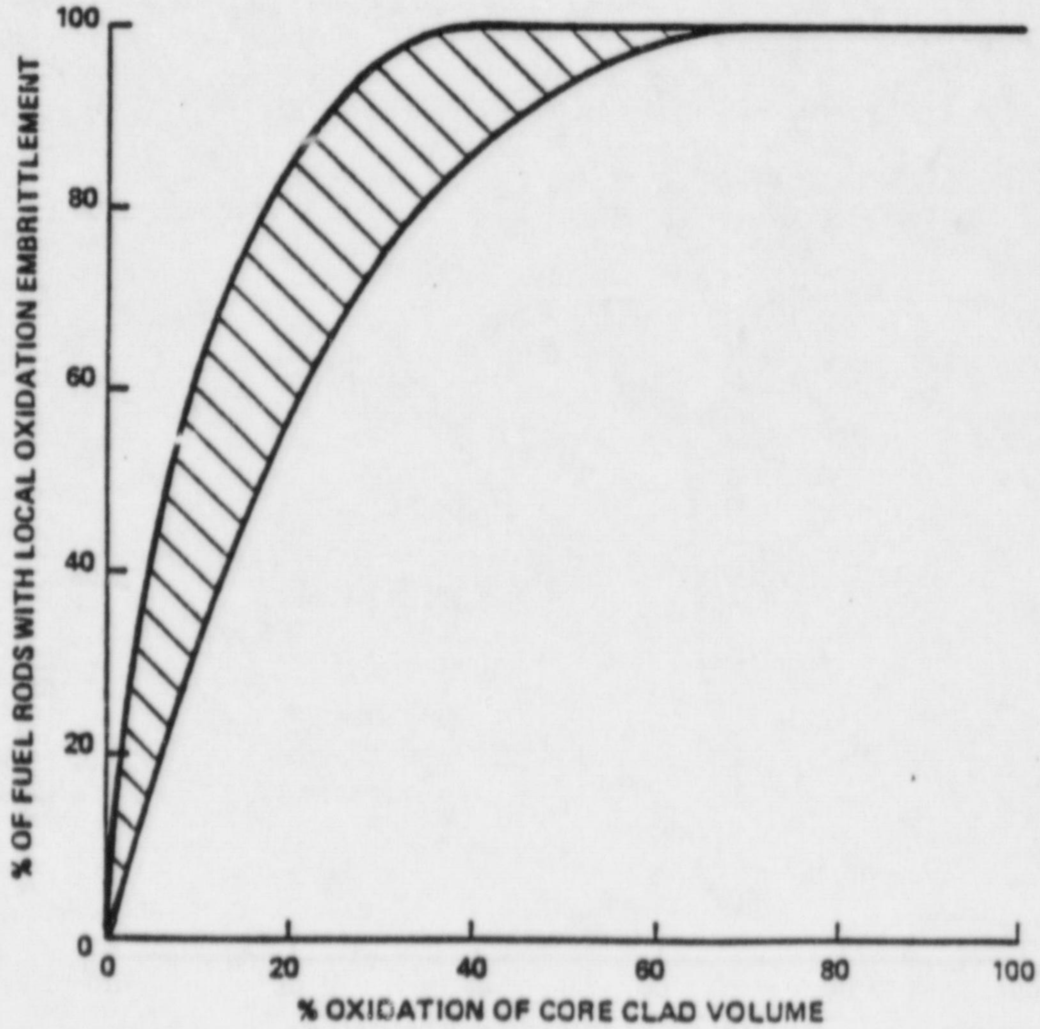
ENCLOSURE 5

PERCENT OF FUEL RODS WITH RUPTURED CLAD vs CORE CLAD OXIDATION



ENCLOSURE 6

% OF THE FUEL RODS WITH OXIDATION EMBRITTLEMENT vs
TOTAL CORE OXIDATION
FOR 1% TO 3% DECAY HEAT AND 300 PSIA TO 2500 PSIA
WHEN COOLANT LEVEL DROPS BY BOILOFF WITH
NO INLET FLOW UNTIL CORE IS RAPIDLY QUENCHED



Fort Calhoun Station Unit No. 1
ADDENDUM TO EPIP-TSC-8-C

Estimation of hydrogen Volume in Reactor Vessel Head Void

I. PURPOSE

The purpose of this addendum is to provide a guideline for estimating the amount of hydrogen gas contained in a void at the top of the reactor vessel. This volume of hydrogen is added to the measured hydrogen in procedure Step d. of EPIP-TSC-8-C to yield the total hydrogen generated by all sources.

II. PRECAUTIONS AND LIMITATIONS

This addendum should only be used to supplement the procedure when the primary system could not be filled prior to taking the liquid sample. This addendum can then be used to estimate the hydrogen in the vessel void which is not evident from the hot leg liquid sample.

This addendum only applies when the coolant level is above the hot leg and the remainder of the primary system is filled. Verification that the steam generator tubes are filled can be provided by the existence of natural convection flow in the primary system.

The reactor vessel level monitoring system is required to provide the reactor coolant level. The volume of the void is obtained by relating the volume in the vessel above the reactor coolant level to the value of level for the Fort Calhoun reactor vessel design.

This addendum only provides the analytical means to estimate the hydrogen contained in the void. The presence of other gases including helium, nitrogen and fission product gases will add uncertainty to the result.

III. PROCEDURE

a. Determine the conditions of the void as follows:

V = Void volume (ft^3), derived from measurement of coolant level
T_L = Temperature of liquid at coolant surface (°F)
P_{SAT} = Water saturation pressure at temperature T_L
P_{TOT} = Reactor coolant system pressure (psia)

b. A first approximation is made using the following assumptions:

The partial pressure of vapor in the void is equal to the saturation pressure at the liquid temperature, T. This implies no heating of the void gas by the reactor vessel walls or head. They are normally at reactor outlet temperature and could remain above the temperature of the void causing the vapor to be superheated.

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ADDENDUM (Continued)

All the non-condensible gas in the void is assumed to be hydrogen and there is no helium or fission product gas from ruptured fuel rods and no nitrogen from the Safety Injection Tanks. A second approximation which eliminates this assumption is given in Step d.

c. Calculate the amount of hydrogen as follows:

$P_{H_2} = P_{TOT} - P_{SAT}$:

$$FT^3\ H_2\ @\ STP = (V)\ \frac{P_{H_2}}{(14.7)}\ \frac{492}{(T_L + 460)}$$

Add this amount to the total hydrogen in Step d. of EPIP-TSC-8-C.

d. A second approximation can be made using the Post Accident Sampling System and measuring the total gas and hydrogen dissolved in the hot leg liquid sample. This approximation assumes the following:

The gases have the same values of Henry's law constant which relates the partial pressure of a gas to the amount of gas dissolved in a liquid sample at equilibrium.

The dissolved gas is not in equilibrium with the gas in the void, the dissolved concentrations are still in the same relative proportion as if equilibrium did exist.

e. The partial pressure of hydrogen is calculated from:

$$P_{H_2} = (P_{TOT} - P_{SAT})\ \frac{(cc/kg)_{H_2}}{(cc/kg)}$$

Calculate the amount of hydrogen in the vessel head void by using the equation above in Step c.

SECTION D

Estimate of Core Damage Using Core Exit Thermocouple Temperatures

I. PREREQUISITES

A. A plant accident with the potential for core damage has occurred.

B. An operational core cooling instrumentation system which includes core exit thermocouple temperatures, pressurizer pressure and core level indications. It should be able to select and permanently record the highest thermocouple temperature for convenient, later inspection.

II. PRECAUTIONS AND LIMITATIONS

The assessments of core damage obtained by using this procedure are only estimates and represent lower limit estimates of clad damage.

This procedure provides an estimate of damage up to the time the core temperature reaches about 2300°F. At that point the rods are expected to have ruptured clad but little other structural degradation. More severe core damage cannot be quantified by this procedure.

Although this procedure yields a more immediate assessment of core damage, accuracy is limited to relatively less severe accidents such as slow core uncovery by boiloff of the reactor coolant. For other more rapid uncovery scenarios this procedure could yield a very low estimate for the number of ruptured rods. In general, for core uncovery at pressures below about 1200 psia there is high confidence that at least the predicted estimate of rods are actually ruptured.

III. PROCEDURE

Estimation of Core Damage Using CET Measurements

a. From the recordings of maximum core exit thermocouple temperature and reactory coolant system pressure as a function of time, obtain and record the following data.

Maximum Core Exit Thermocouple Temperature ____________ F

Time of Maximum Temperature ____________

Pressurizer Pressure at Above Time ________ psia

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III. PROCEDURE (Continued)

b. Select the curve on Enclosure 2 which is labeled with a pressure approximately equal to or greater than the pressure recorded above. Enter the abscissa at the maximum temperature from above and read on the ordinate the percent of the fuel rods which have ruptured clad and record below.

Percent of ruptured rods. ____________ %

c. The result in step b is probably a lower limit estimate of damage. Some judgement on the bias is available as follows.

A smooth core exit thermocouple recording and an uncovery duration of 20 minutes or longer will yield a good prediction of clad ruptures.

A large break is indicated when the pressure in step a drops below 100 psia in less than two minutes after accident initiation. This causes undetected core heatup followed by flashing during refill. Depending on the rate of refill, the thermocouple temperature may rise rapidly then quench when the core is recovered. Under these conditions, this procedure could yield a very low estimate for the percent of rods ruptured.

If the pressure in step a is above about 1650 psia, it could exceed the rod internal gas pressure, depending on rod burnup, and cause clad collapse onto the fuel pellet instead of outward clad ballooning. The clad rupture criteria are less well defined for those conditions, but at temperatures above 1800°F where the highest pressure curve applies in step b, clad failure sufficient to release fission gas is likely and this procedure may be used to obtain estimates of damage.

d. CORE DAMAGE ASSESSMENT

Use the percent of rods ruptured from step c and the clad damage characteristics of Enclosure 1 to determine the NRC category of cladding failure. This procedure yields damage estimates in categories 2, 3, or 4.

NRC category of cladding failure from Enclosure 1 ______________

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Enclosure 1

Clad Damage Characteristics of NRC Categories of Fuel Damage

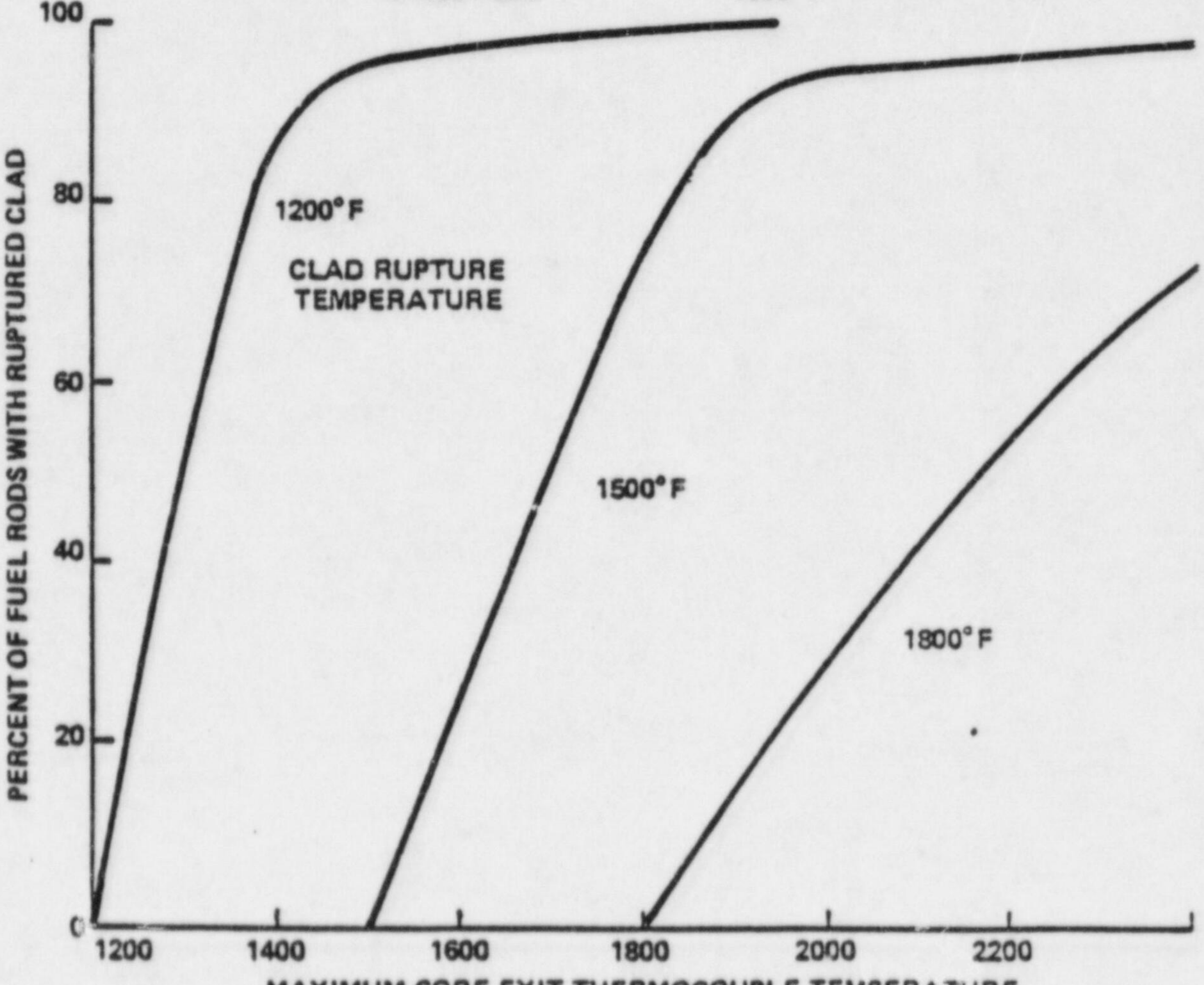
NRC Category of Fuel Damage	Temperature Range (°F)	Mechanism of Damage	Characteristic Measurement	Measurement Range	Percent of Damage Rods
No Fuel Damage	~750	None	--	--	Less Than 1
Initial Cladding Failure	1200-1800	Rupture Due to Gas Gap Overpressurization	Maximum Core Exit Thermocouple Temperature	<1550°F*	Less Than 10
Intermediate Cladding Failure	1200-1800			<1700°F*	10 to 50
Major Cladding Failure	1200-1800			$\gtrsim$2300°F $\gtrsim$2% Oxidation	Greater Than 50
Initial Fuel Pellet Overheating	1800-3350	Loss of Structural Integrity Due to Fuel Clad Oxidation	Amount of Hydrogen Gas Produced (Equivalent to % Oxidation of Core)	Equivalent Core Oxidation <3%	Less Than 10
Intermediate Fuel Pellet Overheating	1800-3350			<18%	
Major Fuel Pellet Overheating				$\gtrsim$65%	Greater Than 50

* Depends on Reactor Pressure and Fuel Burnup. Values Given for Pressure ≤1200 psia and Burnup ≥0.

ENCLOSURE 2

PERCENT OF FUEL RODS WITH RUPTURED CLAD vs MAXIMUM CORE EXIT THERMOCOUPLE TEMPERATURE

WHEN THE PRESSURE IN STEP a IS	USE CURVE LABELED WITH TEMPERATURE
< 100 PSIA	1200° F
< 1200 PSIA	1500° F
< 1650 PSIA	1800° F



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Fort Calhoun Station Unit No. 1
EMERGENCY PLAN IMPLEMENTING PROCEDURE
EPIP-RR-72

Emergency Recovery Organization's Dose Assessment Specialist

I. PURPOSE

The purpose of this procedure is to detail assignment and responsibilities of personnel in the Emergency Recovery Organization filling the position of Dose Assessment Specialist.

II. PREREQUISITE

Both primary and alternate individuals filling the position of Dose Assessment Specialist have been fully trained and are aware of their duties and responsibilities.

III. PRECAUTIONS

None

IV. PROCEDURE

Upon activation of the Emergency Recovery Organization, those individuals assigned to the position of Dose Assessment Specialist shall carry out this assignment in Appendix 1 of this Implementing Procedure.

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Fort Calhoun Station Unit No. 1
EMERGENCY PLAN IMPLEMENTING PROCEDURE
EPIP-RR-72

APPENDIX 1
DOSE ASSESSMENT SPECIALIST

A. Personnel Assignment

Primary (Job Title)

By Recovery Manager Designation

Alternate (Job Title)

By Recovery Manager Designation

B. Reporting Location

Emergency Operations Facility

C. Reports To:

Dose Assessment Coordinator

D. Supervises/Coordinates

Offsite Monitor Teams

E. Primary Responsibility

Provide control and direction of offsite monitor teams, record offsite monitor team readings and locations and provide continuous updated information to the Dose Assessment Coordinator.

F. Basic Duties:

1. Upon notification of Emergency Recovery Organization activation the primary and/or alternate Dose Assessment Specialist designate(s) will report to their assigned location and inform the Dose Assessment Coordinator of his/her presence.

2. Be prepared to provide around-the-clock support.

3. Assume control of offsite monitor teams from the monitor coordinator when directed by the Dose Assessment Coordinator.

4. Maintain constant radio communications with all offsite teams and monitor radio communications between onsite monitor teams, TSC and the FCS access Road Security Guard.

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F. Basic Duties: (Continued)

5. Coordinate with states to direct offsite monitor teams to specific monitor locations within the affected sectors.

6. Ensures off-site monitors are briefed on the plant condition and projected or known release information periodically when teams are in plume sectors.

7. Obtain monitor team locations and survey results from state field monitoring teams.

8. Record offsite monitor teams sample readings on FC-185 and pass this information to the clerical assistant for distribution.

9. Record projected and measured dose rates on correlation sheet (attachment F-1, EPIP-EOF-6). Notify the Dose Assessment Coordinator or the Emergency Coordinator of any discrepancies immediately.

10. Maintain dosimetry log on each of the off site monitor team members.

11. Record, on the large monitor locations map, monitor team location, survey results and time surveys were taken for each of the field monitoring teams (OPPD teams and state teams).

12. Contact the National Weather Service in Omaha 9-571-8351 and request projected meteorological weather information necessary to make long term dose projections. Provides this information to the Dose Assessment Operator and Dose Assessment Coordinator.

13. Assist the Dose Assessment Coordinator as needed.

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