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**TITLE:** OFFSITE DOSE CALCULATION - STRAIGHT LINE GAUSSIAN (MANUAL METHOD)

**TRANSMITTAL:** LISTED BELOW ARE NEW/REVISED PROCEDURES WHICH MUST BE IMMEDIATELY INSERTED INTO OR DISCARDED FROM YOUR PROCEDURE MANUAL.

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| REMOVE AND DESTROY | EI-6.10, R/5, ENTIRE PROCEDURE |
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***SIGN, DATE, AND RETURN THE ACKNOWLEDGEMENT FORM WITHIN 10 DAYS TO THE PALISADES PLANT DOCUMENT CONTROL.***

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A045

**Procedure No EI-6.10**
**Revision 5**
**Issued Date** 12/13/01

**PALISADES NUCLEAR PLANT**
**EMERGENCY IMPLEMENTING PROCEDURE**

# TITLE: OFFSITE DOSE CALCULATION - STRAIGHT LINE GAUSSIAN (MANUAL METHOD)

JWPontbriand 12/12/01
Procedure Sponsor Date

NKBrott 11/21/94
Technical Reviewer Date

User Reviewer Date

# TITLE: OFFSITE DOSE CALCULATION - STRAIGHT LINE GAUSSIAN (MANUAL METHOD)

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ATTACHMENTS

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# TITLE: OFFSITE DOSE CALCULATION - STRAIGHT LINE GAUSSIAN (MANUAL METHOD)

**USER ALERT**
INFORMATION USE PROCEDURE

The activities covered by this procedure may be performed from memory.

## 1.0 PERSONNEL RESPONSIBILITY

The Health Physics Group Leader is responsible for the implementation of this procedure. In the absence of a Health Physics Group Leader, the Site Emergency Director or EOF Director shall delegate this responsibility.

## 2.0 PURPOSE

This procedure implements the same equations and assumptions as used in the automated dose calculations. All calculations are performed manually through the use of precalculated dose factors for whole body dose rates and thyroid dose rates.

Results from this procedure can be used to check the dose calculations performed in the automated dose assessment program "Offsite."

## 3.0 REFERENCES

### 3.1 SOURCE DOCUMENTS

3.1.1 NUREG 0654 Section I, "Accident Assessment"

3.1.2 EPA-400 Manual, "Protective Action Guideline and Protective Actions for Nuclear Incidents"

### 3.2 REFERENCE DOCUMENTS

3.2.1 Emergency Implementing Procedure EI-6.0, "Offsite Dose Calculation and Recommendations for Protective Actions"

3.2.2 Emergency Implementing Procedure EI-1, "Emergency Classification and Actions"

3.2.3 Palisades Administrative Procedure 10.46, "Plant Records"

# TITLE: OFFSITE DOSE CALCULATION - STRAIGHT LINE GAUSSIAN (MANUAL METHOD)

## 4.0 DEFINITIONS

### 4.1 CDE

Committed Dose Equivalent: 50-year integrated dose to organs or tissues due to an intake at time zero.

### 4.2 CEDE

Committed Effective Dose Equivalent: The dose committed to an individual over the next 50 years due to intake of radioactive material, weighted (by organ) to represent a risk equivalent to that of whole body exposure.

### 4.3 DDE

Deep Dose Equivalent: Dose equivalent due to external radiation at 1 cm tissue depth.

### 4.4 TEDE

Total Effective Dose Equivalent: Sum of deep dose equivalent due to external radiation exposure and committed effective dose equivalent due to internal exposure. When no other designator is applied to dose in units of rem, TEDE is implied.

### 4.5 RELEASE OF RADIOACTIVE MATERIAL

e

Any discharge of radioactive effluent to the environment that is the result of or associated with the emergency event.

## 5.0 INITIAL CONDITIONS AND/OR REQUIREMENTS

This procedure shall be implemented per Emergency Implementing Procedure EI-6.0, "Offsite Dose Calculation and Recommendations for Protective Actions," when there is a potential for, or an actual significant release of radioactive materials from the Plant site (as specified by Emergency Implementing Procedure EI-1, "Emergency Classification and Actions"), and the automated dose assessment program "Offsite" is not available.

# TITLE: OFFSITE DOSE CALCULATION - STRAIGHT LINE GAUSSIAN (MANUAL METHOD)

## 6.0 PROCEDURE

**USER ALERT**
INFORMATION USE PROCEDURE

The activities covered by this procedure may be performed from memory.

6.1 From the attached work sheets, select the one corresponding to the current Pasquill stability category (A - G).

6.2 Record the required input information in Items 1 through 6, for any applicable page of each stability class.

6.3 Complete dose calculations per instructions on the work sheet.

6.4 All completed attachments should be forwarded to the Health Physics Support Group Leader or designate for review. |e

## 7.0 ATTACHMENTS AND RECORDS

### 7.1 ATTACHMENTS

Attachment 1, "Manual Dose Work Sheet"

### 7.2 RECORDS

Records generated by this procedure (ie, Attachment 1) shall be filed in accordance with Palisades Administrative Procedure 10.46, "Plant Records."

## 8.0 SPECIAL REVIEWS

None |e

# MANUAL DOSE WORK SHEET
## GROUND LEVEL RELEASE

Stability A

| | | | |
|---|---|---|---|
| 1. | Noble Gas Release Rate (Ci/sec) | _____ | (A) |
| 2. | Iodine Release Rate (Ci/sec) | _____ | (B) |
| 3. | Wind Speed (mph) | _____ | (C) |
| 4. | Stability Class (A-G) | A | (D) |
| 5. | Release Duration (hours) | _____ | (E) (Default = 2 hrs) |
| 6. | Average Energy (Mev) | _____ | (F) (Default = 0.7) |

Downwind Distances (Miles)

| | 0.5 Mi | 2 Mi | 5 Mi | 10 Mi | |
|---|---|---|---|---|---|
| Wholebody DDE Dose Factor | 9.780E+00 | 3.434E-01 | 1.723E-01 | 9.275E-02 | (G) |
| Wholebody Dose Rate (mrem/hr)<br>(A x G x F)/C | _____ | _____ | _____ | _____ | (H) |
| Wholebody Dose (mrem)<br>H x E | _____ | _____ | _____ | _____ | (I) |
| Thyroid CDE Factor | 1.837E+04 | 4.760E+02 | 1.875E+02 | 9.037E+01 | (J) |
| Thyroid CDE Rate (mrem/hr)<br>(B x J)/C | _____ | _____ | _____ | _____ | (K) |
| Thyroid CDE (mrem)<br>K x E | _____ | _____ | _____ | _____ | (L) |
| TEDE Rate (mrem/hr)<br>H + (K/30) | ---------- | ---------- | ---------- | ---------- | (M) |
| TEDE (mrem)<br>I + (L/30) | ---------- | ---------- | ---------- | ---------- | (N) |

Above doses based on actual/potential (circle one) releases.

Date: _____ Time: _____ Completed By: _____

# MANUAL DOSE WORK SHEET
## GROUND LEVEL RELEASE

Stability B

| | | | |
|---|---|---|---|
| 1. | Noble Gas Release Rate (Ci/sec) | _____ | (A) |
| 2. | Iodine Release Rate (Ci/sec) | _____ | (B) |
| 3. | Wind Speed (mph) | _____ | (C) |
| 4. | Stability Class (A-G) | B | (D) |
| 5. | Release Duration (hours) | _____ | (E) (Default = 2 hrs) |
| 6. | Average Energy (Mev) | _____ | (F) (Default = 0.7) |

Downwind Distances (Miles)

| | 0.5 Mi | 2 Mi | 5 Mi | 10 Mi | |
|---|---|---|---|---|---|
| Wholebody (DDE) Dose Factor | 3.199E+01 | 2.979E+00 | 6.071E-01 | 1.616E-01 | (G) |
| Wholebody Dose Rate (mrem/hr) (A x G x F)/C | _____ | _____ | _____ | _____ | (H) |
| Wholebody Dose (mrem) H x E | _____ | _____ | _____ | _____ | (I) |
| Thyroid CDE Factor | 8.185E+04 | 4.827E+03 | 6.987E+02 | 1.575E+02 | (J) |
| Thyroid CDE Rate (mrem/hr) (B x J)/C | _____ | _____ | _____ | _____ | (K) |
| Thyroid CDE (mrem) K x E | _____ | _____ | _____ | _____ | (L) |
| TEDE Rate (mrem/hr) H + (K/30) | ---------- | ---------- | ---------- | ---------- | (M) |
| TEDE (mrem) I + (L/30) | ---------- | ---------- | ---------- | ---------- | (N) |

Above doses based on actual/potential (circle one) releases.

Date: _____ Time: _____ Completed By: _____

# MANUAL DOSE WORK SHEET
## GROUND LEVEL RELEASE

Stability C

| | | | |
|---|---|---|---|
| 1. | Noble Gas Release Rate (Ci/sec) | _____ | (A) |
| 2. | Iodine Release Rate (Ci/sec) | _____ | (B) |
| 3. | Wind Speed (mph) | _____ | (C) |
| 4. | Stability Class (A-G) | C | (D) |
| 5. | Release Duration (hours) | _____ | (E) (Default = 2 hrs) |
| 6. | Average Energy (Mev) | _____ | (F) (Default = 0.7) |

Downwind Distances (Miles)

| | 0.5 Mi | 2 Mi | 5 Mi | 10 Mi | |
|---|---|---|---|---|---|
| Wholebody (DDE) Dose Factor | 5.496E+01 | 7.591E+00 | 1.976E+00 | 6.343E-01 | (G) |
| Wholebody Dose Rate (mrem/hr) (A x G x F)/C | _____ | _____ | _____ | _____ | (H) |
| Wholebody Dose (mrem) H x E | _____ | _____ | _____ | _____ | (I) |
| Thyroid CDE Factor | 1.792E+05 | 1.403E+04 | 2.410E+03 | 6.180E+02 | (J) |
| Thyroid CDE Rate (mrem/hr) (B x J)/C | _____ | _____ | _____ | _____ | (K) |
| Thyroid CDE (mrem) K x E | _____ | _____ | _____ | _____ | (L) |
| TEDE Rate (mrem/hr) H + (K/30) | ---------- | ---------- | ---------- | ---------- | (M) |
| TEDE (mrem) I + (L/30) | ---------- | ---------- | ---------- | ---------- | (N) |

Above doses based on actual/potential (circle one) releases.

Date: _____ Time: _____ Completed By: _____

# MANUAL DOSE WORK SHEET
## GROUND LEVEL RELEASE

| | | Stability D | |
|---|---|---|---|
| 1. | Noble Gas Release Rate (Ci/sec) | _____ | (A) |
| 2. | Iodine Release Rate (Ci/sec) | _____ | (B) |
| 3. | Wind Speed (mph) | _____ | (C) |
| 4. | Stability Class (A-G) | D | (D) |
| 5. | Release Duration (hours) | _____ | (E) (Default = 2 hrs) |
| 6. | Average Energy (Mev) | _____ | (F) (Default = 0.7) |

| | Downwind Distances (Miles) | | | | |
|---|---|---|---|---|---|
| | 0.5 Mi | 2 Mi | 5 Mi | 10 Mi | |
| Wholebody (DDE) Dose Factor | 9.378E+01 | 2.070E+01 | 7.572E+00 | 3.578E+00 | (G) |
| Wholebody Dose Rate (mrem/hr) (A x G x F)/C | _____ | _____ | _____ | _____ | (H) |
| Wholebody Dose (mrem) H x E | _____ | _____ | _____ | _____ | (I) |
| Thyroid CDE Factor | 4.298E+05 | 5.087E+04 | 1.184E+04 | 3.875E+03 | (J) |
| Thyroid CDE Rate (mrem/hr) (B x J)/C | _____ | _____ | _____ | _____ | (K) |
| Thyroid CDE (mrem) K x E | _____ | _____ | _____ | _____ | (L) |
| TEDE Rate (mrem/hr) H + (K/30) | ---------- | ---------- | ---------- | ---------- | (M) |
| TEDE (mrem) I + (L/30) | ---------- | ---------- | ---------- | ---------- | (N) |

Above doses based on actual/potential (circle one) releases.

Date: _____ Time: _____ Completed By: _____

## MANUAL DOSE WORK SHEET
## GROUND LEVEL RELEASE

Stability E

| | | | |
|---|---|---|---|
| 1. | Noble Gas Release Rate (Ci/sec) | _____ | (A) |
| 2. | Iodine Release Rate (Ci/sec) | _____ | (B) |
| 3. | Wind Speed (mph) | _____ | (C) |
| 4. | Stability Class (A-G) | E | (D) |
| 5. | Release Duration (hours) | _____ | (E) (Default = 2 hrs) |
| 6. | Average Energy (Mev) | _____ | (F) (Default = 0.7) |

Downwind Distances (Miles)

| | 0.5 Mi | 2 Mi | 5 Mi | 10 Mi | |
|---|---|---|---|---|---|
| Wholebody (DDE) Dose Factor | 1.328E+02 | 3.498E+01 | 1.429E+01 | 7.427E+00 | (G) |
| Wholebody Dose Rate (mrem/hr) (A x G x F)/C | _____ | _____ | _____ | _____ | (H) |
| Wholebody Dose (mrem) H x E | _____ | _____ | _____ | _____ | (I) |
| Thyroid CDE Factor | 7.506E+05 | 1.060E+05 | 2.755E+04 | 9.916E+03 | (J) |
| Thyroid CDE Date (mrem/hr) (B x J)/C | _____ | _____ | _____ | _____ | (K) |
| Thyroid CDE (mrem) K x E | _____ | _____ | _____ | _____ | (L) |
| TEDE Rate (mrem/hr) H + (K/30) | ---------- | ---------- | ---------- | ---------- | (M) |
| TEDE (mrem) I + (L/30) | ---------- | ---------- | ---------- | ---------- | (N) |

Above doses based on actual/potential (circle one) releases.

Date: _____ Time: _____ Completed By: _____

## MANUAL DOSE WORK SHEET
## GROUND LEVEL RELEASE

Stability F

| | | | |
|---|---|---|---|
| 1. | Noble Gas Release Rate (Ci/sec) | _____ | (A) |
| 2. | Iodine Release Rate (Ci/sec) | _____ | (B) |
| 3. | Wind Speed (mph) | _____ | (C) |
| 4. | Stability Class (A-G) | F | (D) |
| 5. | Release Duration (hours) | _____ | (E) (Default = 2 hrs) |
| 6. | Average Energy (Mev) | _____ | (F) (Default = 0.7) |

Downwind Distances (Miles)

| | 0.5 Mi | 2 Mi | 5 Mi | 10 Mi | |
|---|---|---|---|---|---|
| Wholebody (DDE) Dose Factor | 1.775E+02 | 6.136E+01 | 2.769E+01 | 1.537E+01 | (G) |
| Wholebody Dose Rate (mrem/hr) (A x G x F)/C | _____ | _____ | _____ | _____ | (H) |
| Wholebody Dose (mrem) H x E | _____ | _____ | _____ | _____ | (I) |
| Thyroid CDE Factor | 1.251E+06 | 2.287E+05 | 6.508E+04 | 2.484E+04 | (J) |
| Thyroid CDE Rate (mrem/hr) (B x J)/C | _____ | _____ | _____ | _____ | (K) |
| Thyroid CDE (mrem) K x E | _____ | _____ | _____ | _____ | (L) |
| TEDE Rate (mrem/hr) H + (K/30) | ---------- | ---------- | ---------- | ---------- | (M) |
| TEDE (mrem) I + (L/30) | ---------- | ---------- | ---------- | ---------- | (N) |

Above doses based on actual/potential (circle one) releases.

Date: _____ Time: _____ Completed By: _____

## MANUAL DOSE WORK SHEET
## GROUND LEVEL RELEASE

Stability G

| | | | |
|---|---|---|---|
| 1. | Noble Gas Release Rate (Ci/sec) | _____ | (A) |
| 2. | Iodine Release Rate (Ci/sec) | _____ | (B) |
| 3. | Wind Speed (mph) | _____ | (C) |
| 4. | Stability Class (A-G) | G | (D) |
| 5. | Release Duration (hours) | _____ | (E) (Default = 2 hrs) |
| 6. | Average Energy (Mev) | _____ | (F) (Default = 0.7) |

Downwind Distances (Miles)

| | 0.5 Mi | 2 Mi | 5 Mi | 10 Mi | |
|---|---|---|---|---|---|
| Wholebody (DDE) Dose Factor | 1.810E+02 | 9.741E+01 | 4.940E+01 | 2.871E+01 | (G) |
| Wholebody Dose Rate (mrem/hr) (A x G x F)/C | _____ | _____ | _____ | _____ | (H) |
| Wholebody Dose (mrem) H x E | _____ | _____ | _____ | _____ | (I) |
| Thyroid CDE Factor | 1.833E+06 | 5.007E+05 | 1.557E+05 | 6.094E+04 | (J) |
| Thyroid CDE Rate (mrem/hr) (B x J)/C | _____ | _____ | _____ | _____ | (K) |
| Thyroid CDE (mrem) K x E | _____ | _____ | _____ | _____ | (L) |
| TEDE Rate (mrem/hr) H + (K/30) | ---------- | ---------- | ---------- | ---------- | (M) |
| TEDE (mrem) I + (L/30) | ---------- | ---------- | ---------- | ---------- | (N) |

Above doses based on actual/potential (circle one) releases.

Date: _____ Time: _____ Completed By: _____