



Charles County Department of Emergency Services
STANDARD OPERATING PROCEDURES

Section 400 - Operational Safety

Operational Safety - 400.00		
S.O.P. # 400.13	Radiation Monitoring Devices	PAGE: 1 OF 5
EFFECTIVE: 07/01/2012	Authorized: John Filer, Chief	
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400.13.01 Purpose

To provide a policy and process for monitoring external radiation exposures of personnel working in the field and responding to emergencies where they may be exposed to potentially hazardous environments.

400.13.02 Cited References

- Code of Federal Regulation, Title 10 Part 20: Standards for Protection Against Radiation
- NIST, website, <http://www.nist.gov/nvlap/>

400.13.03 General

Radiation monitor/alerts, such as the NUKAlert monitoring and alarm device (radiation monitor) or equivalent, will be used for monitoring doses due to external ionizing radiation.

Workers' external doses are monitored to ensure that exposures are limited in accordance with the principle of ALARA and that occupational dose limits are not exceeded. This SOP is pursuant to the dose limits provided in 10 CFR Part 20, Subpart C.

400.13.04 Responsibilities

1. The Department will provide radiation monitoring devices to staff who have the potential to be exposed to radiation during the execution of their job duties.
2. The Department will train staff on the operation and troubleshoots of the issued radiation monitor.
3. The Special Operations Coordinator will be responsible for having the monitor calibrated/inspected on an annual basis by an authorized technician.
4. Supervisors must ensure adherence to the work procedures outlined in this SOP.
5. Employees must follow the SOP when responding to potential radiation incidents and initiate response procedures.



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6. Employees shall ensure that the issued radiation monitor is present and operational at all times.
7. Employees should report missing or failed radiation monitor to their immediate supervisor or the Special Operations Coordinator.
8. Supervisors should ensure the timely replacement of failed radiation monitors.

400.13.05 Policy

1. A radiation monitor will be issued to each piece of county apparatus.
 - i. ALS units will have the radiation monitor fixed to the cardiac monitor/defibrillator.
 - ii. BLS units will have the radiation monitor fixed to the primary aid bag.
 - iii. Non-EMS units will have the radiation monitor fixed to the primary aid bag.
 - iv. The exception to this policy is hazardous materials specific apparatus.
2. The radiation monitor is to remain on and operational at all times.
3. The Special Operations Coordinator will facilitate the calibration and inspection of radiation monitors with the on-duty Medical Duty Officer.
4. If a crew reports a failed radiation monitor, it will be replaced as soon as possible.

400.13.06 Definitions

1. As Low as Reasonably Achievable (ALARA): Maintaining occupational doses and doses to members of the public as low as is reasonably achievable using, to the extent practical, procedures and engineering controls based upon sound radiation protection principles.
2. CDE (committed dose equivalent): The CDE (HT,50) is the dose equivalent to organs or tissue of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.
3. CEDE (committed effective dose equivalent): The CEDE (HE,50) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalents for each of the body organs or tissues that are irradiated multiplied by the weighting factors (WT) applicable to each of those organs or tissues ($HE,50 = \sum WTHT,50$).
4. DDE (deep-dose equivalent, Hd): The external whole-body exposure dose equivalent at a tissue depth of 1 cm (1000 mg/cm²).
5. Dose equivalent (HT): The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert (Sv).
6. Dosimeter: A small portable instrument (such as a film badge, thermoluminescent dosimeter, or pocket dosimeter) used to measure and record the total accumulated personal dose of ionizing radiation.



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7. Gray (Gy): The SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 Joule/kilogram (100 rads).
8. LDE (lens-dose equivalent): The external exposure dose equivalent to the lens of the eye at a tissue depth of 0.3 centimeters (300 mg/cm²).
9. rad (Radiation Absorbed Dose): The special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 gray).
10. rem (Roentgen Equivalent Man): The special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem=0.01 sievert).
11. SDE (shallow-dose equivalent, HS): The external exposure dose equivalent to the skin of the whole body or the skin of an extremity at a tissue depth of 0.007 centimeters (7 mg/cm²) averaged over an area of 1 square centimeter.
12. Sievert (Sv): The SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv=100 rems).
13. TEDE (Total Effective Dose Equivalent): The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

400.13.07 Operational Procedures

1. Operational dose limits: The limit for TEDE is 5 rem/year (0.05 Sv/year)

Type of Exposure	10 CFR Part 20 Designation	CEDE Dose Limit
External Dose	Deep Dose Equivalent (DDE)	(a)
Skin Dose	Shallow Dose Equivalent (SDE), Skin of Whole Body	50 rem/year (0.5 Sv/year)
Extremity Dose	Shallow Dose Equivalent (SDE), Maximum Extremity	50 rem/year (0.5 Sv/year)
Eye Dose	Eye Dose Equivalent to Lens of the Eye (LDE)	15 rem/year (0.15 Sv/year)

(a) Included in limits for whole body and individual organs. In the absence of any internal exposure, external dose is limited to 5 rem per year. In the absence of any external exposure, internal exposure is limited to 2000 DAC-hours per year or 1 annual limit on intake (ALI) (50 rem/yr non-stochastic, 5 rem/yr stochastic).

1. Should a radiation monitor alarm at double the base background in the field during an active incident, staff should immediately remove themselves and the patient from the potentially hazardous environment.
2. If other occupants of the resident are present, they too should be evacuated.
3. Personnel should practice rescue and medical decisions based off of ALARA principles.



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- Staff should then report the alarm to the 911 Communications Center via radio and ask for support of the first due engine company and hazardous materials team.
- Radiation metering of the area, patient, crew and related equipment should be conducted by the hazardous materials team.
- If a positive exposure to radiation is confirmed by the hazardous materials team, personnel should take decontamination and treatment guidance from the established radiation safety officer.
- In the unlikely event of a failed radiation monitor, the device should be reported and replaced as soon as possible.
- The NUKAlert radiation monitor and alarm limits are set to the follow:

# OF CHIRPS	R/hr	TIME TO 100R EXP
1	0.1	41.6 d
2	0.2	20.8 d
3	0.4	10.4 d
4	0.8	5.2 d
5	1.6	2.6 d
6	3.2	1.3 d
7	6.4	15.6 h
8	12.8	7.8 h
9	25.6	3.9 h
10	50+	< 2.0 h

400.13.07 Radiation Poisoning Symptoms

The severity of signs and symptoms of radiation sickness depends on how much radiation you've absorbed. How much you absorb depends on the strength of the radiated energy, the time of your exposures, and the distance between you and the source of radiation.

Signs and symptoms are also affected by the type of exposure – such as total or partial body. The severity of radiation sickness also depends on how sensitive the affected tissue is. For instance, the gastrointestinal system and bone marrow are highly sensitive to radiation.



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Initial signs and symptoms

1. The initial signs and symptoms of treatable radiation sickness are usually nausea and vomiting. The amount of time between exposure and when these symptoms develop is a clue to how much radiation a person has absorbed.
2. After the first round of signs and symptoms, a person with radiation sickness may have a brief period with no apparent illness, followed by the onset of new, more-serious symptoms.
3. If you've had a mild exposure, it may take hours to weeks before any signs and symptoms begin. But with severe exposure, signs and symptoms can begin minutes to days after exposure. Possible symptoms include:
 - a. Nausea and vomiting,
 - b. Diarrhea;
 - c. Headache;
 - d. Fever;
 - e. Dizziness and disorientation;
 - f. Weakness and fatigue;
 - g. Hair loss;
 - h. Bloody vomit and stools from internal bleeding;
 - i. Infections; and
 - j. Low blood pressure.
4. Personnel experiencing any of the aforementioned signs and symptoms post a confirmed radiation exposure should seek medical attention and make report to their immediate supervisor.