Contents

List of Tables

1.0 INTRODUCTION

1.1 Purpose

This program provides the maximum safety to employees and contractors while working with or around radiation sources at the Anacortes Refinery. It was developed in accordance with Washington (WA) State radiation safety regulatory requirements. Washington is an agreement state, which has been provided with the Nuclear Regulatory Commission's (NRC) delegation of authority to license and regulate radiation sources.

1.2 Scope

This program applies to Anacortes Refinery employees and contractors. The Anacortes Refinery contains radiation sources, which includes radioactive materials or devices (i.e., equipment, machines, instruments) emitting or capable of producing ionizing radiation. Radiation, as used in this program, does not include non-ionizing radiation. Compliance with this program ensures achieving occupational doses that are as low as reasonably achievable (ALARA).

2.0 REFERENCES

2.1 Marathon Standards, Policies & Procedures

- HLT-2016 Radiation Safety Management Program

2.2 Government Regulations

- WAC 246-220 to 254 Radiation Protection
- WAC 296-62-09004 Ionizing Radiation
- NRC 10 CFR 20 Standards for Protection Against Radiation

3.0 DEFINITIONS

The following definitions are applicable to this procedure.

Table 1 Definitions

Term	Description
ALARA (As Low as Reasonably Achievable)	A concept that all radiation exposures should be minimized by the use of time, distance, shielding and work practices that reduce exposure.
Background Radiation	Radiation from cosmic sources; naturally occurring radioactive materials, including radon and consumer products (such as incandescent gas lantern mantles, and global fallout from testing nuclear explosive devices). Background radiation does not include radiation from source, byproduct or special nuclear materials regulated by the NRC.
Curie	A unit of radioactivity equal to 3.7 x 1010 disintegrations per second.

Table 1 Definitions

Term	Description
High Radiation Area	An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent in excess of 100 mrem in 1 hour at 30 centimeters (or 1 foot) from the radiation source or 1 foot from any surface that the radiation penetrates.
Industrial Radiographer	An individual who performs radiographic operations and who is responsible for assuring compliance with radiation control regulations and license conditions that apply to work performed. (aka Radiographer)
Ionizing Radiation	Electromagnetic or particulate radiation of sufficient energy to ionize matter by removing an electron from an atom. Includes alpha particles, beta particles, x-rays, gamma rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used in this program, does not include non-ionizing radiation.
mCi	Millicurie. By conversion, a unit of radioactivity equal to one thousandth of a curie.
mrem/hr. (millirems per hour)	A dose rate of thousandths of a rem per hour. Used interchangeably with mR/hr. for x-ray, gamma and beat radiation.
Non-Ionizing Radiation	Electromagnetic radiation within the spectral range of approximately 200 nanometers to 3 kilometers, including ultraviolet, visible, infrared and radiofrequency/microwave radiation.
Personal Dosimeter	Device such as a film badge, thermo-luminescent dosimeter (TLDs), or pocket ionization chamber that is designed to be worn by a single person for the assessment of dose equivalent.
Radiation Area or Restricted Area	An area accessible to personnel in which ionizing radiation levels reach or exceed 2 mrem/hr. This area is required to be barricaded to restrict access.
Radiation Machine, Equipment, or Instrument	Any device capable of producing ionizing radiation, except those devices with radioactive materials as the only source of radiation.
Radiation Source	Any radioactive material or any device (i.e., equipment, machine, instrument) emitting or capable of producing ionizing radiation.
Radioactive Material	Any material (i.e., solid, liquid, or gas) which emits radiation spontaneously. Radioactive materials include any material, equipment or system component determined to contain or be contaminated with nuclides undergoing radioactive decay. Radioactive material includes sealed and unsealed sources, and any material that emits ionizing radiation. For compliance with Department of Transportation (DOT) regulations, material with a specific activity greater than 0.002 microcuries per gram.
Radioactivity	A natural and spontaneous process by which the unstable atoms of an element emit or radiate excess energy from their nuclei and, thus, change or decay to atoms of a different element or to a lower energy state of the same element.
Radiography	A method of non-destructive testing (NDT) using gamma or x-ray radiation to determine flaws in metallic objects. Frequently called x-raying regardless of whether x-rays or gamma ray radiation sources are used.

Table 1 Definitions

Term	Description
Rem	Stands for the "roentgen equivalent in man," and is a unit of radiation dose equivalent. It is calculated by multiplying the absorbed dose times a quality factor. The quality factor (QF) accounts for the effectiveness of the type of radiation in causing biological damage.
Standard Radiation Symbol	The three-bladed symbol designed and proportioned as illustrated, in accordance with WAC 246-221-120. 
X-ray	Highly penetrating electromagnetic radiation similar to gamma radiation. For industrial purposes, X-ray radiation is commonly generated from electrically powered machines that can be turned off to eliminate the generation and presence of X-rays.

4.0 ROLES AND RESPONSIBILITIES

4.1 Radiation Safety Officer (RSO)

Radiation Safety Officer (RSO), a role filled by the Refinery Industrial Hygienist, is responsible for maintaining and administering the Radiation Safety Program, in accordance with regulatory requirements. Radiation Contractors have designated RSOs to ensure that radiation safety activities are being performed in accordance with their company's approved Radiation Safety Program.

4.2 Alternate Radiation Safety Officer (ARSO)

Alternate Radiation Safety Officer (ARSO), a role filled by the Engineering RSO, is responsible for performing the RSO duties when the RSO is not available.

4.3 Radiation Contact Individuals

Radiation Contact Individuals (RCI) are responsible for having knowledge of the appropriate radiation regulatory requirements and ensuring day-to-day compliance.

Inspection Department Radiation Contact Individual (RCI), a role filled by the PMI Inspection Lead, is responsible for managing the Inspection Department metal alloy analyzers.

Quality Assurance (Q/A) Laboratory Radiation Contact Individual (RCI), a role filled by the Q/A Lab Superintendent, is responsible for managing the Q/A Lab analytical x-ray machines.

4.4 Radiation Workers

Employees and contractors who bring radiation sources into the Anacortes Refinery are radiation workers. They are responsible for notifying the RSO prior to a new radiation source entering the Anacortes Refinery, and upon relocation, decommissioning, or facility exit.

Employees that function as radiation workers are treated as members of the public, which are not expected to be exposed to radiation above 2 mrem/hr.

4.5 Employees & Contractors

All employees and contractors are responsible for being aware of and complying with these radiation safety requirements. The Anacortes Refinery treats all non-radiation workers as members of the public, which are not expected to be exposed to radiation at levels above 2 mrem/hr.

Non-radiation workers are not authorized to enter into a radiation restricted area marked by radiation warning tape and signs unless escorted by a Radiographer on the job, and the 2 mrem/hr. limit continues to apply.

5.0 RADIATION SOURCES

Radiation sources that may be found at the Anacortes Refinery include the following:

- Instruments that contain radioactive materials used for industrial radiography or x-raying process equipment.
- Analytical instruments that generate x-rays, such as sulfur-in-oil analyzers.
- Metallic alloy analyzers that contain radioactive materials and/or generate x-rays.

5.1 Sources

The Q/A Laboratory utilizes Marathon-owned x-ray machines. The Inspection Department also utilized Marathon-owned x-ray instruments used for positive material identification (PMI). The Anacortes Refinery currently does not own fixed density, gauge or level measuring ionizing radiation devices.

Manufacturer recommendations must be followed for operating ionizing radiation analytical machines. Anacortes Refinery employees are not licensed to service radiation sources. Radiation sources may only be repaired by a qualified representative of the manufacturer or by a manufacturer-approved contractor. Servicing, including surveys/wipe tests, shall be performed per the manufacturer's instrument literature.

5.2 Contractor Sources

Radiation contractors bring non-Marathon owned radiation-producing machines and/or radioactive materials into the Anacortes Refinery for use in work contracted by Marathon. Only licensed individuals may perform radiation surveys and handle, install, relocate, maintain, repair, replace, or dispose of radiation sources. A calibrated radiation survey meter must be available for use with radiography, wipe testing, instrument inspections, and emergency situations.

5.3 Leak Testing

The leak testing method shall be based on Manufacturer's recommendations, and the leak testing intervals shall be based on licensing requirements. Leak tests must be performed by trained and qualified individuals. The licensee must document all leak tests and retain documents per required schedule. If any leaks are detected, they must be reported to the licensing agency within the required time frame.

Leak testing shall be performed on all new sources:

- Prior to shipment to the Anacortes Refinery.
- Upon receipt at the Anacortes Refinery.
- Upon installation and commissioning.

6.0 RADIATION SAFETY

6.1 Exposure Limits

The ionizing radiation exposure limit for members of the public and for non-radiation workers is 100 mrem/year (i.e., above background levels). Non-radiation workers and employees that function as radiation workers are treated as members of the public, which are not expected to be exposed to radiation at levels above 2 mrem/hr.

Contractor radiation workers must control their radiation exposures to as low as reasonably achievable (ALARA), in accordance with regulatory requirements. The regulatory limit for radiation worker exposure is no more than 1,250 mrem/3-month period. In addition, radiation worker exposure must not exceed the following: 5 rem/yr whole body, 15 rem/yr eye, or 50 rem/yr skin or extremity. Declared pregnant radiation workers are limited to 0.5 rem during the entire pregnancy. Exposure to 0.5 rem during a 9-month period is not expected to occur for non-radiation workers and employees that function as radiation workers.

6.2 Exposure Monitoring

Non-radiation workers and employees that function as radiation workers are not expected to receive exposures to ionizing radiation at rates of more than 10% of the radiation worker limits. If they receive over 10% of the exposure limit for radiation workers, placement in a radiation monitoring program must occur.

Contractor radiation workers are required to barricade areas to ensure 2 mrem/hr. or less at the perimeter of the area. Non-radiation workers and employees that function as radiation workers shall not enter or remain in a barricaded area with radiation levels above 2 mrem/hr. If such individuals may have been exposed to radiation above 2 mrem/hr., immediately notify the RSO, Alternate RSO, Health & Safety (H&S) Department Representative, or Safety Duty Person. Any radiation overexposures shall be reported by the licensee to the licensing agency, in accordance with WAC 246-221-260. Overexposed individuals are to be notified of such reporting. Potentially overexposed employees will be referred to the Medical Clinic for determination and further testing. Contractors must adhere to their company's requirements on medical surveillance and monitoring.

6.3 Emergency Response

In the event of an emergency involving a radiation source, notify the RSO, Alternate RSO, H&S Department Representative, or Safety Duty Person. A radiation emergency includes, but is not limited to, the following: damage to source housing, transfer accidents, fires, and spills.

Electrically powered machines that generate x-ray radiation may be turned off to eliminate the presence of x-rays. If x-ray machines could be impacted from an emergency event, remove the source of electricity.

Radiographers are responsible for ensuring radioactive material is retrieved into the shutter upon emergency notification. Portable radiation sources must be secured in a location removed from potential emergency impact.

If radiation source damage or malfunction occurs, barricade at least a 30-foot radius around the source, and immediately notify the RSO, Alternate RSO, H&S Department Representative, or Safety Duty Person. Notify Emergency Responders if a radiation source cannot be removed from the incident vicinity. Radiation contractors shall adhere to their company's emergency procedures for responding to the incident.

The licensee shall perform incident notifications to the licensing agency, in accordance with WAC 246-221-250. The Department of Health's (DOH) 24-hour radiation emergency reporting number is 206-682-5327. A prompt incident investigation must be conducted by the licensee for each event requiring notification.

6.4 Security

Radiation workers must accompany radiation sources at all times (i.e. constant surveillance and immediate control), or place them in a secure location to prevent unauthorized access, use, removal, or loss. Immediately notify the RSO, Alternate RSO, H&S Department Representative, or Safety Duty Person of any loss or theft of a radiation source. The licensee shall report stolen, lost or missing radiation sources to the licensing agency, in accordance with WAC 246-221-240.

Contractors utilizing radiation sources must contact the Facility Security Officer (FSO) to develop a written Radiation Security Response Plan, and submit the final written plan to the FSO and RSO. The Radiation Security Response Plan must include the following, at a minimum:

- Contact information for notifications
- Secure storage locations of radiation sources
- On-shift and off-shift emergency response protocol

6.5 Transportation

Radiation sources must be secured in a storage compartment of the transporting vehicle to prevent shifting or loss during transport. A radioactive materials caution sign must be posted on the radiation source compartment (see Attachment 1).

7.0 RADIATION USE

7.1 Qualifications

Only qualified, licensed users shall be permitted to use radiation sources. Anacortes Refinery work permitting procedures shall be followed by radiation workers, in addition to precautions and procedures required for the work with radiation sources.

Radiographers must meet the Radiography Procedure D-53-352 qualification requirements. These requirements do not supersede those set forth in this program. Radiation exposure monitoring devices or personal dosimeters such as film badges, thermo-luminescent detectors and/or direct reading pocket dosimeters, shall be worn by personnel entering radiation restricted areas with radiation levels at or above 2 mrem/hr.

Radiography workers must also wear radiation dosimeters when working with ionizing radiation sources.

At times, it may be necessary to use bungee cords when securing film boards to various locations. Only non-hooked bungee cords are permitted for this task. This implies that the bungee cord must not have any rigid hooking devices attached at the ends that could spring back and strike the individual.

7.2 Notifications & Documentation

The RSO must be notified prior to a new radiation source entering the Anacortes Refinery and upon license change, source relocation, decommissioning, or facility exit. This includes any radioactive isotopes for use in leak detection.

The following information must be provided to the RSO for approval prior to any radiation work, and upon document revision:

- License: Any change in the status of an ionizing radiation source, such as purchase, receipt, transfer, relocation or disposal, requires a change in the facility radiation license.
- Source Inventory: Number, type, strength, manufacturer, model, serial number and location of radiation sources to be used at the Anacortes Refinery. The Anacortes Refinery's Radiation Source Inventory is within Attachment 2.
- Radiation Safety Program & Emergency Response Plan: Procedures must be in place before an initial or additional radiation source is purchased or received. Procedures must include minimizing exposures per the ALARA (as low as reasonably achievable) regulatory requirement.

The WA DOH Radiation Protection Notice to Employees must be posted in areas accessible to personnel if ionizing radiation sources are in use or in storage at their workplace (see Attachment 3).

The following documents are required to be available upon request:

- Proof of training or certification, in accordance with state and federal regulations.
- License, including equipment inventory.
- Purchasing, shipping, installation, relocation, and returns/disposal
- Survey results (i.e., including wipe tests), maintenance, damage to sources, and corrective measures necessary.
- Survey meter calibrations.
- Survey results (i.e., to demonstrate compliance with the dose limit for non-radiation workers).
- Personal Dosimetry Monitoring Program, including records of exposure.

7.3 Source Disposal/Relocation

The RSO must be notified before disposing/replacing/de-commissioning an x-ray or radiation source. Sources are typically shipped back to the manufacturer for disposal, but other state recycling/waste optional may also be utilized. Special shipping requirements typically apply to these situations and record of receipt is required for record keeping purposes.

8.0 RADIATION AREAS

8.1 Radiation Markings

Radiation workers are responsible for utilizing appropriate markings for radiation sources, and for preventing unauthorized entry into restricted areas. The regulatory required radiation markings are described within Attachment 1.

Areas where radiation levels reach or exceed 2 mrem/hr should be minimized to the extent possible with methods such as additional shielding, when feasible. If radiation levels cannot be reduced, and reach or exceed 2 mrem/hr., the area must be posted at the 2 mrem/hr boundary. Contractor radiation workers are responsible for establishing barricaded, radiation restricted areas where radiation levels may exceed 2 mrem/hr. In addition, they must ensure that barricade tape and warning signs are clearly visible to prevent entry at all access routes, including possible access from levels above or below the work area.

Immediately notify the RSO, Alternate RSO, H&S Department Representative, or Safety Duty Person of any suspected exposure to ionizing radiation, or radiation area violations.

8.2 Radiography Area

Industrial Radiographers are responsible for searching areas to ensure that no other personnel are in their work area where exposure to ionizing radiation (i.e., above background levels) might occur. The radiographic work must not begin until all other personnel are confirmed to be out of the radiation barricaded area. A member of the radiographic crew must be assigned the responsibility of ensuring that no unauthorized workers enter the barricaded area. A calibrated survey meter must be used at radiographic work sites to confirm that the barricaded area is adequately sized to prevent exposure above 2 mrem/hr. Survey meters may not be intrinsically safe and may generate high internal voltages.

If non-radiation workers or employees that function as radiation workers must enter an area barricaded for radiography, personnel at the site must be notified before the entry occurs so that radiography can first be discontinued. These individuals must not enter a marked radiation restricted area unless escorted by a Radiographer on the job, and the 2 mrem/hr. limit continues to apply. Radiographers must be prepared to cease work and retrieve the radioactive material into the shutter if such individuals need immediate access to the barricaded area for emergencies or other urgent reasons.

If any unauthorized person enters an area barricaded for radiography, the unauthorized entry should be reported immediately to the RSO, Alternate RSO, H&S Department Representative, or Safety Duty Person.

9.0 RECORDKEEPING

Records required by this program shall be retained for a minimum of 30 years or until the applicable license is terminated. Anacortes Refinery radiation source records are retained in the Q/A Laboratory, Inspection Department, and Industrial Hygiene files. Contractor radiation worker records must be retrievable upon Anacortes Refinery's request

10.0 TRAINING

Anacortes Refinery employees who work in areas where radiation sources are used or stored shall receive awareness training on this program. Employees that function as radiation workers shall be trained to a level appropriate for their required interaction with radiation sources.

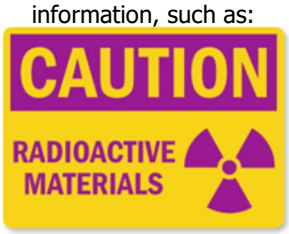
Contractors shall train their personnel on the Anacortes Refinery's radiation safety requirements. Contractor radiation workers must be trained to a level appropriate for their required interaction with radiation sources.

Anacortes Refinery and Contractor Radiation Safety Officers (RSO) shall be trained to the level mandated per radiation source licensing. At a minimum, RSOs must be certified through a 40-hour Radiation Safety Officer Training Course, or equivalent.

11.0 REVIEW AND REVISION HISTORY

Revision #	Preparer	Date	Description
0	Mark Willand	12/15/2021	Reformatted and Numbered per Document Control Policy, R-63-001.

12.0 ATTACHMENT 1 – RADIATION MARKINGS

Criteria	Requirement	Sign Postings
Device Surface <2 mrem/hr	Warning signs must be posted in locations where ionizing radiation sources are permanently mounted if radiation levels at the accessible surfaces of a source device are below 2 mrem/hr.	Signs shall contain information, such as: 
Area >2 mrem/hr	Areas near radiation sources with radiation levels at or above 2 mrem/hr shall be posted.	Signs stating "Radiation Area," such as: 
Area >100 mrem/hr	Areas with radiation levels above 100 mrem/hr shall be conspicuously posted.	Signs stating "High Radiation Area," such as: 
Temporary Radiation Area	Temporary radiation areas shall be marked with barricade tape and signs located to be observable by personnel approaching the radiation area from any direction. The barricaded area shall be established so that non-radiation workers or employees that function as radiation workers do not enter areas with radiation levels above 2 mrem/hr.	Signs stating "Caution - Radiation Area, Keep Out," such as: 
Instruments Containing Radioactive Material	Instruments containing licensed or registered radioactive material must be labeled. Instrument label information must also include the name and quantity of the radionuclide, the estimated dates of radioactivity, and precautions to avoid or minimize exposure from use of the instrument.	Labels shall contain the radiation symbol and words such as "Caution – Radioactive Material." 

Criteria	Requirement	Sign Postings
X-Ray Analytical Machine Area	Quality Assurance (Q/A) Labs containing x-ray analytical machines shall have signs posted in the area.	A sign similar to the following shall be posted: 
X-Ray Analytical Machine	X-ray analytical machines must be labeled.	Label shall be similar to the following: 

13.0 ATTACHMENT 2 – RADIATION SOURCE INVENTORY

	Location	Manufacturer	Source	Type/ Strength	Model	S/N
1	Q/A Lab	Horiba	Analytical X-Ray Machine	X-Ray Fluorescence Tube	SLFA-2800 Sulfur-in-Oil Analyzer	433202900101
2	Q/A Lab	XOS	Analytical X-Ray Machine	X-Ray Fluorescence Tube	7039 M-Series Sindie Sulfur Analyzer	BT120504001
3	Crude Lab	XOS	Analytical X-Ray Machine	X-Ray Fluorescence Tube	7039 Sindie Sulfur Analyzer	BT060711010
4	Q/A Lab	XOS	Analytical X-Ray Machine	X-Ray Fluorescence Tube	M-Series Chlora Chlorine Analyzer	BT121102001
5	Q/A Lab	Horiba	Analytical X-Ray Machine	X-Ray Fluorescence Tube	SLFA-1800 Sulfur-in-Oil Analyzer	I01QASULFUR
6	Inspection Trailer	ThermoFisher Scientific	Niton Metal Alloy Analyzer	X-Ray Fluorescence Tube	XL5	X501383
7	Inspection Trailer	ThermoFisher Scientific	Niton Metal Alloy Analyzer	X-ray Fluorescence Tube	XL3t 980	68385
8	Inspection Trailer	ThermoFisher Scientific	Niton Metal Alloy Analyzer	X-ray Fluorescence Tube	XL PMI+Ultra	91074
9	Q/A Lab	XOS	Analytical X-Ray Machine	X-Ray Fluorescence Tube	2622-10 Sindie Sulfur Analyzer	BT160413001
10	Butamer Lab	XOS	Analytical X-Ray Machine	X-Ray Fluorescence Tube	6010ZP-001 Chlora Chlorine Analyzer	OL-180402001

14.0 ATTACHMENT 3 – NOTICE TO EMPLOYEES

Washington State Department of Health

Radiation Protection
NOTICE TO EMPLOYEES

Employer _____

Radioactive Materials License # WN_____

X-Ray Registration # _____

State standards are designed to protect you against radiation hazards

Washington Administrative Code Title 246, chapters 220 through 254

This RHF-3 notice must be conspicuously posted so that employees working in or entering any portion of a radiation "restricted area" will see it.

Your employer is required to:

- Comply with regulations pertaining to sources of radiation.
- Post or otherwise make available to you a copy of Department of Health regulations, licenses and operating procedures that apply to your work, and explain them to you.
- Post each Notice of Noncompliance involving radiological working conditions, and other orders by Department of Health.
- These documents are available at:

_____

- Provide adequate radiation safety training to you, including the use of radiation-producing devices or radioactive materials you may be expected to use.
- Keep your radiation exposure as far below the maximum allowable limits as is "reasonably achievable."

As an employee, you must:

- Familiarize yourself with those provisions of the state regulations, and the operating procedures, which apply to your work.
- Follow their provisions for your own protection, the protection of your co-workers, patients, clients, and the public.
- Immediately report any violations of the requirements that you observe, or safety concerns you may have to your supervisor. You may also report directly to Department of Health.

Your radiation exposure history:

- Your employer must inform you annually, in writing, of your exposure to radiation if monitoring is required by Department of Health.
- If you receive an exposure in excess of any applicable limits, your employer must give you a written report within 30 days of learning of the overexposure. Exposure limits for employees are defined in WAC 246-221-010, 246-221-050, and 246-221-055 of the regulations.
- If you quit your employment, you may ask for a written report of your exposure during the current year up to the date you quit. This may be an estimate as long as it is identified as such.

Inspections:

- Department of Health may inspect any licensed or registered activity. During inspections, you may tell the inspectors about past or present conditions you believe contribute to or caused problems with work involving radiation.
- Department of Health inspectors want to talk to you if you are worried about radiation safety or have related concerns. Your employer must not prevent you from talking with an inspector. We will make all reasonable efforts to protect your identity.
- Any worker or worker representative who believes there is noncompliance with Chapter 70.98 of the Revised Code of Washington, the radiation regulations, or the terms of your employer's license or registration involving the worker's radiation working conditions, may request an inspection by the Department of Health. The request must specify exactly what is wrong, and must be signed by the worker or worker representative.

Deliberate misconduct: You must not do anything to deliberately cause a violation of state requirements. You must not deliberately provide inaccurate or incomplete information to either Department of Health or your employer. If you do, you may be subject to enforcement action. This does not apply to "mistakes" or actions that weren't planned.

Reporting safety concerns and violations

Radioactive materials: 360-236-3220

Radiation-producing machines and facilities –X-ray: 1-800-299-XRAY (9729)

By mail: Office of Radiation Protection, Washington State Department of Health, P.O. Box 47827, Olympia, WA 98504-7827.

Website: www.doh.wa.gov/ehp/rp

For people with disabilities, this document is available on request in other formats. To submit a request, please call 1-800-525-0127 (TDD/TTY call 711). DOH 320-098 August 2013