DRAFT Environmental Assessment for High Energy Mobile X-Ray Inspection Systems at the Bayport and Barbours Cut Terminals, Port of Houston, Harris County, Texas

December 2008

U.S. Customs and Border Protection

DEPARTMENT OF HOMELAND SECURITY
U.S. CUSTOMS AND BORDER PROTECTION
OFFICE OF INFORMATION AND TECHNOLOGY
LABORATORIES AND SCIENTIFIC SERVICES
INTERDICTION TECHNOLOGY BRANCH

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Lead Agency: U.S. Department of Homeland Security
U.S. Customs and Border Protection
Office of Information and Technology
Laboratories and Scientific Services
Interdiction Technology Branch
1300 Pennsylvania Ave., N.W.
Washington, DC 20229

Point of Contact: Ms. Sharon Sharp-Harrison
Office of Information and Technology
Laboratories and Scientific Services
Interdiction Technology Branch
1300 Pennsylvania Avenue NW, Suite 1575
Washington, DC 20229

U.S. Department of Homeland Security
Washington, DC 20229

U.S. Customs and
Border Protection

November 18, 2008

Subject: Notice of Availability of the Draft Environmental Assessment Establishing High Energy Mobile X-Ray Inspection Systems at the Bayport and Barbours Cut Terminals, Port of Houston, Harris County, Texas

Dear Reader,

U.S. Customs and Border Protection (CBP), Office of Information and Technology (OIT), Laboratories and Scientific Services (LSS), Interdiction Technology Branch (ITB) has prepared a Draft Environmental Assessment (DEA) to address the potential effects of establishing High Energy Mobile X-Ray Inspection Systems at the Bayport and Barbours Cut Terminals, Port of Houston, Harris County, Texas. The purpose of the Proposed Action is to enable CBP to conduct non-intrusive inspections of high-density cargo containers for contraband such as illicit drugs, currency, guns, and weapons of mass destruction.

The DEA will be available for a 30-day review beginning December 12, 2008 and ending January 13, 2009. The DEA is available during the review period at the following public libraries: La Porte Branch, 600 South Broadway, La Porte, TX 77571; Central Branch, 500 McKinney, Houston, TX 77002; and Park Place Branch, 8145 Park Place, Houston, TX 77017. The DEA can be obtained from Organizational Strategies, Inc., 1436 S Legend Hills Dr, Ste 140, Clearfield, UT 84015, telephone (801) 773-6459, facsimile (801) 525-1175. The DEA can also be viewed and downloaded via the internet at the following address: http://ecso.swf.usace.army.mil/Pages/Publicreview.cfm.

Comments must be postmarked, e-mailed or faxed by January 13, 2009 to ensure that they receive full consideration. Please address all comments to the attention of Mr. Gary Armstrong of Organizational Strategies, Inc. at the above address or facsimile number.

Executive Summary

Introduction

This Environmental Assessment (EA) addresses the potential environmental effects, beneficial and adverse, of the fielding and operation of two High Energy Mobile X-Ray Inspection Systems (HEMXRIS) by the U.S. Customs and Border Protection (CBP) at the Bayport and Barbours Cut terminals, Port of Houston, Harris County, Texas. This EA satisfies the requirements specified in the National Environmental Policy Act of 1969 (NEPA) as amended, the Council on Environmental Quality regulations implementing NEPA (40 CFR 1500-1508), and Department of Homeland Security (DHS) Management Directive 5100.0, Environmental Planning Program (71 FR 16790-16820, April 4, 2006). NEPA requires CBP and other federal agencies to fully understand, and take into consideration during decision making, the environmental consequences of proposed federal actions.

HEMXRISs, which are part of a comprehensive mix of technologies designed to complement one another and present a layered defense to smuggling attempts, allow CBP officers to inspect for contraband without having to physically enter into or unload cargo containers. Congressionally funded and directed, the systems fulfill Non-Intrusive Inspection (NII) technology requirements found in:

(1) the Office of National Drug Control Policy (ONDCP) *National Drug Control Strategy*;
(2) the Office of National Drug Control Policy (ONDCP) *Ten Year Counterdrug Technology Plan and Development Roadmap*;
(3) the CBP *Container Security Initiative*;
(4) National Security Presidential Directive – 17/Homeland Security Presidential Directive; 4 *National Strategy to Combat Weapons of Mass Destruction*;
(5) National Security Presidential Directive – 43/Homeland Security Presidential Directive – 14 *Domestic Nuclear Detection*;
(6) *U.S. Customs and Border Protection 2005-2010 Strategic Plan;* and
(7) the *Security and Accountability For Every Port Act of 2006*.

Purpose and Need

The purpose for the Proposed Action is to perform NIIs of high-density cargo containers for contraband such as illicit drugs, currency, guns, and weapons of mass destruction. Selection and deployment of NII equipment at ports is based on the following criteria: size of the port and of the equipment, budget, schedule, mission requirements and cost.

The need of the Proposed Action is to assist in fulfilling the requirement for the 100% scanning of containers entering the United States as directed in the Security and Accountability For Every (SAFE) Port Act of 2006 (H.R. 4954). Because of the volume of sea container traffic and the opportunities it presents for terrorists, containerized shipping is uniquely vulnerable to terrorist attack. During 2007, the Port of Houston was

ranked as the 10th busiest container port in North America, having 1,080,580 containers pass the port during that year (AAPA 2008).

Proposed Action and Alternatives Considered

Under NEPA, the proponent for an action is responsible for considering a reasonable range of alternatives that could accomplish the agency's objectives. If alternatives were eliminated from detailed study, reasons for their elimination must be briefly discussed.

Two alternatives were evaluated based upon their ability to provide the required operational capacities identified in the purpose and need statement. The two alternatives considered were:

1. Fielding and Operation of HEMXRISs
2. The No-Action Alternative

Fielding and operation of the HEMXRISs was chosen as the preferred alternative and is presented as the Proposed Action.

Proposed Action

The Proposed Action consists of the fielding and operation of two HEMXRISs at the Bayport and Barbours Cut terminals, Port of Houston for the purpose of conducting NIIs of high-density cargo containers. The model chosen by CBP for deployment is the Heimann Cargo Vision Mobile (HCVM). This decision was based on the manufacturer's ability to satisfy specification requirements for the penetration of high density cargo, budget, and deadline schedules. The systems will be moved to any previously disturbed areas within the port suitable for conducting inspections, as required. The systems are discussed in section 1.5. There is no additional construction or infrastructure required for the operation or storage of the systems.

Fielding and operation of the HEMXRISs was chosen as the preferred alternative since it meets the requirements of the SAFE Port Act as well as the functional requirement for penetrating high density cargo and containers. This alternative is presented in the EA as the Proposed Action. In addition, the No Action Alternative is presented as required by NEPA.

No Action Alternative

The No Action Alternative is to continue to inspect cargo containers entering the United States at the Port of Houston with existing equipment and methods. This inspection process involves visual and manual inspections with a limited number of tools such as other NII technology. This approach is not as efficient and effective at detecting the range of materials that could be detected with HEMXRISs in addition to current inspection techniques. Furthermore, it would not reduce the need for CBP officers to enter potentially dangerous situations to carry out these inspections. The No Action Alternative does not meet the purpose and need, however it serves as a basis of comparison to the Proposed Action.

Other Alternatives Considered

Three additional alternatives were initially evaluated to determine whether they could fulfill the purpose and need of the Proposed Action, which is to support CBP's mission by providing the capability to inspect high density cargoes and containers.

3. Mid-Energy X-Ray Inspections Systems
4. Gamma Imaging Inspection Systems
5. Conducting inspection of containers at a dedicated cargo inspection facility at another location other than the marine terminals.

Alternatives 3 and 4 were dismissed from further consideration because they failed to meet the required functional capability of penetrating high-density cargo and containers. Alternative 5 was not carried forward for analysis in this EA because it conflicted with legal requirements of the SAFE Port Act. A more detailed discussion of these alternatives and the reasons why they were not analyzed is presented in Chapter 2.

Environmental Consequences of the Proposed Action and Alternatives

This EA documents that the Proposed Action will result in no significant environmental impacts, direct, indirect, cumulative or otherwise.

The Port of Houston is located in Harris County, Texas. The port operates several terminals along the Houston Ship Canal, on the east side of the City of Houston. The Bayport Terminal is located at the west side of Galveston Bay. The Barbours Cut Terminal is also at the west side of the Galveston Bay, north of the Bayport Terminal.

Climate – Each HEMXIRS engine and each onboard generator, as well as cargo-moving equipment, will emit small amounts of air pollutants and greenhouse gases as a result of the Proposed Action. Analysis presented in this EA has established that these emissions will be *de minimis*, as defined by the Clean Air Act. Accordingly, effects on the climate are expected to be negligible.

Geology and Soils – No construction or excavation is required for the Proposed Action. Scattered X-radiation will not contaminate soils because it is energy that dissipates as soon as the source is turned off, just as a room becomes dark as soon as the light switch is turned off. No direct impacts to geology and soils would occur from the implementation of the Proposed Action.

Hydrology and Water Quality – The Proposed Action will not affect hydrology, water resources or water quality.

Floodplains – The Proposed Action will not result in any floodplain loss, adverse impacts to human safety, health, and welfare, or adverse impacts to the natural and beneficial values served by floodplains. HEMXRIS are mobile units that can be moved away from floodplains in the event of flooding or other natural disasters.

Wetlands – The Proposed Action will occur on previously paved surfaces and will not impact any wetlands.

Coastal Zone – The port is located in the Texas Coastal Zone. The Proposed Action is consistent with current actions at the port. No coastal zone resources will be adversely affected by the Proposed Action. Correspondence related to this determination is included in Appendix A.

Vegetation and Wildlife – The Proposed Action will occur on previously paved surfaces and will be consistent with current actions at the port. No vegetation or wildlife will be impacted by the Proposed Action.

Threatened and Endangered Species – The Proposed Action will take place in paved, industrial areas where suitable wildlife habitat and species do not exist. Therefore, the Proposed Action will have no effect on threatened or endangered species. Correspondence related to this determination is included in Appendix A.

Air Quality – All estimated emission levels from the activities associated with the Proposed Action are below the tons/year *de minimis* threshold values applicable to nonattainment and maintenance areas for all pollutants as specified in 40 CFR 93.153(b)(1)(2). Therefore the Proposed Action is not anticipated to cause an exceedance of any NAAQS for criteria pollutants. The Proposed Action will not conflict with conformity requirements of section 176 of the Clean Air Act for federal actions or any approved SIP. The Proposed Action will not have a significant impact on local or regional air quality within the context of the Clean Air Act or NEPA (see section 3.2 and Appendix B).

Noise – The Proposed Action is consistent with current actions at the port and will not measurably change the existing noise environment or violate any noise ordinances. As a result, the Proposed Action will not have a significant noise impact.

Land Use and Zoning – The Proposed Action is consistent with current actions at the port and will not impact land use or zoning.

Aesthetics and Visual Resources – The Proposed Action would not obscure or result in abrupt changes to the complexity of the landscape and skyline when viewed from points readily accessible to the public. No long-term change to the character of the area would occur as a result of the Proposed Action.

Infrastructure and Utilities – The port has pre-existing water and electrical services. The Proposed Action will not impact the infrastructure and utility services of the port.

Traffic and Transportation – During the planning process for each NII system and prior to deployment, site surveys are conducted, and coordinations with the appropriate stakeholders are made to ensure that the placement and operation of systems are

integrated with port traffic patterns and facilities to minimize delays to legitimate transportation.

Waste Management – Wastes associated with the Proposed Action are used oil and lubricants for the operation and maintenance of the HEMXRISs. These will be accumulated and stored in compliance with applicable regulations at or near the point of generation and recycled by a licensed used oil recycler. 40 CFR Part 279 exempts used oil and lubricants from regulation as a hazardous waste if they are recycled and not mixed with any other hazardous wastes. It is not anticipated that the operation and maintenance of the systems will generate amounts of hazardous wastes that would have any affect on the port's current generator status. There is no radioactive source or byproduct material used in the systems, therefore there is no risk of a release of radioactive materials.

If a system or system component is replaced or decommissioned, the handling, storage, use, transfer, and disposal of all materials will comply with applicable regulations. This will prevent human exposure and releases to the environment of any hazardous material that could potentially be within the systems.

Historical and Archeological (Cultural) Resources – The HEMXRISs will be operated in an industrial setting and will not have an impact on sites that are listed on, or potentially eligible for listing on, the National Register of Historic Places. There is no construction or excavation related to the Proposed Action. If, in the course of deploying and operating the systems CBP discovers that historical or archeological resources could be impacted, then project operations will be suspended and the appropriate authorities will be consulted. Implementing the Proposed Action will not have a significant impact on cultural or historic resources. Correspondence related to this determination is included in Appendix A.

Socioeconomics – The Proposed Action will not affect employment, housing or demographics. Implementation of the Proposed Action may produce indirect socioeconomic effects by deterring the movement of illicit drugs, explosives, firearms, or other contraband into the U.S. Similar indirect effects could result if the Proposed Action led to the apprehension of criminals or terrorists attempting to enter the U.S. Such effects, however, are only theoretical and will not be further evaluated in this document.

Environmental Justice – Implementation of the Proposed Action is not expected to have any negative or disproportionate effects on minority and low income populations or children.

Transboundary Impacts – The port is not located adjacent to any international borders and potential environmental effects from the Proposed Action will not extend beyond the territory of the U.S.

Irreversible and Irretrievable Commitment of Resources – The irreversible and irretrievable commitment of resources associated with the Proposed Action will be the procurement of the HEMXRISs, materials, utilities, labor and time expended in the

operation of the systems. No sensitive environmental resources will be lost or permanently altered due to the Proposed Action.

Radiological Health and Safety – While the use of any NII screening system must be evaluated to ensure that there are no adverse impacts to the health and safety of the public, CBP officers, and port employees, HEMXRISs are designed and operated to avoid these impacts. As promulgated by the Nuclear Regulatory Commission (NRC) in 10 CFR Part 20, the maximum permissible level of radiation dose to the general public is 0.1 rem in a year. As discussed in section 3.3, CBP will use this protective limit for the public and CBP employees and other port workers.

The term "rem" is an abbreviation for "roentgen equivalent man" and is a special unit used for expressing dose equivalent[1]. Some types of radiation produce greater biological effects for the same amount of energy imparted than other types. The rem is a unit that relates the dose of absorbed radiation to the biological effect of that dose on human tissues and organs. (See section 3.3 and Appendices C & D for additional analysis and information on radiation exposure).

HEMXRIS Occupants **–** HEMXRISs are designed so that the radiation dose levels within the driver's cab and at the inspector work-stations (systems operators) will be below 0.00005 rem in any one hour. With an annual work limit of 2,000 hours, this hourly dose limit will prevent annual cumulative exposures that exceed the limit of 0.1 rem in a year.

Detailed radiation surveys, performed by or under the supervision of the CBP Radiation Safety Office, have confirmed that these design and exposure criteria have been met. In all cases, exposures were measured using a "worst-case" scatter in the X-ray beam. Since such a worst-case scatter scenario is not likely to occur, these estimated exposure levels are conservative by a substantial amount. As an additional precaution, as the systems are delivered, exposure measurements will be made in the cabs and work-station areas to ensure that the systems are in compliance with exposure limits.

CBP Officers and Port Employees – Due to the nature of their work, CBP officers and port employees who work around HEMXRISs have the potential to be "occupationally exposed"[2] to radiation. The NRC and the Occupational Safety and Health Administration (OSHA) allow a higher permissible exposure level ("occupational dose") for radiation workers in restricted areas (5 rem in a year).

CBP has elected to use the general public protection standard of 0.1 rem in a year as the maximum permissible level of radiation dose for CBP officers and port employees. This standard is 50 times more stringent than occupational dose limits established by the NRC and OSHA for radiation workers. The radiation dose from HEMXRISs will be no more

[1] rem is often expressed as mrem (millirem, or thousandths of a rem) or µrem (microrem, or millionths). For the sake of consistency, this document will use the notation "rem."
[2] As defined by the International Commission on Radiological Protection (ICRP) (ICRP 2007)

than 0.00005 rem in any one hour since personnel will stand behind a marker delineating a "controlled area."

An analysis of potential exposure was based on 2,000 work hours per year as the maximum exposure time. This assumes that an individual spends all of a forty-hour work week, every week of the year, standing at the boundary of a system's controlled area. Even under those circumstances, neither CBP officers, port employees or the public will receive a cumulative dose greater than the NRC limit for protecting the general public.

Controlled Areas **–** To meet the threshold radiation dose limit, CBP establishes controlled areas for HEMXRISs. No personnel are allowed in the controlled areas during scanning operations. The HCVM has two operational settings: 3.8 MeV and 4.2 MeV, with each operational setting having a specific controlled area which must be maintained during operation. System modes of operation are set based on the density of the walls of the containers scanned. In the event images are not acquired from an initial scan with the system set at 3.8 MeV, the HCVM can be operated at 4.2 MeV to obtain data from denser containers.

When operating at 3.8 MeV, the safe operating dimensions of the controlled area are 110 feet in length and 82 feet in width, as depicted in Figure 3. When operating at 4.2 MeV the safe operating dimensions for the controlled area are 135 feet in length and 133 feet in width, as depicted in Figure 4.

In the extreme, a system operator (or a member of the general public) could be situated at the edge of the controlled area 8 hours a day, every workday of the year (that is to say, 2,000 hours per year) and not receive more exposure than the limits prescribed by the NRC. The controlled areas ensure that the systems conform to the radiation protection guidelines of reducing the radiation levels As Low as is Reasonably Achievable (ALARA).

Controlled areas are calculated and verified for each NII system and are designed to provide adequate separation from other NII operating areas, adjacent structures, work areas and traffic flows to protect workers, the general public and occupants of adjacent buildings. Controlled area dimensions may be adjusted when needed by using cargo containers as a backstop, or by using masonry walls. The controlled area would only be adjusted under the supervision of the CBP Radiation Safety Officer in order to maintain the radiation exposure limit of 0.00005 rem in any one hour limit and 0.1 rem per year.

Effects of Irradiation on Food **–** The Food and Drug Administration (FDA) at 21 CFR 179.21 requires a label be affixed to each machine stating that no food shall be exposed to X-ray radiation sources to receive an absorbed dose in excess of 50 rem. The CBP Radiation Safety Office conducted tests to determine the worst-case scenario of radiation doses to food as a result of implementing the Proposed Action. The HEMXRIS absorbed dose is 37,037 times less than this limit. Based on these measurements and compliance with the provisions of 21 CFR 179.21 it is concluded that radiation from the Proposed Action will have no significant impact on food that may be located in scanned containers.

***Effects of Irradiation on Persons Hiding in Cargo Containers* –** It is possible that people will hide themselves in cargo containers in order to surreptitiously enter the United States. A person concealed in a cargo container that is scanned by a HEMXRIS will be exposed to radiation as a direct consequence of the inspection process. The total absorbed dose to persons hiding in cargo containers subjected to scanning by a system operating at 4.2 MeV (worst case) is approximately 0.00135 rem per scan, on the same order of that received by food. This dose is 266 times less than the average annual background dose in the U.S. of 0.360 rem and 74 times below levels permissible to the general public.

Assuming 0.00135 rem per scan, to reach the maximum allowable "in a year" radiation dose, a person would have to be scanned 74 times in a year. Since the chance of this frequency of exposure is remote, it is concluded that radiation from HEMXRISs will not have a significant impact on persons located in scanned cargo containers.

Analysis and testing for this environmental assessment shows that exposures are expected to be well below the maximum levels of exposure set by the NRC, OSHA and the FDA to protect the general public (which includes system operators, truck drivers, port personnel and other CBP personnel) therefore, the health and safety impacts from radiological exposure for the Proposed Action were found to not be significant. See section 3.3 for further discussion of radiological health and safety.

Summary of Best Management Practices and Mitigation Actions Planned

Best Management Practices for Air – The emission estimates prepared for this EA were based on the assumption that the HEMXRIS vehicles and generators would be idling for 16 hours per day. In practice, to reduce emissions from the Proposed Action, cargo container handling equipment waiting for the inspection of containers by the systems will follow applicable regulations regarding the control of idling times. The systems are vehicle mounted, where the X-radiation equipment is installed on 2006-2007 model vehicles which meet the Best Available Control Technology as defined by the U.S. Environmental Protection Agency (EPA).

Best Management Practices for Wastes – Petroleum, oils, and lubricants will be stored, handled, and disposed of in compliance with applicable laws and regulations. Procedures for the safe refueling of HEMXRISs and for the containment and clean-up of potential spills will be in accordance with existing port procedures for preventing and controlling releases. CBP personnel will be trained in spill prevention and countermeasures as required by the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. §6901, *et seq*.) and the Oil Pollution Act of 1990 (OPA) (33 U.S.C §2701 *et seq.*)

HEMXRISs might contain materials that could be hazardous if the materials are handled improperly. An example of such a material would be lead metal which is used for radiation shielding. As a system component, the lead will be innocuous and will provide a protective function from ionizing radiation.

As a CBP asset, all materials within the systems will be in use for their intended purpose, under the supervision of appropriately trained personnel. Under this scenario, there is no hazard to the human environment because the materials will be contained within the systems as functional components of the systems.

In the event of an accident, hazardous materials would not be expected to cause any significant harm to the human environment, because the amount of materials is small, and most materials will be in solid form which is readily contained and recovered. Accident response procedures are in place at the port to contain and remove fluids such as lubricants and fuel.

The most important action to ensure that hazardous materials have no significant effect on the human environment will be upon the replacement or decommissioning of a component or system. Appropriate disposition will depend upon type and quantity of materials involved and the applicable regulations. If a component is replaced or decommissioned, the handling, storage, use, transfer, and disposal of all materials will comply with applicable regulations. This will prevent human exposure and releases to the environment of any hazardous material.

Best Management Practices and Mitigation Measures for Radiological Health and Safety – Best management practices for radiological health and safety include but are not limited to:

- Incorporation of safety warnings and precautions into technical manuals and operator manuals.
- Training of operators and screening operations supervisors in the hazards associated with radiation producing equipment.
- Incorporation of emergency stop buttons (e-stops) on the equipment that allow the system, including X-ray production, to be quickly shut down if necessary.
- Training operators and screening operations supervisors in the location and use of e-stops.
- The establishment of radiation controlled areas during screening operations.

The combination of these precautions will ensure that the cumulative radiation dose to officers and the general public will not exceed 0.00005 rem in any one hour or 0.1 rem per year.

Cumulative Impacts

Cumulative impact is defined by the Council on Environmental Quality in 40 CFR 1508.7 as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The following relevant issues were analyzed for potential cumulative effects.

Air Quality

Emissions estimates for proposed and existing NII operations are (tons per year): 19.4 nitrogen oxides, 2.83 volatile organic compounds, 16.6 carbon monoxide and 1.18 PM10. These cumulative emissions estimates are below the tons/year *de minimis* threshold values applicable to nonattainment and maintenance areas as specified in 40 CFR 93.153(b)(1)(2). Therefore the Proposed Action is not anticipated to cause significant, cumulative, air quality impacts (see tables 3 and 4, Appendix B).

Radiological Health and Safety

Aside from NII equipment operated or proposed by CBP, there is no other known NII equipment at the port that could combine with the proposed action and cause a significant cumulative effect. NII equipment has little potential to create cumulative health impacts under normal operating conditions when they are used for their intended purpose by qualified personnel under the supervision of a radiation safety officer in accordance with applicable heath and safety regulations.

Controlled areas are calculated and verified for each NII system and are designed to provide adequate separation from other NII operating areas, adjacent structures, work areas and traffic flows to protect workers, the general public and occupants of adjacent buildings. Limiting access to the controlled areas ensures that the public (which includes system operators and port personnel) are not exposed to radiation levels exceeding those prescribed by applicable regulations (see Appendix C and Appendix D). In the event that other NII technologies are present or planned for operation at the port, CBP will ensure that controlled areas for each technology are adequately designated and do not overlap with one another.

Each HEMXRIS and associated controlled area will occupy a maximum of 17,955 square feet (35,910 maximum if both operate simultaneously) of space on the port during operations (this includes the deployed system and necessary controlled area). The placement of these systems combines with placement of other proposed and existing NII systems to occupy a total maximum (if all NII systems operate simultaneously) of 1.06 acre of port space. Bayport and Barbours Cut terminals both have adequate space to accommodate the proposed NII systems and existing and planned systems.

Findings and Conclusions

The evaluation of the Proposed Action, fielding and operation of two HEMXRISs at the Port of Houston, demonstrates that there will be no significant, adverse effects on the human environment as long as identified best management practices and mitigation measures are followed. Therefore, no further environmental impact analysis is warranted.

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1 Introduction

This Environmental Assessment (EA) addresses the potential environmental effects, beneficial and adverse, of the fielding and operation of two High Energy Mobile X-Ray Inspection Systems (HEMXRIS) by the U.S. Customs and Border Protection (CBP) at the Bayport and Barbours Cut terminals, Port of Houston, Harris County, Texas. This EA satisfies the requirements specified in the National Environmental Policy Act of 1969 (NEPA) as amended, the Council on Environmental Quality regulations implementing NEPA (40 CFR 1500-1508), and Department of Homeland Security (DHS) Management Directive 5100.0, Environmental Planning Program (71 FR 16790-16820, April 4, 2006). NEPA requires CBP and other federal agencies to fully understand, and take into consideration during decision making, the environmental consequences of proposed federal actions.

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(7) the *Security and Accountability For Every Port Act of 2006*.

1.1 Background

DHS was established in the aftermath of the terrorist attacks of September 11, 2001. The following elements are central to the mission of the department:

AWARENESS – Identify and understand threats, assess vulnerabilities, determine potential impacts, and disseminate timely information to our homeland security partners and the American public.

PREVENTION – Detect, deter, and mitigate threats to our homeland.

PROTECTION – Safeguard our people and their freedoms, critical infrastructure, property, and the economy of our Nation from acts of terrorism, natural disasters, or other emergencies.

RESPONSE – Lead, manage, and coordinate the national response to acts of terrorism, natural disasters, or other emergencies.

RECOVERY – Lead national, state, local, and private sector efforts to restore services and rebuild communities after acts of terrorism, natural disasters, or other emergencies.

SERVICE – Serve the public effectively by facilitating lawful trade, travel, and immigration.

ORGANIZATIONAL EXCELLENCE – Value our most important resource, our people. Create a culture that promotes a common identity, innovation, mutual respect, accountability and teamwork to achieve efficiencies, effectiveness, and operational synergies.

On March 1, 2003, the Immigration and Naturalization Service (INS) ceased to exist, U.S. Customs was renamed CBP and various border functions from INS and the Department of Agriculture were transferred to CBP. As the single, unified border agency, CBP's mission is vital to the protection of America and the American people. CBP's priority mission is preventing terrorists and terrorist weapons from entering the United States, while also facilitating the flow of legitimate trade and travel. In performing its mission, CBP intercepts large quantities of contraband at the seaports and ports of entry. In Fiscal Year 2007 a total of 2,786,137 pounds of marijuana, 281,371 pounds of cocaine, 3,248 pounds of methamphetamine, and 2,167 pounds of heroin were seized nationally by CBP (CBP 2007).

To improve the inspection process, CBP continuously seeks technological solutions that are safe for both humans and the environment and are cost effective. One method of conducting inspections used by CBP involves the use of NII technology, which uses X-ray or gamma radiation sources to "see" into cargo containers to identify potential contraband as well as persons attempting to illegally enter the country by hiding within a cargo container. These NII technologies can perform effective, rapid inspections without having to physically enter into or unload cargo containers, thereby reducing the risks for CBP officers.

At ports of entry, CBP's Office of Field Operations (OFO) secures the flow of people and cargo into and out of the country, while facilitating legitimate travel and trade. OFO's Strategic Plan, *Securing America's Borders at Ports of Entry, Office of Field Operations Strategic Plan FY 2007–2011*, defines CBP's national strategy for securing America's borders specifically at ports of entry. OFO's strategic plan includes a mission statement that fully supports the CBP mission statement, but narrows the scope to ports of entry: *"Ports of entry are America's gateways. At ports of entry, CBP prevents entry of people and goods that are prohibited or threaten our citizens, infrastructure, resources, and food supply, while efficiently facilitating legitimate trade and travel."*

HEMXRISs directly support the four elements outlined below in the operational vision for secure borders at the ports of entry. The successful combination of these elements creates ports of entry where only lawful border crossers and legitimate goods are allowed to enter the United States:

Deterrence – Potential violators are unwilling to attempt to enter the country through the ports of entry.
Interception – Dangerous and inadmissible people and goods are detected and prevented from entry.
Facilitation – Known low-risk people and goods are separated from those of higher risk and moved quickly and securely through the port.
Consistency – Violators have an equal risk of detection and prevention regardless of mode of transportation or port of entry.

1.2 Purpose and Need

The purpose for the Proposed Action is to perform NIIs of high-density cargo containers for contraband such as illicit drugs, currency, guns, and weapons of mass destruction. Selection and deployment of NII equipment at ports is based on the following criteria: size of the port and of the equipment, budget, schedule, mission requirements and cost.

The need of the Proposed Action is to assist in fulfilling the requirement for the 100% scanning of containers entering the United States directed in the Security and Accountability For Every (SAFE) Port Act of 2006 (H.R. 4954). Because of the volume of sea container traffic and the opportunities it presents for terrorists, containerized shipping is uniquely vulnerable to terrorist attack. During 2007, the Port of Houston was ranked as the 10th busiest container port in North America, having 1,080,580 containers pass the port during that year (AAPA 2008).

1.3 Public Involvement

In keeping with established policy regarding an open decision-making process, this EA and resulting decision document of either a Finding of No Significant Impact (FONSI) or a Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) will be made available to agencies and the general public for review and comment. A Notification of Availability (NOA) will be published in applicable local newspapers and copies of the EA made available to the general public at local libraries and the folowing public review website: http://ecso.swf.usace.army.mil/Pages/Publicreview.cfm.

For further information on the Proposed Action or to request a copy of the EA, please contact Ms. Sharon Sharp-Harrison, Branch Director, Office of Information and Technology, Laboratories and Scientific Services, Interdiction Technology Branch, 1300 Pennsylvania Avenue, NW, Suite 1575, Washington, DC 20229.

1.4 Framework for Analysis

This EA was prepared in compliance with the National Environmental Policy Act (NEPA), (Public Law 91-190, 42 U.S.C. 4321-4347, as amended), the Council on Environmental Quality (CEQ) Regulations for implementing the procedural provisions of

NEPA (40 CFR Parts 1500-1508) and DHS Management Directive 5100.1, "Environmental Planning Program," (April 19, 2006). [See also, 71 Fed. Reg. 16,790 (April 4, 2006).] NEPA directs federal agencies to fully understand and take into consideration during decision-making, the environmental consequences of proposed federal actions. This EA is intended to be a concise public document that provides sufficient evidence and analysis for determining whether to prepare an EIS or a FONSI.

In addition to the evaluation for potential direct and indirect impacts, the Proposed Action was also evaluated for cumulative impacts on the environment as described later in section 4, "Cumulative Impacts," of this EA.

1.5 Description of HEMXRIS

The model chosen by CBP for deployment is the Heimann Cargo Vision Mobile (HCVM). Selection and deployment of this NII equipment was dependent upon the size of the port and of the equipment itself, cost of the equipment, satisfaction of specification requirements, and whether the manufacturer could meet mission deadlines. Representative photographs of the system are shown in figures 1 and 2.

HEMXRISs employ an X-ray source to produce images of tankers, commercial trucks, sea and air containers, and other cargo containers for contraband such as drugs, explosives, and weapons. The systems are able to scan cargo containers in one pass. The systems are mounted on a truck chassis and operated by a three-man crew. The systems operate by slowly driving past a cargo container with the boom extended over the target container. When deployed for scanning operations the HCVM is approximately 18.33 feet high, 29.0 feet wide, and 34.5 feet long (see figures 1 and 2). No radiation source material is used to produce images.

1.5.1 Detector and Source Boom Assembly

The detection boom is aligned with the X-ray emission subsystem, and when deployed, forms the complete detection subsystem. The detection boom is comprised of an L-shaped detection line made up of a series of detectors that convert the X-ray emissions produced by the accelerator into an electronic signal. These detectors are placed along the length of a rigid metal structure, which is enclosed in a casing.

1.5.2 Imaging System

HEMXRISs utilize a linear accelerator to produce the X-ray emissions that are targeted at the detector box assembly. An onboard generator provides the electric power supply during scanning operations.

1.5.3 Radiation Safety Features

1.5.3.1 Operator Controls and Displays

HEMXRISs are equipped with the operator controls and displays required for scanning targets and reviewing images acquired from the scan. The X-ray linear accelerator is controlled through these interfaces when performing inspections. An emergency stop "e-

stop" switch can immediately stop all operations, including X-ray production when activated.

1.5.3.2 Radiation Controlled Area

Controlled Area is defined by 10 CFR 20.1003 as *"an area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason."* CBP has elected to use the term "controlled area" rather than "restricted area" as the scanning systems are not in continuous scanning mode. Further, the traditional wording of restricted area has other uses on the port and does not accurately reflect the caution that CBP desires to show the public.

CBP establishes controlled areas around each HEMXRIS which help limit the potential doses to CBP personnel and the public to below 0.00005 rem in any one hour. The dimensions of the controlled areas are established through radiation surveys conducted by the CBP Radiation Safety Office (see figures 3 and 4 for dimensions). At the edges of these controlled areas, the radiation dose will not exceed this limit. Based on a limit of 2,000 work hours per year, the 0.00005 rem limit ensures that the cumulative annual radiation dose to workers and the public will not exceed the NRC's public dose limit of 0.1 rem in a year. No personnel will be allowed in the radiation controlled area during scanning operations.

Controlled areas are moving footprints of specified dimensions. During an inspection process, the controlled area will be coincident with the movement of each HEMXRIS. Controlled area dimensions may be adjusted when needed by using cargo containers as a backstop, or by using masonry walls. The controlled area would only be adjusted under the supervision of the CBP Radiation Safety Officer in order to maintain the radiation exposure limit of 0.00005 rem in any one hour limit and 0.1 rem per year. In the event other NII technologies are present at the port, CBP will ensure that controlled areas for each technology are adequately designated and do not overlap with one another.

During scanning operations, signs in multiple languages are posted at the controlled area boundary indicating the radiation hazard. Ground guides are positioned at various locations around the controlled area to warn persons of the danger as well as provide visual queues to the drivers of the HEMXRISs. Both systems are capable of incorporating an infrared safety barrier that stops the forward movement of the inspection system as well as the production of X-rays should the beam barrier be broken.

Figure 1: HCVM (Stowed Configuration)

Image Source: Smiths Heimann

Figure 2: HCVM (Deployed Configuration)

Image Source: CBP

Figure 3: HCVM Controlled Area for Operation at 3.8 MeV

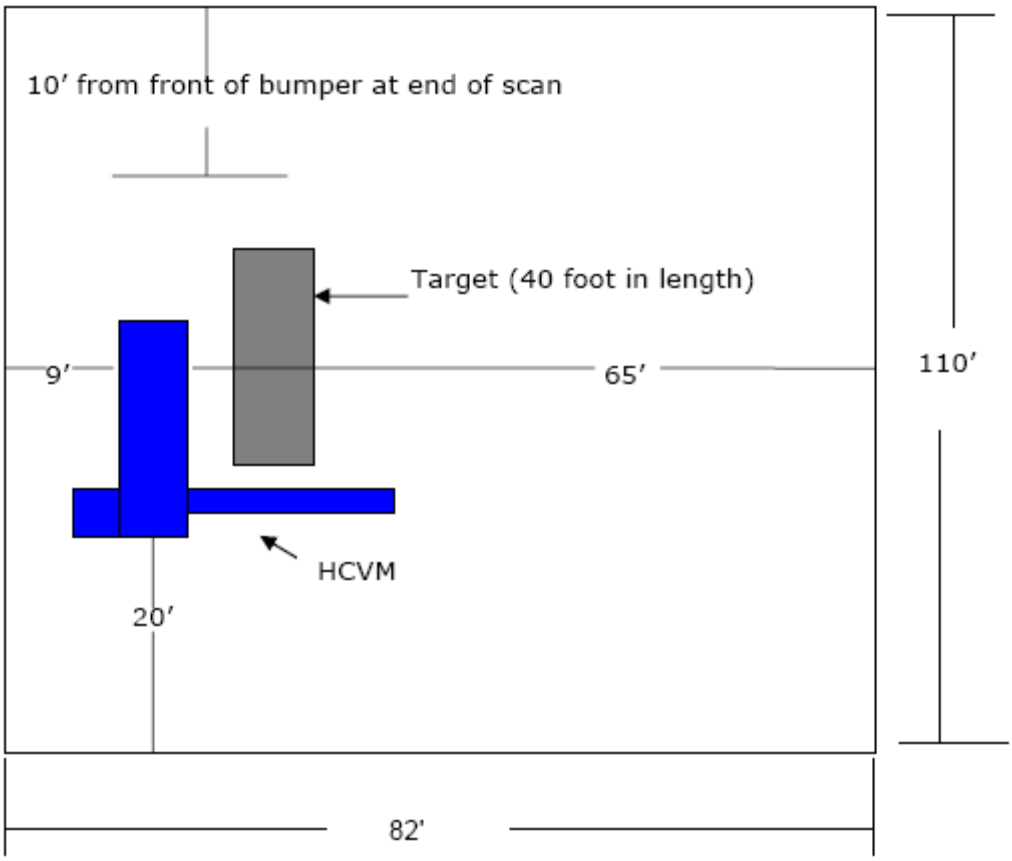
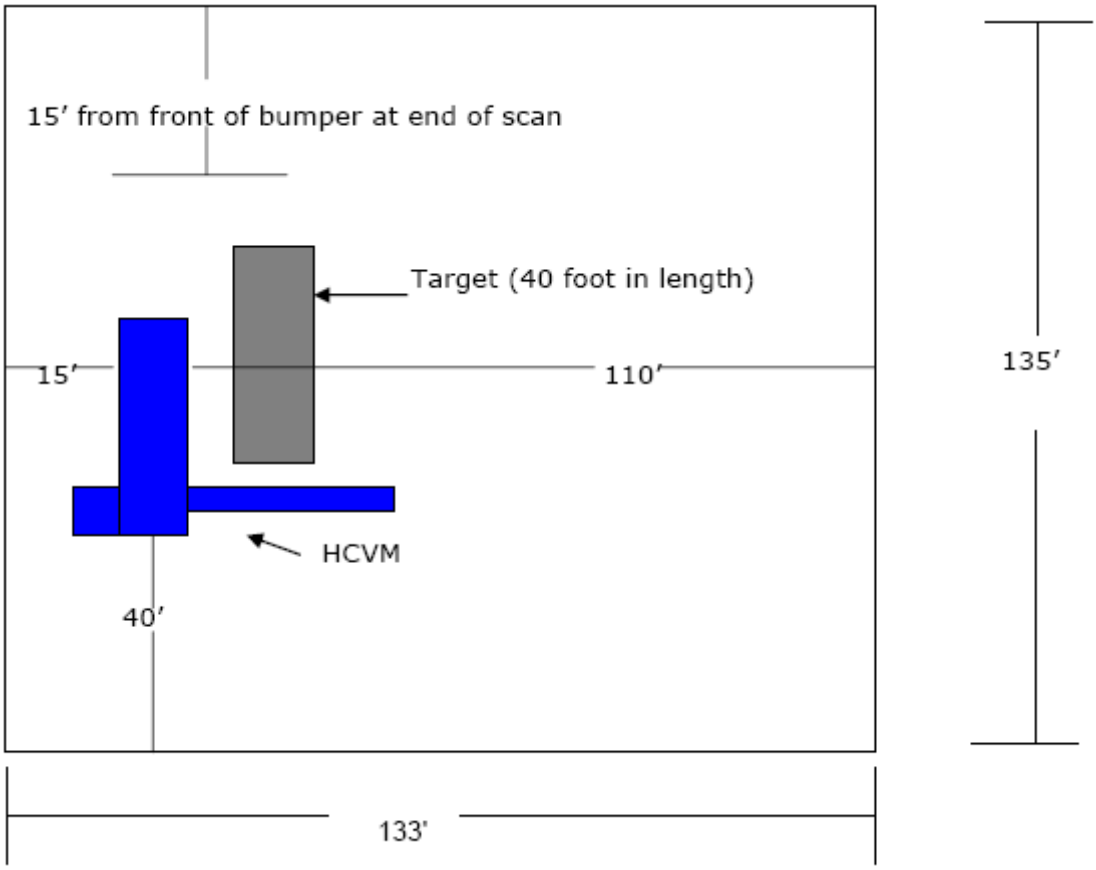


Figure 4: HCVM Controlled Area for Operation at 4.2 MeV



2 The Proposed Action and Alternatives

Under NEPA, the proponent for an action is responsible for considering a reasonable range of alternatives for achieving a goal or implementing a project or program. This section provides a description of the Proposed Action and alternatives considered in order to identify potentially affected environments and potential impacts to these environments. Two action scenarios were evaluated in the EA.

1. Fielding and Operation of HEMXRISs
2. The No-Action Alternative

Fielding and Operation of the HEMXRISs was chosen as the preferred alternative and is presented as the Proposed Action, in this EA, along with the No Action Alternative.

2.1 Alternative 1 – Proposed Action

The Proposed Action consists of the fielding and operation of two HEMXRISs at the Bayport and Barbours Cut terminals, Port of Houston for the purpose of conducting NIIs of high-density cargo containers. The model chosen by CBP for deployment is the Heimann Cargo Vision Mobile (HCVM). This decision was based on the manufacturer's ability to satisfy specification requirements for the penetration of high density cargo, budget, and deadline schedules. The systems will be moved to any previously disturbed areas within the port suitable for conducting inspections, as required. The systems are discussed in section 1.5. There is no additional construction or infrastructure required for the operation or storage of the systems.

Fielding and operation of the HEMXRISs was chosen as the preferred alternative since it meets the requirements of the SAFE Port Act as well as the functional requirement for penetrating high density cargo and containers. This alternative is presented in the EA as the Proposed Action. In addition, the No Action Alternative is presented as required by NEPA.

2.2 Alternative 2 – No Action Alternative

The No Action Alternative is to continue to inspect cargo containers entering the United States at the Port of Houston with existing equipment and methods. This inspection process involves visual and manual inspections with a limited number of tools such as other NII technology. This approach is not as efficient and effective at detecting the range of materials that could be detected with HEMXRISs in addition to current inspection techniques. Furthermore, it would not reduce the need for CBP officers to enter potentially dangerous situations to carry out these inspections. Although the No Action Alternative does not meet the purpose and need, it serves as a basis of comparison to the Proposed Action.

2.3 Other Alternatives Considered

Three additional alternatives were initially evaluated to determine whether they could fulfill the purpose and need of the Proposed Action, which is to support CBP's mission by providing the capability to inspect high density cargoes and containers.

3. Mid-Energy X-Ray Inspections Systems
4. Gamma Imaging Inspection Systems
5. Conducting inspection of containers at a dedicated cargo inspection facility at another location other than the marine terminals.

Alternative (3), Mid-Energy X-Ray Inspection Systems, was not evaluated further in this EA because it does not meet the mission requirement for penetration of high-density cargo. Mid-Energy X-ray systems operate between 0.25 and 2 million electron volts (MeV) of energy and are useful for many inspection needs, but are not capable of imaging high-density cargo and containers. Therefore, it was determined that these systems did not meet the purpose and need of this federal action, and further analysis of this alternative was not undertaken.

Alternative (4), Gamma Imaging Inspection Systems, was dismissed from further consideration for the same reasons as Alternative (3). Gamma imaging systems use ionizing gamma radiation from either radioactive cesium-137 (^{137}Cs) or cobalt-60 (^{60}Co) to create images of the contents of cargo and containers. These systems are already in use by CBP at a number of ports and ports of entry. However, as with mid-energy X-ray systems, the gamma-imaging systems are not capable of penetrating high density cargoes and containers. Therefore, this alternative did not meet the purpose and need of the Proposed Action and was not evaluated further in this EA.

Alternative (5) was not carried forward for detailed analysis due to specific language in the SAFE Port Act requiring the use of non-intrusive imaging equipment in tandem with radiation detection equipment. Additionally, the SAFE Port Act requires that 100 percent of the containers that have been identified as high-risk are scanned before such containers leave a United States seaport facility.

3 The Affected Environment and Consequences

This section describes the current condition of environmental resources at the Port of Houston and the possible impacts to these resources from the Proposed Action and No Action Alternative. The descriptions represent baseline conditions for the comparison of changes caused by implementation of the Proposed Action and No Action Alternative. Potential changes or impacts to the resources are described in each section as potential consequences. Cumulative impacts, or impacts attributable to the Proposed Action combined with other past, present or reasonably foreseeable future impacts regardless of the source, are presented in section 4.

3.1 Preliminary Impact Scoping

Table 1 presents the results of the preliminary impact scoping and explains why certain resources were excluded from further discussion. In keeping with the CEQ guidelines (40 CFR 1500.4) on reducing paperwork and focusing the analysis on issues of concern to the public and policymakers, only those environmental resources that could potentially be affected (i.e. those resources that are retained in Table 1) will be discussed in detail.

Table 1: Preliminary Impact Scoping

Resource	Potential for Impact	Retained (Y/N)
Climate	Each HEMXIRS engine and each onboard generator, as well as cargo-moving equipment, will emit small amounts of air pollutants and greenhouse gases as a result of the Proposed Action. Analysis presented in this EA has established that these emissions will be *de minimis*, as defined by the Clean Air Act. Accordingly, effects on the climate are expected to be negligible.	N
Geology and Soils	No construction or excavation is required for the Proposed Action. Scattered X-radiation will not contaminate soils because it is energy that dissipates as soon as the source is turned off, just as a room becomes dark as soon as the light switch is turned off. The systems are mobile and can be moved as needed. No direct impacts to geology and soils would occur from the implementation of the Proposed Action.	N
Hydrology and Water Quality	The Proposed Action will not affect hydrology, water resources or water quality.	N
Floodplains	The Proposed Action will not result in any floodplain loss, adverse impacts to human safety, health, and welfare, or adverse impacts to the natural and beneficial values served by floodplains. HEMXRIS are mobile units that can be moved away from floodplains in the event of flooding or other natural disasters.	N
Wetlands	The Proposed Action will occur on previously paved	N

Resource	Potential for Impact	Retained (Y/N)
	surfaces and will not impact any wetlands.	
Coastal Zone	The port is located in the Texas Coastal Zone. The Proposed Action is consistent with current actions at the port. No coastal zone resources will be adversely affected by the Proposed Action. Correspondence related to this determination is included in Appendix A.	N
Vegetation and Wildlife	The Proposed Action will occur on previously paved surfaces and will be consistent with current actions at the port. No vegetation or wildlife will be impacted by the Proposed Action.	N
Threatened and Endangered Species	The Proposed Action will take place in paved, industrial areas where suitable wildlife habitat and species do not exist. Therefore the Proposed Action will have no effect on threatened or endangered species. Correspondence related to this determination is included in Appendix A.	N
Air Quality	Air quality impacts associated with the Proposed Action would be limited to localized effects associated with emissions generated by the HEMXRISs, the onboard generators and other idling vehicles during operations. Although emission levels are expected to be well below prescribed limits, further evaluation is warranted. See section 3.2 and Appendix B	Y
Noise	The Proposed Action is consistent with current actions at the port and will not measurably change the existing noise environment or violate any noise ordinances. As a result, the Proposed Action will not have a significant noise impact.	N
Land Use and Zoning	The Proposed Action is consistent with current land use and zoning practices at the terminal.	N
Aesthetics and Visual Resources	The Proposed Action would not obscure or result in abrupt changes to the complexity of the landscape and skyline when viewed from points readily accessible to the public. No long-term change to the character of the area would occur as a result of the Proposed Action.	N
Infrastructure/Utilities	The port has pre-existing water and electrical services. The Proposed Action will not impact the infrastructure and utility services of the port.	N
Traffic / Transportation	During the planning process for each NII system and prior to deployment, site surveys are conducted, and coordinations with the appropriate stakeholders are made to ensure that the placement and operation of systems are integrated with port traffic patterns and facilities to minimize delays to legitimate transportation	N

Resource	Potential for Impact	Retained (Y/N)
Waste Management	Wastes associated with the Proposed Action are used oil and lubricants for the operation and maintenance of the HEMXRISs. These will be accumulated and stored in compliance with applicable regulations at or near the point of generation and recycled by a licensed used oil recycler. 40 CFR Part 279 exempts used oil and lubricants from regulation as a hazardous waste if they are recycled and not mixed with any other hazardous wastes. It is not anticipated that the operation and maintenance of the systems will generate amounts of hazardous wastes that would have any affect on the port's current generator status. There is no radioactive source or byproduct material used in the systems, therefore there is no risk of a release of radioactive materials. HEMXRISs might contain materials that could be hazardous if the materials are handled improperly. An example of such a material would be lead metal which is used for radiation shielding. As a system component, the lead will be innocuous and will provide a protective function from ionizing radiation. As a CBP asset, all materials within the systems will be in use for their intended purpose, under the supervision of appropriately trained personnel. Under this scenario, there is no hazard to the human environment because the materials will be contained within the systems as functional components of the systems. In the event of an accident, hazardous materials would not be expected to cause any significant harm to the human environment, because the amount of materials is small, and most materials will be in solid form which is readily contained and recovered. Accident response procedures are in place at the port to contain and remove fluids such as lubricants and fuel. The most important action to ensure that hazardous materials have no significant effect on the human environment will be upon the replacement or decommissioning of a component or system. Appropriate disposition will depend upon type and quantity of materials involved and the applicable regulations. If a component is replaced or decommissioned, the handling,	N

Resource	Potential for Impact	Retained (Y/N)
	storage, use, transfer, and disposal of all materials will comply with applicable regulations. This will prevent human exposure and releases to the environment of any hazardous material.	
Historic and Archeological (Cultural) Resources	The HEMXRISs will be operated in an industrial setting and will not have an impact on sites that are listed on, or potentially eligible for listing on, the National Register of Historic Places. There is no construction or excavation related to the Proposed Action. If, in the course of deploying and operating the HEMXRISs CBP discovers that historical or archeological resources could be impacted, then project operations will be suspended and the appropriate authorities will be consulted. Implementing the Proposed Action will not have a significant impact on cultural or historic resources. Correspondence related to this determination is included in Appendix A.	N
Socioeconomics	The Proposed Action will not affect employment, housing or demographics. Implementation of the Proposed Action may produce indirect socioeconomic effects by deterring the movement of illicit drugs, explosives, firearms, or other contraband into the U.S. Similar indirect effects could result if the Proposed Action led to the apprehension of criminals or terrorists attempting to enter the U.S. Such effects, however, are only theoretical and will not be further evaluated in this document.	N
Environmental Justice	Implementation of the Proposed Action will not have any negative effect on minority and low-income populations or children.	N
Transboundary Impacts	The port is not located adjacent to any international borders and potential environmental effects from the Proposed Action will not extend beyond the territory of the U.S.	
Irreversible and Irretrievable Commitment of Resources	The irreversible and irretrievable commitment of resources associated with the Proposed Action will be the procurement of the HEMXRISs, materials, utilities, labor and time expended in the operation of the systems. No sensitive environmental resources will be lost or permanently altered due to the Proposed Action.	N
Radiological Health and Safety	X-radiation from the HEMXRISs has the potential to impact the health and safety of operators, officers, and the general public. Although exposures are expected to be well below the EPA and OSHA prescribed limits, further evaluation is warranted.	Y

3.2 Air Quality

3.2.1 Criteria for Significance

The air quality analysis presented below responds to two separate federal statutes – NEPA, which is the basis of this EA, as well as the Clean Air Act (CAA). These two statutes vary considerably in terms of the analysis required as well as the mandated response to potential air quality impacts. Fulfillment of one requirement does not fulfill the other requirement, nor does the exemption of one automatically exempt the other. NEPA requires that agencies evaluate whether there will be significant air quality impacts resulting from their actions, with significance defined in terms of the "context" and "intensity" of impacts.

The CAA imposes certain duties on federal agencies. In November 1993, the Environmental Protection Agency (EPA) published the General Conformity Final Rule in the Federal Register (EPA 1993). The purpose of the rule is to ensure that all federal actions that take place in a nonattainment area or a maintenance area conform to any existing state implementation plan (SIP) or maintenance plan to protect air quality in the area where the Proposed Action occurs. Conformity to the purpose of the SIP means that the proposed federal action will not cause new air quality violations, worsen existing violations, or delay timely attainment of the relevant national ambient air quality standards (NAAQS or "standards").

Not all federal actions are required to make a formal conformity determination. If an initial review determines that annual emissions resulting from the Proposed Action will not reach certain threshold levels (40 CFR Part 93.153), then there is no obligation to proceed with a formal conformity determination. Additionally, conformity analysis is only required for those criteria pollutants for which the area is in non-attainment.

The applicable regulations for defining "conformity" are cited in 40 CFR Parts 6, 51, and 93. A "federal action" is defined in 40 CFR 93.152 as "any activity engaged in by a department, agency, or instrumentality of the federal government, or any activity that a department, agency or instrumentality of the federal government supports in any way, provides financial assistance for, licenses, permits, or approves, other than activities related to transportation plans, programs, and projects developed, funded, or approved under title 23 U.S.C. or the Federal Transit Act (49 U.S.C.1601 *et seq*.)." The General Conformity Rule is only applicable to non-attainment and maintenance areas.

Air quality impacts resulting from the Proposed Action would be considered significant, within the NEPA context, if the following were to occur:

- The Proposed Action or the No Action Alternative caused an exceedance of one or more of the NAAQS for criteria pollutants within the region of concern.
- The Proposed Action or the No Action Alternative is not in conformity with section 176 of the Clean Air Act for federal actions or an approved SIP.

3.2.2 Baseline Environment

Harris County, Texas is a moderate nonattainment area for 8-hour ozone (EPA 2008a).

3.2.3 Potential Consequences

3.2.3.1 Proposed Action - Fielding and Operation of HEMXRIS

Minimum emissions will be produced from the HEMXRIS, onboard generator and other idling vehicles during operations. Detailed air quality analysis and emissions estimates for the Proposed Action and cumulative emissions are provided in Appendix B. The estimates for the Proposed Action were based on the following assumptions:

- the HEMXRIS vehicle and generator will be idling for 16 hours per day;
- heavy duty diesel vehicles will be used to move cargo containers and will remain idling during the inspections; and
- the HEMXRIS will process an average of 20 vehicles per hour (i.e. processing time equals 3 minutes per vehicle/cargo container and the system processes 320 vehicles/cargo containers per day).

All estimated emission levels from the activities associated with the Proposed Action are below the tons/year *de minimis* threshold values applicable to nonattainment and maintenance areas for all pollutants as specified in 40 CFR 93.153(b)(1)(2). Therefore the Proposed Action is not anticipated to cause an exceedance of any NAAQS for criteria pollutants. The Proposed Action will not conflict with conformity requirements of section 176 of the Clean Air Act for federal actions or any approved SIP. The Proposed Action will not have a significant impact on local or regional air quality within the context of the Clean Air Act or NEPA.

3.2.3.1.1 Best Management Practices

To reduce emissions from the Proposed Action, cargo container handling equipment waiting for the inspection of containers by the HEMXRISs will follow applicable regulations regarding the control of idling times. The systems are vehicle mounted, where the X-radiation equipment is installed on 2006-2007 model vehicles which meet the Best Available Control Technology as defined by the U.S. Environmental Protection Agency (EPA).

3.2.3.2 No Action Alternative

No change in existing ambient air quality would occur and no new pollution sources would be introduced. The No Action Alternative includes inspecting cargo containers visually and with other technologies currently in use at the port. No impact to air quality is anticipated under the No Action Alternative.

3.3 Radiological Health and Safety

3.3.1 Criteria for Significance

Evaluation of the potential effect of radiation exposure on public safety is based on both the potential for an accident and the consequences of any project-related effect associated with normal operations. Beneficial impacts may result from any direct or indirect safety improvements due to project implementation. An alternative could have a significant impact if it would increase or decrease the risk of exposure of personnel or the public to radiation hazards.

3.3.2 Baseline Environment

3.3.2.1 Ionizing Radiation

Radiation is the most complex of all considerations pertaining to the operation of HEMXRISs. The focus of this section, Radiological Health and Safety, is ionizing radiation. See Appendix C for background information on ionizing radiation.

HEMXRISs employ advanced high energy digital X-ray imaging technology that has successfully been used in various industrial applications such as field inspection of structures like bridges and buildings. As radiation-producing devices, these systems are subject to review by radiation protection authorities. It should be noted that radiation equipment being operated by a federal agency is not subject to state regulation. Therefore, the information in this EA related to the state's radiation regulations is for informational purposes only. Regulations that cover radiation related to the operation of the HEMXRS are discussed in detail in Appendix C.

During normal operating conditions, the affected environment includes the area surrounding the cargo containers being scanned by the HEMXRISs. System operators and maintenance personnel as well as people in the area around the systems are the key component of the affected environment. For purposes of discussion, people are classified into two categories:

1. Maintenance personnel
2. General public (including system operators, truck drivers, port personnel and other CBP personnel)

All maintenance personnel are employees of the equipment manufacturer. Due to the nature of their jobs, they have the potential to be exposed to a higher level of radiation than system operators and members of the general public.

For its officers, port employees and truck drivers, CBP has adopted the same effective radiation dose standard that the Nuclear Regulatory Commission (NRC) and the State of Texas prescribe for members of the general public, which is 0.1 rem in a year. These personnel do not pass through the beam during scanning operations.

3.3.3 Potential Consequences

3.3.3.1 Proposed Action - Fielding and Operation of HEMXRIS

3.3.3.1.1 Exposure Pathways

The radiation exposure pathway for the general public is created from exposure to scattered radiation from the X-ray source during container scanning operations. However, in all cases, the radiation dose received by the general public will not exceed 0.1 rem in a year.

3.3.3.1.2 Normal Operations

3.3.3.1.2.1 Human Exposure

All maintenance personnel who maintain the linear accelerator (linac) and X-ray source components are employees of the equipment manufacturer. By the nature of their jobs, they have the potential to be exposed to a higher level of radiation than the system operators and members of the general public. Maintenance of the linac and X-ray source components will have to comply with the EPA, OSHA, and State of Texas' strict dose standards for radiation workers. For a more detailed discussion of dose standards, see Appendix C.

HEMXRISs are designed so that the radiation dose levels within the driver's cab and at the inspector work-stations (systems operators) will be below the CBP prescribed limits of 0.1 rem in a year. Detailed radiation surveys, performed by or under the supervision of the CBP Radiation Safety Office, have confirmed that these design criteria have been met. In all cases, exposures were measured using a "worst-case" scatter in the X-ray beam. A worst-case scatter scenario is not likely to occur; therefore the estimated exposure levels are conservative by a substantial amount. As an additional precaution, as the HEMXRISs are delivered, exposure measurements will be made in the cabs and work-station areas to ensure that the systems are in compliance with exposure limits.

CBP has adopted the same effective radiation dose standard that the Nuclear Regulatory Commission (NRC) and the State of Texas prescribe for members of the general public (i.e. 0.1 rem). CBP has adopted the NRC standard because the OSH Act only addresses occupational dose exposure limits. As defined by the International Commission on Radiological Protection (ICRP) (ICRP 2007), CBP officers are "occupationally exposed," because their assigned duties involve exposure to radiation or to radioactive material. CBP has decided to limit the officers "occupational dose" to no more than that allowable for the general public.

This exposure limit applies to all CBP employees or contractors who work on or maintain HEMXRISs, but not the linac or X-ray source components. This means that, as far as radiation dose standards are concerned, system operators are the same as members of the general public. For a more detailed discussion of dose standards, see Appendix C. Occupational exposure, to the effective radiation dose standard CBP has adopted, is not expected to cause a significant increase in the risk of cancer. For a more detailed

discussion of information concerning risks from occupational radiation exposure, see Appendix D.

To meet the threshold radiation dose limit, CBP establishes controlled areas for HEMXRISs. No personnel are allowed in the controlled areas during scanning operations. The HCVM has two operational settings: 3.8 MeV and 4.2 MeV, with each operational setting having a specific controlled area which must be maintained during operation. System modes of operation are set based on the density of the walls of the containers scanned. In the event images are not acquired from an initial scan with the system set at 3.8 MeV, the HCVM can be operated at 4.2 MeV to obtain data from denser containers.

When operating at 3.8 MeV, the safe operating dimensions of the controlled area are 110 feet in length and 82 feet in width, as depicted in Figure 3. When operating at 4.2 MeV the safe operating dimensions for the controlled area are 135 feet in length and 133 feet in width, as depicted in Figure 4.

In the extreme, a system operator (or a member of the general public) could be situated at the edge of the controlled area 8 hours a day, every workday of the year (that is to say, 2,000 hours per year) and not receive more exposure than the limits prescribed by the NRC and the State of Texas. The controlled areas ensure that the systems conform to the radiation protection guidelines of reducing the radiation to levels to As Low as is Reasonably Achievable (ALARA).

ALARA is defined in 10 CFR 20.1003 as: *"… means making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest."* In addition, 10 CFR 20.1101(b) requires that: *"[t]he licensee shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA)."*

Controlled areas are calculated and verified for each NII system and are designed to provide adequate separation from other NII operating areas, adjacent structures, work areas and traffic flows to protect workers, the general public and occupants of adjacent buildings. Controlled area dimensions may be adjusted when needed by using cargo containers as a backstop, or by using masonry walls. The controlled area would only be adjusted under the supervision of the CBP Radiation Safety Officer in order to maintain the radiation exposure limit of 0.00005 rem in any one hour limit and 0.1 rem per year.

Analysis and testing for this environmental assessment shows that exposures are expected to be well below the maximum levels of exposure set by the NRC, OSHA, FDA and the

State of Texas to protect the general public (which includes system operators, truck drivers, port personnel and other CBP personnel) therefore, the health and safety impacts from radiological exposure for the Proposed Action were found to not be significant. See section 3.3 for further discussion of radiological health and safety.

3.3.3.1.2.2 Effects of Irradiation on Food

The CBP Radiation Safety Office has conducted tests to determine the worst-case scenario of radiation doses to food as a result of implementing the Proposed Action. The total absorbed dose deposited in food subjected to scanning by a HEMXRIS operating at 4.2 MeV (worst-case) is approximately 0.00135 rem per scan, on the same order as that received by a person hidden in a cargo container. This dose is 266 times less than the average annual background dose in the U.S. of 0.360 rem.

The Food and Drug Administration at 21 CFR 179.21 requires a label be affixed to each machine stating that no food shall be exposed to X-ray radiation sources to receive an absorbed dose in excess of 50 rem. The HEMXRIS's absorbed dose is 37,037 times less than this limit.

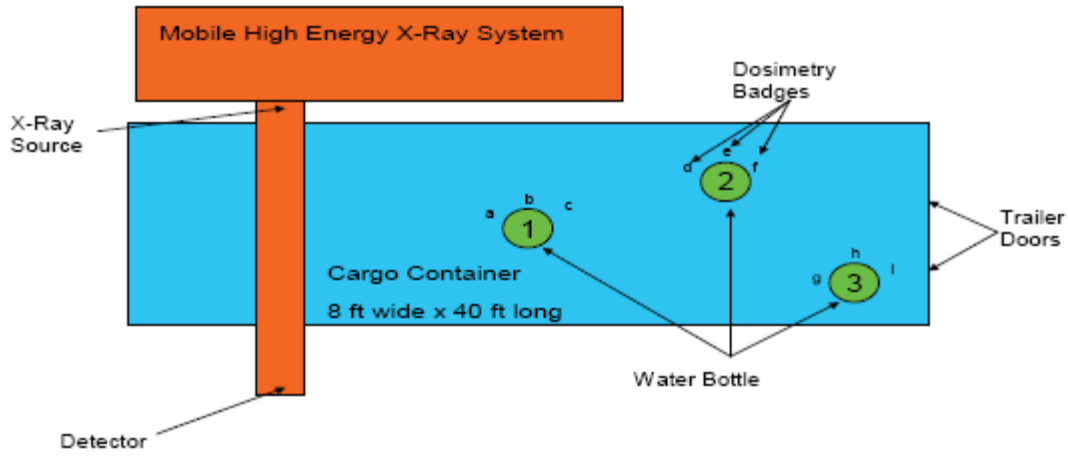
Table 2 lists the results of testing performed by the CBP Radiation Safety Officer. Three water bottles were positioned inside the cargo container as illustrated in Figure 5. Bottle 1 was positioned along the centerline of the cargo container approximately 19 feet forward of the rear entry doors. Bottle 2 was positioned next to the container wall (closest to the accelerator) approximately 14 feet forward of the rear entry doors. Bottle 3 was positioned next to the container wall (farthest from the accelerator) approximately 7 feet forward of the rear entry doors. Each bottle had 3 dosimetry badges attached (left, center, and right side) facing the accelerator.

Based on these measurements and in compliance with the provisions of 21 CFR 179.21 it is concluded that radiation from the Proposed Action will have no significant impact on food that may be located in scanned containers.

Table 2: Dosimetry Results

Location	Position	Results (rem)	Number of Scans	Results (rem/scan)
HCVM				
1	a	0.022	23	0.00096
1	b	0.019	23	0.00083
1	c	0.024	23	0.00104
2	d	0.028	23	0.00122
2	e	0.026	23	0.00113
2	f	0.031	23	0.00135
3	g	0.007	23	0.00030
3	h	0.009	23	0.00039
3	i	0.007	23	0.00030

Figure 5: Location of Water Bottles and Dosimetry Badges



3.3.3.1.2.3 Maintenance

CBP personnel will not perform any maintenance of the linac or the X-ray source enclosure. CBP personnel will periodically perform maintenance of the detectors and test the systems using procedures described in the Operator's Manual. Non-routine linac and X-ray source maintenance will be performed by the manufacturers.

3.3.3.1.2.4 Radiation Safety Engineering Controls

HEMXRISs incorporate redundant safety controls, such as emergency stop buttons (e-stops) at several locations on the systems that allow the system, including X-ray production, to be quickly shut down if necessary. In addition, the personnel assigned to operate the systems will be specifically trained for safe X-radiation system operations according to the CBP Office of Training and Development standards. Training for the system operators will consist of lectures, courses and a written examination in basic radiation physics, radiation safety, biological effects of radiation, instrumentation, radiation control and operating procedures during normal and emergency conditions.

3.3.3.1.3 Abnormal Events

3.3.3.1.3.1 Effects of Irradiation on Persons Hiding in Cargo Containers

As stated in section 3.3.3.1.2.1 (Human Exposure), the NRC and the State of Texas have established the maximum allowable value of radiation dose that may be received by individuals (individual members of the general public) to be 0.1 rem in a year.

It is possible that people will hide themselves in cargo containers in order to surreptitiously enter the United States. A person concealed in a cargo container that is

scanned by a HEMXRIS will be exposed to radiation as a direct consequence of the inspection process.

The CBP Radiation Safety Officer conducted testing to determine the dose that a person hidden in a cargo container would experience during HEMXRIS scanning operations. The total absorbed dose to persons hiding in cargo containers subjected to scanning by a system operating at 4.2 MeV (worst-case) is approximately 0.00135 rem per scan, on the same order of that received by food. This dose is 266 times less than the average annual background dose in the U.S. of 0.360 rem and 74 times below levels permissible to the general public. Neither cargo container drivers nor any other personnel pass through the beam during scanning operations.

Assuming 0.00135 rem per scan, to reach the maximum allowable "in a year" radiation dose, a person would have to be scanned 74 times in a year. Since the chance of this frequency of exposure is remote, it is concluded that radiation from the HEMXRISs will not have a significant impact on persons located in scanned cargo containers.

3.3.3.1.4 Best Management Practices and Mitigation Measures for Radiological Health and Safety

Best management practices for radiological health and safety include but are not limited to:

- Incorporation of safety warnings and precautions into technical manuals and operator manuals.
- Training of operators and screening operations supervisors in the hazards associated with radiation producing equipment.
- Incorporation of emergency stop buttons (e-stops) on the equipment that allow the system, including X-ray production, to be quickly shut down if necessary.
- Training operators and screening operations supervisors in the location and use of e-stops.
- The establishment of radiation controlled areas during screening operations.

3.3.3.2 No Action Alternative

Under the No Action Alternative, the inspection process at the port will continue to be conducted with current techniques and equipment, including other NII technology, visual and manual inspections. Persons entering the United States hidden in cargo containers would not be exposed to radiation levels above those that are naturally occurring if the No Action Alternative is implemented.

Alternatively, contraband that HEMXRISs are designed to detect could pass through the port unnoticed. As a consequence, there would be no health, public safety, or environmental benefits to society that could theoretically result from intercepting a higher percentage of contraband at the U.S. border. Moreover, CBP officers would continue to engage in the same rate of potentially risky inspections of confined spaces to intercept contraband and prevent illegal entry into the United States.

4 Cumulative Impacts

The Council on Environmental Quality (CEQ) regulations stipulate that the cumulative effects analysis in an Environmental Assessment (EA) should consider the potential environmental impacts resulting from "the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" 40 CFR 1508.7. Recent CEQ guidance (CEQ 1997) addressing cumulative effects affirms this requirement, stating that the first steps in assessing cumulative effects involves defining the scope of the other actions and their interrelationship with the Proposed Action. The scope must consider other projects that coincide with the location and timetable of the Proposed Action and other actions. Cumulative effects analysis must also evaluate the nature of interactions among these actions.

In this EA, an effort has been made to identify all actions that are being considered and are in the planning phase at this time that could affect the area in the vicinity of the proposed HEMXRISs at the port. To the extent that details regarding such actions exist and the actions have a potential to interact with the Proposed Action in this EA, these actions are included in this cumulative analysis. This approach enables decision-makers to have the most complete information available so that they can evaluate the environmental consequences of a Proposed Action in relation to other projects that may affect the same region of influence.

4.1 Past and Present Actions Relevant to the Proposed Action and Alternative

CBP operates presently, or plans to operate in the near future, other NII technologies suited to the various inspection needs at the port. Cumulative emission estimates for the other NII were made based on similar assumptions as the HEMXRISs, and the processing speeds of each system (see Appendix B and section 4.3.1 below).

4.2 Reasonably Foreseeable Actions that Could Interact with the Proposed Action and Alternative

Currently there are no known future actions that could combine with the resource areas analyzed within this EA to create a significant cumulative impact. It is likely that future projects at the port would be expected to improve the efficiency of the movement of traffic through the port and therefore reduce air quality impacts related to port operations. Alternatively, this could be counterbalanced by an increase in trade leading to increased cargo movements and increased emissions from NII trucks, onboard generators and cargo moving equipment. Other national factors, such as more stringent emissions controls on diesel engines or an increase in fuel costs, will also effect vehicle emissions and the number of vehicle miles driven.

4.3 Summary of Cumulative Effects

The potential for cumulative impacts resulting from the actions described above when combined with the Proposed Action in this EA are summarized here. The scope is

limited to the resources analyzed in section 3 of this EA. Since the Proposed Action will have no impact on the resources that were determined to be unaffected by the Proposed Action, they would not contribute to cumulative impacts either.

4.3.1 Air Quality

Emissions estimates for proposed and existing NII operations are (tons per year): 19.4 nitrogen oxides, 2.83 volatile organic compounds, 16.6 carbon monoxide and 1.18 PM10. These cumulative emissions estimates are below the tons/year *de minimis* threshold values applicable to nonattainment and maintenance areas as specified in 40 CFR 93.153(b)(1)(2). Therefore the Proposed Action is not anticipated to cause significant, cumulative, air quality impacts (see tables 3 and 4, Appendix B).

4.3.2 Radiological Health and Safety

Aside from NII equipment operated or proposed by CBP, there is no other known NII equipment at the port that could combine with the proposed action and cause a significant cumulative effect. NII equipment has little potential to create cumulative health impacts under normal operating conditions when they are used for their intended purpose by qualified personnel under the supervision of a radiation safety officer in accordance with applicable heath and safety regulations.

Controlled areas are calculated and verified for each NII system and are designed to provide adequate separation from other NII operating areas, adjacent structures, work areas and traffic flows to protect workers, the general public and occupants of adjacent buildings. Limiting access to the controlled areas ensures that the public (which includes system operators and port personnel) are not exposed to radiation levels exceeding those prescribed by applicable regulations (see Appendix C and Appendix D). In the event other NII technologies are present or planned for operation at the port, CBP will ensure that controlled areas for each technology are adequately designated and do not overlap with one another to prevent any cumulative health impacts from radiation related to the operation of the HEMXRIS equipment.

Each HEMXRIS and associated controlled area will occupy a maximum of 17,955 square feet (35,910 maximum if both operate simultaneously) of space on the port during operations (this includes the deployed system and necessary controlled area). The placement of these systems combines with placement of other proposed and existing NII systems to occupy a total maximum (if all NII systems operate simultaneously) of 1.06 acre of port space. The Bayport and Barbours Cut terminals both have adequate space to accommodate the proposed NII systems and existing and planned systems.

Controlled area dimensions may be adjusted when needed by using cargo containers as a backstop, or by using masonry walls. The controlled area would only be adjusted under the supervision of the CBP Radiation Safety Officer in order to maintain the radiation exposure limit of 0.00005 rem in any one hour limit.

5 Findings and Conclusions

5.1 Environmental Consequences of the Proposed Action and Alternatives

The evaluation of the Proposed Action, fielding and operation of two HEMXRISs at the Port of Houston, Harris County, Texas, indicates that the human environment, as defined in NEPA, at the port will not be significantly affected. The predicted consequences on resource areas are briefly described below.

Climate – Each HEMXIRS engine and each onboard generator, as well as cargo-moving equipment, will emit small amounts of air pollutants and greenhouse gases as a result of the Proposed Action. Analysis presented in this EA has established that these emissions will be *de minimis*, as defined by the Clean Air Act. Accordingly, effects on the climate are expected to be negligible.

Geology and Soils – No construction or excavation is required for the Proposed Action. Scattered X-radiation will not contaminate soils because it is energy that dissipates as soon as the source is turned off, just as a room becomes dark as soon as the light switch is turned off. No direct impacts to geology and soils would occur from the implementation of the Proposed Action.

Hydrology and Water Quality – The Proposed Action will not affect hydrology, water resources or water quality.

Floodplains – The Proposed Action will not result in any floodplain loss, adverse impacts to human safety, health, and welfare, or adverse impacts to the natural and beneficial values served by floodplains. HEMXRIS are mobile units that can be moved away from floodplains in the event of flooding or other natural disasters.

Wetlands – The Proposed Action will occur on previously paved surfaces and will not impact any wetlands.

Coastal Zone – The port is located in the Texas Coastal Zone. The Proposed Action is consistent with current actions at the port. No coastal zone resources will be adversely affected by the Proposed Action. Correspondence related to this determination is included in Appendix A.

Vegetation and Wildlife – The Proposed Action will occur on previously paved surfaces and will be consistent with current actions at the port. No vegetation or wildlife will be impacted by the Proposed Action.

Threatened and Endangered Species – The Proposed Action will take place in paved, industrial areas where suitable wildlife habitat and species do not exist. Therefore, the Proposed Action will have no effect on threatened or endangered species. Correspondence related to this determination is included in Appendix A.

Air Quality – All estimated emission levels from the activities associated with the Proposed Action are below the tons/year *de minimis* threshold values applicable to nonattainment and maintenance areas for all pollutants as specified in 40 CFR 93.153(b)(1)(2). Therefore the Proposed Action is not anticipated to cause an exceedance of any NAAQS for criteria pollutants. The Proposed Action will not conflict with conformity requirements of section 176 of the Clean Air Act for federal actions or any approved SIP. The Proposed Action will not have a significant impact on local or regional air quality within the context of the Clean Air Act or NEPA (see section 3.2 and Appendix B).

Noise –The Proposed Action is consistent with current actions at the port and will not measurably change the existing noise environment or violate any noise ordinances. As a result, the Proposed Action will not have a significant noise impact.

Land Use and Zoning – The Proposed Action is consistent with current actions at the port and will not impact land use or zoning.

Aesthetics and Visual Resources – The Proposed Action would not obscure or result in abrupt changes to the complexity of the landscape and skyline when viewed from points readily accessible to the public. No long-term change to the character of the area would occur as a result of the Proposed Action.

Infrastructure and Utilities – The port has pre-existing water and electrical services. The Proposed Action will not impact the infrastructure and utility services of the port.

Traffic and Transportation – During the planning process for each NII system and prior to deployment, site surveys are conducted, and coordinations with the appropriate stakeholders are made to ensure that the placement and operation of systems are integrated with port traffic patterns and facilities to minimize delays to legitimate transportation.

Waste Management – Wastes associated with the Proposed Action are used oil and lubricants for the operation and maintenance of the HEMXRISs. These will be accumulated and stored in compliance with applicable regulations at or near the point of generation and recycled by a licensed used oil recycler. 40 CFR Part 279 exempts used oil and lubricants from regulation as a hazardous waste if they are recycled and not mixed with any other hazardous wastes. It is not anticipated that the operation and maintenance of the systems will generate amounts of hazardous wastes that would have any affect on the port's current generator status. There is no radioactive source or byproduct material used in the systems, therefore there is no risk of a release of radioactive materials.

If a system or system component is replaced or decommissioned, the handling, storage, use, transfer, and disposal of all materials will comply with applicable regulations. This will prevent human exposure and releases to the environment of any hazardous material that could potentially be within the systems.

Historical and Archeological (Cultural) Resources – The HEMXRISs will be operated in an industrial setting and will not have an impact on sites that are listed on, or potentially eligible for listing on, the National Register of Historic Places. There is no construction or excavation related to the Proposed Action. If, in the course of deploying and operating the HEMXRISs CBP discovers that historical or archeological resources could be impacted, then project operations will be suspended and the appropriate authorities will be consulted. Implementing the Proposed Action will not have a significant impact on cultural or historic resources. Correspondence related to this determination is included in Appendix A.

Socioeconomics – The Proposed Action will not affect employment, housing or demographics. Implementation of the Proposed Action may produce indirect socioeconomic effects by deterring the movement of illicit drugs, explosives, firearms, or other contraband into the U.S. Similar indirect effects could result if the Proposed Action led to the apprehension of criminals or terrorists attempting to enter the U.S. Such effects, however, are only theoretical and will not be further evaluated in this document.

Environmental Justice – Implementation of the Proposed Action is not expected to have any negative or disproportionate effects on minority and low income populations or children.

Transboundary Impacts – The port is not located adjacent to any international borders and potential environmental effects from the Proposed Action will not extend beyond the territory of the U.S.

Irreversible and Irretrievable Commitment of Resources – The irreversible and irretrievable commitment of resources associated with the Proposed Action will be the procurement of the HEMXRISs, materials, utilities, labor and time expended in the operation of the systems. No sensitive environmental resources will be lost or permanently altered due to the Proposed Action.

Radiological Health and Safety – While the use of any NII screening system must be evaluated to ensure that there are no adverse impacts to the health and safety of the public, CBP officers, and port employees, HEMXRISs are designed and operated to avoid these impacts. As promulgated by the Nuclear Regulatory Commission (NRC) in 10 CFR Part 20, the maximum permissible level of radiation dose to the general public is 0.1 rem in a year. As discussed in section 3.3, CBP will use this protective limit for the public and CBP employees and other port workers.

The term "rem" is an abbreviation for "roentgen equivalent man" and is a special unit used for expressing dose equivalent[3]. Some types of radiation produce greater biological effects for the same amount of energy imparted than other types. The rem is a unit that relates the dose of absorbed radiation to the biological effect of that dose on human

[3] rem is often expressed as mrem (millirem, or thousandths of a rem) or µrem (microrem, or millionths). For the sake of consistency, this document will use the fractional notation.

tissues and organs. (See section 3.3 and Appendices C & D for additional analysis and information on radiation exposure).

HEMXRIS Occupants **–** HEMXRISs are designed so that the radiation dose levels within the driver's cab and at the inspector work-stations (systems operators) will be below 0.00005 rem in any one hour. With an annual work limit of 2,000 hours, this hourly dose limit will prevent annual cumulative exposures that exceed the limit of 0.1 rem in a year.

Detailed radiation surveys, performed by or under the supervision of the CBP Radiation Safety Office, have confirmed that these design and exposure criteria have been met. In all cases, exposures were measured using a "worst-case" scatter in the X-ray beam. Since such a worst-case scatter scenario is not likely to occur, these estimated exposure levels are conservative by a substantial amount. As an additional precaution, as the systems are delivered, exposure measurements will be made in the cabs and work-station areas to ensure that the systems are in compliance with exposure limits.

CBP Officers and Port Employees – Due to the nature of their work, CBP officers and port employees who work around HEMXRISs have the potential to be "occupationally exposed"[4] to radiation. The NRC and the Occupational Safety and Health Administration (OSHA) allow a higher permissible exposure level ("occupational dose") for radiation workers in restricted areas (5 rem in a year).

CBP has elected to use the general public protection standard of 0.1 rem in a year as the maximum permissible level of radiation dose for CBP officers and port employees. This standard is 50 times more stringent than occupational dose limits established by the NRC and OSHA for radiation workers. The radiation dose from a HEMXRIS will be no more than 0.00005 rem in any one hour since personnel will stand behind a marker delineating a "controlled area."

An analysis of potential exposure was based on 2,000 work hours per year as the maximum exposure time. This assumes that an individual spends all of a forty-hour work week, every week of the year, standing at the boundary of a system's controlled area. Even under those circumstances, neither CBP officers, port employees or the public will receive a cumulative dose greater than the NRC limit for protecting the general public.

Controlled Areas **–** To meet the threshold radiation dose limit, CBP establishes controlled areas for each HEMXRIS. No personnel are allowed in the controlled areas during scanning operations. The HCVM has two operational settings: 3.8 MeV and 4.2 MeV, with each operational setting having a specific controlled area which must be maintained during operation. System modes of operation are set based on the density of the walls of the containers scanned. In the event images are not acquired from an initial scan with the system set at 3.8 MeV, the HCVM can be operated at 4.2 MeV to obtain data from denser containers.

[4] As defined by the International Commission on Radiological Protection (ICRP) (ICRP 2007)

When operating at 3.8 MeV, the safe operating dimensions of the controlled area are 110 feet in length and 82 feet in width, as depicted in Figure 3. When operating at 4.2 MeV the safe operating dimensions for the controlled area are 135 feet in length and 133 feet in width, as depicted in Figure 4.

In the extreme, a system operator (or a member of the general public) could be situated at the edge of the controlled area 8 hours a day, every workday of the year (that is to say, 2,000 hours per year) and not receive more exposure than the limits prescribed by the NRC. The controlled areas ensure that the systems conform to the radiation protection guidelines of reducing the radiation levels As Low as is Reasonably Achievable (ALARA).

Controlled areas are calculated and verified for each NII system and are designed to provide adequate separation from other NII operating areas, adjacent structures, work areas and traffic flows to protect workers, the general public and occupants of adjacent buildings. Controlled area dimensions may be adjusted when needed by using cargo containers as a backstop, or by using masonry walls. The controlled area would only be adjusted under the supervision of the CBP Radiation Safety Officer in order to maintain the radiation exposure limit of 0.00005 rem in any one hour limit and 0.1 rem per year.

Effects of Irradiation on Food – The Food and Drug Administration (FDA) at 21 CFR 179.21 requires a label be affixed to each machine stating that no food shall be exposed to X-ray radiation sources to receive an absorbed dose in excess of 50 rem. The CBP Radiation Safety Office conducted tests to determine the worst-case scenario of radiation doses to food as a result of implementing the Proposed Action. The HEMXRIS absorbed dose is 37,037 times less than this limit. Based on these measurements and compliance with the provisions of 21 CFR 179.21 it is concluded that radiation from the Proposed Action will have no significant impact on food that may be located in scanned containers.

Effects of Irradiation on Persons Hiding in Cargo Containers – It is possible that people will hide themselves in cargo containers in order to surreptitiously enter the United States. A person concealed in a cargo container that is scanned by a HEMXRIS will be exposed to radiation as a direct consequence of the inspection process. The total absorbed dose to persons hiding in cargo containers subjected to scanning by a system operating at 4.2 MeV (worst case) is approximately 0.00135 rem per scan, on the same order of that received by food. This dose is 266 times less than the average annual background dose in the U.S. of 0.360 rem and 74 times below levels permissible to the general public.

Assuming 0.00135 rem per scan, to reach the maximum allowable “in a year” radiation dose, a person would have to be scanned 74 times in a year. Since the chance of this frequency of exposure is remote, it is concluded that radiation from HEMXRISs will not have a significant impact on persons located in scanned cargo containers.

Analysis and testing for this environmental assessment shows that exposures are expected to be well below the maximum levels of exposure set by the NRC, OSHA and the FDA to

protect the general public (which includes system operators, truck drivers, port personnel and other CBP personnel) therefore, the health and safety impacts from radiological exposure for the Proposed Action were found to not be significant. See section 3.3 for further discussion of radiological health and safety.

5.2 Summary of Best Management Practices and Mitigation Actions Planned

Best Management Practices for Air – The emission estimates prepared for this EA were based on the assumption that the HEMXRIS vehicles and generators would be idling for 16 hours per day. In practice, to reduce emissions from the Proposed Action, cargo container handling equipment waiting for the inspection of containers by the HEMXRISs will follow applicable regulations regarding the control of idling times. The HEMXRISs are vehicle mounted, where the X-radiation equipment is installed on 2006-2007 model vehicles which meet the Best Available Control Technology as defined by the U.S. Environmental Protection Agency (EPA).

Best Management Practices for Wastes – Petroleum, oils, and lubricants will be stored, handled, and disposed of in compliance with applicable laws and regulations. Procedures for the safe refueling of HEMXRISs and for the containment and clean-up of potential spills will be in accordance with existing port procedures for preventing and controlling releases. CBP personnel will be trained in spill prevention and countermeasures as required by the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. §6901, *et seq*.) and the Oil Pollution Act of 1990 (OPA) (33 U.S.C §2701 *et seq.*)

HEMXRISs might contain materials that could be hazardous if the materials are handled improperly. An example of such a material would be lead metal, which is used for radiation shielding. As a system component, the lead will be innocuous and will provide a protective function from ionizing radiation.

As a CBP asset, all materials within the systems will be in use for their intended purpose, under the supervision of appropriately trained personnel. Under this scenario, there is no hazard to the human environment because the materials will be contained within the systems as functional components of the systems.

In the event of an accident, hazardous materials would not be expected to cause any significant harm to the human environment, because the amount of materials is small, and most materials will be in solid form which is readily contained and recovered. Accident response procedures are in place at the port to contain and remove fluids such as lubricants and fuel.

The most important action to ensure that hazardous materials have no significant effect on the human environment will be upon the replacement or decommissioning of a component or system. Appropriate disposition will depend upon type and quantity of materials involved and the applicable regulations. If a component is replaced or decommissioned, the handling, storage, use, transfer, and disposal of all materials will

comply with applicable regulations. This will prevent human exposure and releases to the environment of any hazardous material.

Best Management Practices and Mitigation Measures for Radiological Health and Safety – Best management practices for radiological health and safety include but are not limited to:

- Incorporation of safety warnings and precautions into technical manuals and operator manuals.
- Training of operators and screening operations supervisors in the hazards associated with radiation producing equipment.
- Incorporation of emergency stop buttons (e-stops) on the equipment that allow the system, including X-ray production, to be quickly shut down if necessary.
- Training operators and screening operations supervisors in the location and use of e-stops.
- The establishment of radiation controlled areas during screening operations.

The combination of these precautions will ensure that the cumulative radiation dose to officers and the general public will not exceed 0.00005 rem in any one hour or 0.1 rem per year.

5.3 Findings and Conclusions

The evaluation of the Proposed Action, fielding and operation of two HEMXRISs at the Port of Houston, demonstrates that there will be no significant, adverse effects on the human environment as long as identified best management practices and mitigation measures are followed. Therefore, no further environmental impact analysis is warranted.

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7 Persons and Organizations Contacted

Debra Beene
Texas Historical Commission
State Historic Preservation Office
PO Box 12276
Austin, Texas 78711-2276

Tom Calnan
Texas General Land Office
Coastal Management Program
P.O. Box 12873
Austin, TX 78711-2873

The Honorable Oscola Clayton,
Principal Chief
Alabama-Coushatta Tribes of Texas
572 State Park Road 56
Livingston, TX 77351

Jennifer Hass
Environmental Program Office
U.S. Customs and Border Protection
1300 Pennsylvania Avenue, NW
Suite 1220
Washington, DC 20229

Luke McCormick
Radiation Safety Officer
U.S. Customs and Border Protection
6650 Telecom Drive
Suite 100
Indianapolis, IN 46278

The Honorable Anthony Street,
President
Tonkawa Tribe of Indians of Oklahoma
1 Rush Buffalo Road
Tonkawa, OK 74653

U.S. Fish and Wildlife Service
Field Supervisor
Corpus Christi Ecological Services
c/o Corpus Christi State University
Campus Box 338
6300 Ocean Drive
Corpus Christi, TX 78412

Carolyn Whorton
NII Program Manager
U.S. Customs and Border Protection
Interdiction Technology Branch
1300 Pennsylvania Avenue NW
Suite 1575
Washington, DC 20229

8 Acronyms and Abbreviations

^{137}Cs	Cesium 137
^{60}Co	Cobalt 60
A	Ampere
AAPA	American Association of Port Authorities
ALARA	As Low As is Reasonably Achievable
BEIR	Biological Effects of Ionizing Radiation
BMP	Best Management Practices
CAA	Clean Air Act
CBP	Customs and Border Protection
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CSI	Container Security Initiative
DHS	Department of Homeland Security
DOT	Department of Transportation
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
Erg	An erg is a small but measurable amount of energy
FDA	Food and Drug Administration
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
FR	Federal Register
Gy	Gray
HCVM	Heimann Cargo Vision-2
HDD	Heavy Duty Diesel
HDDV	Heavy Duty Diesel Vehicle
HEMXRIS	High Energy Mobile X-Ray Inspection System
HP	HorsePower
H_T	Dose equivalent
HVAC	Heating Ventilation and Air Conditioning
Hz	Hertz
ICRP	International Commission on Radiological Protection
lb	Pounds
Ldn	Day-Night average sound level
MeV	Million Electron Volts
mrad	millirad
mrem	millirem
NAA	Nonattainment Area
NAAQS	National Ambient Air Quality Standards
NCRP	National Council on Radiation Protection
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NII	Non-Intrusive Inspection

NOA	Notice of Availability
NOI	Notice of Intent
NOx	Nitrogen Oxides
NRC	Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
O_3	Ozone
OFO	Office of Field Operations
ONDCP	Office of National Drug Control Policy
OSH Act	Occupational Safety and Health Act
OSHA	Occupational Safety and Health Administration
PEA	Programmatic Environmental Assessment
PM_{10}	Particulate Matter 10 micrometers or smaller in diameter
rad	Radiation Absorbed Dose
rem	Roentgen Equivalent Man
RPM	Revolutions Per Minute
RSO	Radiation Safety Officer
SAFE	Security and Accountability for Every (i.e. SAFE Port Act of 2006)
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SOx	Sulfur Oxides
Sv	sievert
TAC	Texas Administrative Code
TEDE	Total Effective Dose Equivalent
TEU	Twenty Foot Equivalent Units
µrad	microrad
µrem	microrem
U.S.	United States
U.S.C.	United States Code
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOC	Volatile Organic Compounds

9 List of Preparers

Name	Agency/Organization	Discipline/Expertise	Experience	Role in Preparing EA
Gary Armstrong	Organizational Strategies, Inc	Environmental Analyst	14 years in NEPA and related studies	Program Manager, Environmental Analysis & Impact Evaluation
Kathryn Child	Organizational Strategies, Inc	Chemistry, Licensed Environmental Health Scientist	13 years in environmental science and regulatory compliance	Research, impact analysis, technical review and editing
Darrell Mensel	Organizational Strategies, Inc	Environmental Analyst	12 years of environmental related experience	Technical review and editing
Anneke Frederick	Organizational Strategies, Inc	Environmental Scientist	13 years in environmental science and regulatory compliance	Technical review and editing

10 Distribution List

Debra Beene
Texas Historical Commission
PO Box 12276
Austin, TX 78711-2276

Tom Calnan
Texas General Land Office
Coastal Management Program
P.O. Box 12873
Austin, TX 78711-2873

Dana Blume
Port of Houston Authority
P.O. Box 2562
Houston, TX 77252-2562

Chuck Carroll
National Maritime Safety Association
919 18th Street, NW
Suite 901
Washington, DC 20006

The Honorable Oscola Clayton, Principal Chief
Alabama-Coushatta Tribes of Texas
572 State Park Road 56
Livingston, TX 77351

The Honorable John Cornyn
U.S. Senate
517 Hart Senate Office Building
Washington, DC 20510

Sylvia R. Garcia, Commissioner
Harris County Commissioner, Precinct 2
1001 Preston, Rm. 950
Houston, TX 77002

Jennifer Hass
Environmental Program Office
U.S. Customs and Border Protection
1300 Pennsylvania Avenue, NW
Suite 1220
Washington, D.C. 20229

The Honorable Kay Bailey Hutchison
U.S. Senate
284 Russell Senate Office Building
Washington, DC 20510

The Honorable Mike Jackson
Texas State Senate
P.O. Box 12068
Capitol Station
Austin, TX 78711

The Honorable Nick Lampson
U.S. House of Representatives
436 Cannon HOB
Washington, DC 20515-4322

Librarian
Harris County Public Library
La Porte Branch
600 South Broadway
La Porte, TX 77571

Librarian
Houston Public Library
Central Branch
500 McKinney
Houston, TX 77002

Librarian
Houston Public Library
Park Place Branch
8145 Park Place
Houston, TX 77017

Luke McCormick
Radiation Safety Officer
U.S. Customs and Border Protection
6650 Telecom Drive
Suite 100
Indianapolis, IN 46278

The Honorable Rick Perry
State of Texas
Office of the Governor
P.O. Box 12428
Austin, TX 78711-2428

The Honorable Alton E. Porter, Mayor
City of La Porte
604 W. Fairmont Parkway
La Porte, TX 77571

The Honorable Wayne Smith
Texas State House of Representatives
Room EXT E2.822
P.O. Box 2910
Austin, TX 78768

The Honorable John E. Davis
Texas State House of Representatives
Room EXT E1.320
P.O. Box 2910
Austin, TX 78768

The Honorable Anthony Street, President
Tonkawa Tribe of Indians of Oklahoma
1 Rush Buffalo Road
Tonkawa, OK 74653

U.S. Customs and Border Protection
Supervisor
2350 N. Sam Houston Pkwy E. #1000
Houston, TX 77032-3100

The Honorable Jayo Washington, Mayor
City of Shoreacres
601 Shoreacres Blvd
Shoreacres, TX 77571

The Honorable Bill White, Mayor
City of Houston
P.O. Box 1562
Houston, TX 77251

Carolyn Whorton
NII Program Manager
U.S. Customs and Border Protection
Interdiction Technology Branch
1300 Pennsylvania Avenue NW, Suite 1575
Washington, DC 20229

Richard A. Ratliff
Bureau of Radiation Control
Dept. of State Health Services
Division for Regulatory Services
P.O. Box 149347-Mail Code 2835
Austin, TX 78714-9347

Texas Parks and Wildlife Department
4200 Smith School Road
Austin, TX 78744

Occupational Safety and Health Administration
Regional Office
525 Griffin Street, Room 602
Dallas, TX 75202

John Guerra
Texas Commission on Environmental Quality
Air Quality Planning Section
Mobile Source Program Team
P.O. Box 13087,
MC-164 Austin TX 78711-3087

Appendix A: Correspondence

RECEIVED

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FISH & WILDLIFE SERVICE
CORPUS CHRISTI, TX

U.S. Department of Homeland Security
Washington, DC 20229

U.S. Customs and Border Protection

November 8, 2007

U.S. Fish and Wildlife Service
Field Supervisor
Corpus Christi Ecological Services
c/o Corpus Christi State University
Campus Box 338
6300 Ocean Drive
Corpus Christi, TX 78412

SUBJECT: Fielding and Operation of Two High Energy Mobile X-Ray Inspection Systems at the Bayport and Barbours Cut Terminals, Port of Houston, Harris County, Texas.

Dear Supervisor:

The United States Customs and Border Protection (CBP) is notifying you of the Proposed Action noted above. An Environmental Assessment (EA) is being drafted to evaluate the potential environmental effects of the Proposed Action. As soon as the draft EA is available you will be sent a copy for your immediate review and comment. If you do not wish to have a copy of the draft EA for review, please notify Mr. David Walls at (202) 393-8441 extension 235.

The Proposed Action consists of the fielding and operation of two high energy mobile x-ray inspection systems at the Bayport and Barbours Cut terminals, Port of Houston, Harris County, Texas for the purpose of conducting non-intrusive inspections of cargo containers entering the United States. The systems use a linear accelerator to produce images of the contents of the cargo containers. No x-rays will be produced when the systems are not being operated and no radiation source material is used in the operation of the system. No construction is required for the Proposed Action. These mobile systems will operate on previously paved surfaces at the Bayport and Barbours Cut terminals. Included are maps of the locations and pictures of the proposed systems.

Two federally listed species are known to occur with Harris County, the bald eagle (*Haliaeetus leucocephalus*) and the Texas prairie dawn-flower (*Hymenoxys texana*). Neither species is known to occur within the port's properties. The Proposed Action will take place within heavily urbanized areas of the Bayport and Barbours Cut terminals where no suitable habitat and no critical habitat exist for these species. Therefore, we have determined no threatened or endangered species will be affected by the Proposed Action. We request your concurrence with our determination.

Please provide your response to:
Mr. David Walls
Organizational Strategies, Inc.
1331 Pennsylvania Avenue NW Suite 1415
Washington, DC 20004

If you have any questions to the above, please feel free to contact Mr. David Walls at (202) 393-8441 extension 235 or e-mail dwalls@orgstrategies.com. Thank you in advance for your assistance.

Sincerely,

Sharon Sharp-Harrison
Branch Director
Office of Information and Technology
Laboratories and Scientific Services
Interdiction Technology Branch

Your letter indicates you have determined that the proposed action would have no effect on federally listed species. Therefore, the Service believes your agency has complied with section 7(a)(2) of the Endangered Species Act by making a determination. No further action is required from this office.

Date: 11/30/07

Consultation #: 21410-2008-I-0071

Enclosures

Approved By: for E. Dawn Whitehead

Allan M. Strand, Field Supervisor
U.S. Fish and Wildlife Service, Corpus Christi Ecological Services Office

U.S. Department of Homeland Security
Washington, DC 20229

U.S. Customs and
Border Protection

November 8, 2007

Tom Calnan
Texas General Land Office
Coastal Management Program
P.O. Box 12873
Austin, TX 78711-2873

SUBJECT: Fielding and Operation of Two High Energy Mobile X-Ray Inspection Systems at the Bayport and Barbours Cut Terminals, Port of Houston, Harris County, Texas.

Dear Mr. Calnan:

The United States Customs and Border Protection (CBP) is notifying you of the Proposed Action noted above. An Environmental Assessment (EA) is being drafted to evaluate the potential environmental effects of the Proposed Action. As soon as the draft EA is available you will be sent a copy for your immediate review and comment. If you do not wish to have a copy of the draft EA for review, please notify Mr. David Walls at (202) 393-8441 extension 235.

The Proposed Action consists of the fielding and operation of two high energy mobile x-ray inspection systems at the Bayport and Barbours Cut terminals, Port of Houston, Harris County, Texas for the purpose of conducting non-intrusive inspections of cargo containers entering the United States. The systems use a linear accelerator to produce images of the contents of the cargo containers. No x-rays will be produced when the systems are not being operated and no radiation source material is used in the operation of the system. No construction is required for the Proposed Action. These mobile systems will operate on previously paved surfaces at the Bayport and Barbours Cut terminals. Included are maps of the locations and pictures of the proposed systems.

We have determined that the coastal zone resources of Texas will not be adversely affected by the Proposed Action. We request your concurrence with this determination.

Please provide your response to:
Mr. David Walls
Organizational Strategies, Inc.
1331 Pennsylvania Avenue NW Suite 1415
Washington, DC 20004

If you have any questions to the above, please feel free to contact Mr. David Walls at (202) 393-8441 extension 235 or e-mail dwalls@orgstrategies.com. Thank you in advance for your assistance.

Sincerely,

Sharon Sharp-Harrison
Branch Director
Office of Information and Technology
Laboratories and Scientific Services
Interdiction Technology Branch

Enclosures

U.S. Department of Homeland Security
Washington, DC 20229

U.S. Customs and
Border Protection

November 8, 2007

Ms. Debra Beene
Texas Historical Commission
PO Box 12276
Austin, Texas 78711-2276

SUBJECT: Fielding and Operation of Two High Energy Mobile X-Ray Inspection Systems at the Bayport and Barbours Cut Terminals, Port of Houston, Harris County, Texas.

Dear Ms. Beene:

The United States Customs and Border Protection (CBP) is notifying you of the Proposed Action noted above. An Environmental Assessment (EA) is being drafted to evaluate the potential environmental effects of the Proposed Action. As soon as the draft EA is available you will be sent a copy for your immediate review and comment. If you do not wish to have a copy of the draft EA for review, please notify Mr. David Walls at (202) 393-8441 extension 235.

The Proposed Action consists of the fielding and operation of two high energy mobile x-ray inspection systems at the Bayport and Barbours Cut terminals, Port of Houston, Harris County, Texas for the purpose of conducting non-intrusive inspections of cargo containers entering the United States. The systems use a linear accelerator to produce images of the contents of the cargo containers. No x-rays will be produced when the systems are not being operated and no radiation source material is used in the operation of the system. No construction is required for the Proposed Action. These mobile systems will operate on previously paved surfaces at the Bayport and Barbours Cut terminals. Included are maps of the locations and pictures of the proposed systems.

We have determined that no historic properties listed or eligible for listing within the National Register of Historic Places will be affected by the proposed undertaking and requests your concurrence. We request your concurrence with our determination.

Please provide your response to:
Mr. David Walls
Organizational Strategies, Inc.
1331 Pennsylvania Avenue NW Suite 1415
Washington, DC 20004

If you have any questions to the above, please feel free to contact Mr. David Walls at (202) 393-8441 extension 235 or e-mail dwalls@orgstrategies.com. Thank you in advance for your assistance.

Sincerely,

Sharon Sharp-Harrison
Branch Director
Office of Information and Technology
Laboratories and Scientific Services
Interdiction Technology Branch

Enclosures

U.S. Department of Homeland Security
Washington, DC 20229

U.S. Customs and Border Protection

November 8, 2007

The Honorable Oscola Clayton, Principal Chief
Alabama-Coushatta Tribes of Texas
572 State Park Road 56
Livingston, TX 77351

SUBJECT: Fielding and Operation of Two High Energy Mobile X-Ray Inspection Systems at the Bayport and Barbours Cut Terminals, Port of Houston, Harris County, Texas.

Dear Principal Chief Clayton:

The U.S. Customs and Border Protection (CBP), Office of Information Technology, Laboratories and Scientific Services, Interdiction Technology Branch is notifying you of the Proposed Action noted above. In accordance with Section 106 of the National Historic Preservation Act and its implementing regulations, 36 CFR Part 800, CBP wishes to continue our consultation process with the appropriate federally recognized Native American tribes who historically used this region or continue to use this area. We welcome your comments on this undertaking and look forward to hearing from you regarding known sacred sites or other traditional cultural properties within the proposed project area. CBP is also preparing an Environmental Assessment (EA) for the Proposed Action mentioned above. As soon as the draft EA is available, you will be sent a copy for your immediate review and comment.

The Proposed Action consists of the fielding and operation of two high energy mobile x-ray inspection systems at the Bayport and Barbours Cut terminals, Port of Houston, Harris County, Texas for the purpose of conducting non-intrusive inspections of cargo containers entering the United States. The systems use a linear accelerator to produce images of the contents of the cargo containers. No x-rays will be produced when the systems are not being operated and no radiation source material is used in the operation of the system. No construction is required for the Proposed Action. These mobile systems will operate on previously paved surfaces at the Bayport and Barbours Cut terminals. Included are maps of the locations and pictures of the proposed systems.

If you have any questions or responses to the above, please feel free to contact Mr. David Walls at (202) 393-8441 x235 or facsimile (202) 393-8442.

Sincerely,

Sharon Sharp-Harrison
Branch Director
Office of Information and Technology
Laboratories and Scientific Services
Interdiction Technology Branch

Enclosures

U.S. Department of Homeland Security
Washington, DC 20229

U.S. Customs and Border Protection

November 8, 2007

The Honorable Anthony Street, President
Tonkawa Tribe of Indians of Oklahoma
P.O. Box 70
Tonkawa, OK 74653

SUBJECT: Fielding and Operation of Two High Energy Mobile X-Ray Inspection Systems at the Bayport and Barbours Cut Terminals, Port of Houston, Harris County, Texas.

Dear President Street:

The U.S. Customs and Border Protection (CBP), Office of Information Technology, Laboratories and Scientific Services, Interdiction Technology Branch is notifying you of the Proposed Action noted above. In accordance with Section 106 of the National Historic Preservation Act and its implementing regulations, 36 CFR Part 800, CBP wishes to continue our consultation process with the appropriate federally recognized Native American tribes who historically used this region or continue to use this area. We welcome your comments on this undertaking and look forward to hearing from you regarding known sacred sites or other traditional cultural properties within the proposed project area. CBP is also preparing an Environmental Assessment (EA) for the Proposed Action mentioned above. As soon as the draft EA is available, you will be sent a copy for your immediate review and comment.

The Proposed Action consists of the fielding and operation of two high energy mobile x-ray inspection systems at the Bayport and Barbours Cut terminals, Port of Houston, Harris County, Texas for the purpose of conducting non-intrusive inspections of cargo containers entering the United States. The systems use a linear accelerator to produce images of the contents of the cargo containers. No x-rays will be produced when the systems are not being operated and no radiation source material is used in the operation of the system. No construction is required for the Proposed Action. These mobile systems will operate on previously paved surfaces at the Bayport and Barbours Cut terminals. Included are maps of the locations and pictures of the proposed systems.

If you have any questions or responses to the above, please feel free to contact Mr. David Walls at (202) 393-8441 x235 or facsimile (202) 393-8442.

Sincerely,

Sharon Sharp-Harrison
Branch Director
Office of Information and Technology
Laboratories and Scientific Services
Interdiction Technology Branch

Enclosures

Appendix B: Air Quality Analysis

This analysis considers operational impacts to local and regional air quality that could result from implementation of the Proposed Action.

Construction Emissions

The proposed HEMXRISs and existing NII systems discussed below will be operated on existing paved surfaces at the port. No construction is necessary for the Proposed Action.

Idling Emissions

The Environmental Protection Agency has determined that for analysis not requiring detailed specific emission estimates tailored to local conditions, the summary of idle emission factors contained in EPA420-F-98-014 can be used to obtain first-order approximations of emissions under idling conditions (e.g., drive-thru lanes). This analysis includes emissions estimates for the proposed systems and the existing NII systems. Emissions estimates are summarized below in Table 3.

HEMXRIS Operations

The engine type to be used on HCVM systems is the International DT570 medium duty diesel engine with an average horsepower (HP) rating of 285 HP at 2,200 revolutions per minute (RPM). Designated as a clean fuel fleet vehicle/low emissions vehicle, all engine types meet the EPA requirements for emissions. The onboard generators are Martin Diesel 35.2 kilowatt, 61.2 HP at 1,800 RPM.

Emission estimates for the HEMXRISs assume each system and both diesel powered generators will be operated 16 hours per day, 365 days per year and the systems will be continuously idling, or scanning cargo containers at a speed of less than 0.5 miles per hour. Emission estimates for vehicles that will be inspected assume that each mobile system processes an average of 20 vehicles per hour (i.e. processing time equals 3 minutes per vehicle and each system processes 320 vehicles per day).

Existing and Planned NII Systems

CBP currently operates or plans to operate various NII systems at the port. The emissions estimates for the systems are based on the same assumptions and factors that are used for the HEMXRIS, except the processing times for the systems vary.

Table 3: Emissions Estimate from Proposed, Existing and Future Operations [1&2]

Source	NOx (tons/yr)	VOC (tons/yr)	CO (tons/yr)	PM_{10} (tons/yr)
HEMXRIS Operations	13.6	1.54	6.84	0.910
Other NII System Operations	5.75	1.29	9.71	0.267
Cumulative (tons/yr):	**19.4**	**2.83**	**16.6**	**1.18**

[1]Emission factor source for vehicles, "Idling Vehicle Emissions" (EPA 1998). Average of winter and summer factors for HDDV were used
[2]Emission factor source for generators, AP 42, Fifth Edition, Volume I, chapter 3, Gasoline and Diesel Industrial Engines (EPA 1996).

Table 4 compares the data presented above in Table 3 with the conformity criteria for non-attainment areas. This comparison shows that the estimated yearly emissions attributable to idling vehicles are well below the allowable limits set in 40 CFR Part 93.153, Determining Conformity of Federal Actions to State or Federal Implementation Plans (the rule). The rule applies to those federal actions that are located in areas of non-attainment of the NAAQS.

Table 4: Conformity Criteria for Nonattainment Areas

Pollutant	Criterion (tons/yr) [a]	Idling Emissions Estimate (tons/yr)
Ozone (VOCs or NOx):		2.83 (VOC); 19.4 (NOx)
– Serious NAAs	50	
– Severe NAAs	25	
– Extreme NAAs	10	
– Other ozone NAAs outside an ozone transport region	100	
– Marginal and moderate NAAs inside an ozone transport region		
CO:		16.6
– All NAAs	100	
SO2 or NO2:	100	
– All NAAs		
PM_{10}:		1.18
– Moderate NAAs	100	
– Serious NAAs	70	
Pb:		
– All NAAs	25	

[a] 40 CFR Part 93.153

Table 5 lists the NAAQS and the Texas State Ambient Air Quality Standards. Emissions attributed to the Proposed Action combined with those attributable to past and future actions are well within the limits of the regulations of emissions standards required by both state and federal governments.

Table 5: NAAQS and State Ambient Air Quality Standards

Pollutant	Averaging Time	Texas Standards [a]	Federal Standards [b]	
		Concentration	Primary	Secondary
Ozone (03)	1 Hour	0.12 ppm (235 µg/m3)	0.12 ppm (235 µg/m3)	Same as Primary Standard
	8 Hour	0.08 ppm (157 µg/m3)	0.08 ppm (157 µg/m3)	
Particulate Matter (PM10)	24 Hour	150 µg/m3	150 µg/m3	Same as Primary Standard
Fine Particulate Matter (PM2.5)	24 Hour	50 µg/m3	35 µg/m3	Same as Primary Standard
	Annual Arithmetic Mean	35 µg/m3	15 µg/m3	
Carbon Monoxide (CO)	8 Hour	15 µg/m3	9.0 ppm (10 mg/m3)	None
	1 Hour	9.0 ppm (10 mg/m3)	35 ppm (40 mg/m3)	
Nitrogen Dioxide (NO2)	Annual Arithmetic Mean	35 ppm (40 mg/m3)	0.053 ppm (100 µg/m3)	Same as Primary Standard
Sulfur Dioxide (SO2)	Annual Arithmetic Mean	0.053 ppm (100 µg/m3)	0.03 ppm	0.5 ppm (1300 g/m3) [3-hour]
	24 Hour	0.053 ppm (100 µg/m3)	0.14 ppm (365 µg/m3)	None
	3 Hour	0.14 ppm (365 µg/m3)	None	0.5 ppm (1300 µg/m3)
Lead	Calendar Quarter	None	1.5 µg/m3	Same as Primary Standard

[a] Texas Administrative Code (TAC) Title 30, Chapter 101, Rule 101.21.

[b] 40 CFR Part 50

Conclusion

All emission levels from the activities associated with the Proposed Action are below the tons/year *de minimis* threshold values that are applicable to nonattainment and maintenance areas for all pollutants as specified in 40 CFR 93.153(b)(1)(2). Therefore the Proposed Action

is not anticipated to cause an exceedance of any NAAQS for criteria pollutants. The Proposed Action will not conflict with conformity requirements of section 176 of the Clean Air Act for federal actions or any approved SIP. The Proposed Action will not have a significant impact on local or regional air quality within the context of the Clean Air Act or NEPA. This analysis considers both emissions specific to the Proposed Action and cumulative effects of HEMXRIS operations combined with emissions of existing and/or planned NII systems operations.

Appendix C: Background Information on Ionizing Radiation

The background material contained in this appendix is excerpted from information found in National Council on Radiation Protection and Measures (NCRP) *Uncertainties in Fatal Cancer Risk Estimates Used in Radiation Protection, NCRP Report Number 126*, and is intended to provide the user with the best available background and regulatory information on ionizing radiation.

- **Measurement of Radiation Dose**

Radiation is measured using units that people seldom encounter. It is important to relate the amount of radiation received by the body to its physiological effects. Two terms used to relate the amount of radiation received by the body are "absorbed dose" and "dose equivalent."

Absorbed dose means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray (Gy).

The term "rad" (radiation absorbed dose) is the special unit of absorbed dose of 100 ergs per gram. Different materials that receive the same exposure may not absorb the same amount of energy. The rad is the basic unit of the absorbed dose of radiation (i.e., alpha, beta, gamma, and neutron) to the energy they impart in materials. The dose of one rad indicates the absorption of 100 ergs (an erg is a small but measurable amount of energy) per gram of absorbing material. To indicate the dose an individual receives in the unit rad, the word "rad" follows immediately after the magnitude, for example "50 rad." One thousandth of a rad (millirad) is abbreviated "mrad," and one millionth of a rad (microrad) is abbreviated "µrad."

Dose equivalent (H_T) means 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). At the present time, rem is used in the U.S. while sieverts are used internationally. Eventually, the U.S. will adopt these international terms.

The term "rem" (Roentgen equivalent man) is a special unit used for expressing dose equivalent. Some types of radiation produce greater biological effects for the same amount of energy imparted than other types. The rem is a unit that relates the dose of absorbed radiation to the biological effect of that dose. Therefore, to relate the absorbed dose of specific types of radiation, a "quality factor" must be multiplied by the dose in rad. To indicate the dose an individual receives in the unit rem, the word "rem" follows immediately after the magnitude, for example "50 rem." One thousandth of a rem (millirem) is abbreviated "mrem," and one millionth of a rem (microrem) is abbreviated "µrem." The quality factor allows for the effect of higher energy deposition along particle tracks produced by various radiation types such as neutrons or alpha particles.

Regulations Covering Radiation Dose

Regulations pertaining to radiation exposure are administered by many different federal and state agencies under a variety of legislative authorities.

- **Nuclear Regulatory Commission (NRC) (10 CFR Part 20)**

The Nuclear Regulatory Commission (NRC) promulgates regulations and establishes standards for protection against radiation arising out of activities conducted under licenses issued by the Commission. NRC regulations control the receipt, possession, use, transfer, and disposal of licensed material by any licensee. CBP currently holds an NRC Materials License for ^{137}Cs/ ^{60}Co sealed sources. HEMXRIS do not require source or byproduct material for their operation; therefore these regulations do not apply. However, as discussed above; CBP uses the levels provided by the NRC as a conservative approach for limiting radiation exposure by the systems.

- **Occupational Safety and Health Administration (OSHA) (29 CFR 1910.1096)**

OSHA regulations establish standards for protection against ionizing radiation that result in an occupational risk, but do not regulate the safety of licensed radioactive materials.

- **Food and Drug Administration (FDA) (21 CFR 1020) Performance Standards for Ionizing Radiation Emitting Products)**

The Food and Drug Administration (FDA) promulgates regulations and establishes standards for the protection against radiation by setting performance standards that manufacturers of ionizing radiation emitting products must meet.

- **Environmental Protection Agency (EPA) (Radiation Protection Guidance to Federal Agencies for Occupational Exposure FR 52 2822 January 27, 1987)**

Federal radiation exposure protection guidance for occupational exposure is defined in *Radiation Protection Guidance to Federal Agencies for Occupational Exposure.* Administered by the EPA, the guidance was developed cooperatively by the Nuclear Regulatory Commission, the Occupational Safety and Health Administration, the Mine Safety and Health Administration, the Department of Defense, the Department of Energy, the National Aeronautics and Space Administration, the Department of Commerce, the Department of Transportation, the Department of Health and Human Services, and the Environmental Protection Agency. The guidance provides general principles, and specifies the numerical primary guides for limiting worker exposure. It applies to all workers who are exposed to radiation in the course of their work, either as employees of institutions and companies subject to federal regulation or as federal employees. It is expected that individual federal agencies, on the basis of their knowledge of specific worker exposure situations, will use the guidance as the basis upon which to revise or develop detailed standards and regulations to the extent that they have regulatory or administrative jurisdiction.

- **State Regulations**

Many states have adopted regulations modeled on the *Suggested State Regulations for Control of Radiation*.

State of Texas (Texas Administrative Code Title 25 Chapter 289)

The Texas Department of State Health Services regulates ionizing and non-ionizing sources of radiation to the extent authorized by the NRC. The Texas Administrative Code (TAC) Title 25 Chapter 289, "Radiation Control" govern the regulatory program for any person who is licensed to receive or process radioactive materials, as defined, and not exempted.

Without Congressional expression that sovereign immunity is waived, a federal agency would not be subject to these state regulations. The state implicitly recognizes this in their regulations which exclude federal government agencies from the scope of the state's radiation regulations (TAC Title 25 Chapter 289(b)(67)).

Regulatory Jurisdiction

As it applies to the operation of HEMXRIS, the applicable regulations are FDA [21 CFR Part 1020] and OSHA [29 CFR 1910.1096].

- The NRC Guidance provided in 10 CFR Part 20 Standards for Protection Against Radiation apply to persons licensed by the Commission to receive, possess, use , transfer, or dispose of byproduct, source, or special nuclear material or to operate a production or utilization facility.
- The EPA guidance provided in FR 52 2822, *Radiation Protection Guidance to Federal Agencies for Occupational Exposure,* is to be used as the basis upon which individual federal agencies revise or develop detailed standards and regulations to the extent that they have regulatory or administrative jurisdiction.

Dose Limits

Dose limits represent the upper bound limit below which risks from radiation exposure are deemed to be acceptable. Various federal and state regulations establish dose limits for occupational exposures that occur as a result of a person's employment, and limits for the total exposures received by the public in general.

In 10 CFR Part 20 and TAC 289.201, the NRC and the State of Texas identify two classifications of radiation dose to people.

The first classification, "occupational dose," is *"the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation or to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released under §35.75, from*

voluntary participation in medical research programs, or as member of the public." 20 CFR. 20.1003 and TAC 289.201. The individuals subject to the occupational dose classification must closely monitor their degree of radiation exposure using dosimeters. The annual occupational dose limit for adults shall not exceed whichever is the more limiting of : a total effective dose equivalent of 5 rems or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rem. 10 CFR. 20.1201 and TAC 289.202(f).

The second radiation dose classification, "public dose," is *"the dose received by a member of the public from exposure to radiation or to radioactive material released by a licensee, or to another source of radiation under the control of a licensee. Public dose does not include occupational dose or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released under §35.75 or from voluntary participation in medical research programs."* 10 CFR. 20.1003 and TAC 289.201. The total effective dose equivalent to individual members of the general public from the licensed operations shall not exceed 0.1 rem in a year. 10 CFR. 20.1301 and TAC 289.202. A summary of pertinent dose limits is presented below in Table 6.

Table 6: Summary of Regulatory Dose Limits

Dose Limit by Agency and Regulation (rem in a year)				
	NRC 10 CFR 20	**EPA 52 FR 2822**	**Texas TAC 289.202**	**OSHA 29 CFR 1910.1096**
"Occupational Dose" = "Radiation Workers" in "Restricted Areas"				
Whole Body	5	5	5	5 (1.25 rem/calendar quarter)
Lens of Eye	15	15	15	5 (1.25 rem/calendar quarter)
Skin, Hands and Feet	50	50	50	
Skin of Whole Body				30 (7.5 rem/calendar quarter)
Hands and forearms; feet and ankles				75 (18.75 rem/calendar quarter)
Minors	10% of above limits	10% of above limits	10% of above limits	10% of above limits
Pregnant Women [a]	10% of above limits	10% of above limits	0.500	Not Addressed
"Non-Occupational Dose" = "Controlled Area"				
Member of the General Public	0.1 rem in a year	Not Addressed	0.1 rem in a year	Not Addressed
Radiation Levels in Unrestricted (Uncontrolled) Areas				
Member of the General Public	0.002 rem in any one hour		0.002 rem in any one hour	Not Addressed

[a] Applicable period is nine months, or during the entire length of the pregnancy, rather than 1 year.

Radiation Protection Principles

In the United States and most other countries, three basic principles have governed radiation protection of workers and members of the general public:

1. Any activity involving occupational exposure should be useful enough to society to warrant the exposure of the worker. This same principle applies to virtually any human endeavor that involves some risk of injury.
2. For justified activities, exposure of the work force should be as low as reasonably achievable (ALARA).

3. To provide an upper limit on risk to individual workers, "limitation" of the maximum allowed dose is required. This is required above the protection provided by the first two principles because their primary objective is to minimize the total harm from occupational exposure to the entire work force; they do not limit the way that harm is distributed among individual workers.

As Low as is Reasonably Achievable (ALARA)

"As Low as is Reasonably Achievable" (ALARA) means making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical, consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest. This common sense approach means that radiation doses for both workers and the general public are typically kept lower than their regulatory limits.

The principle reduction of exposure to levels that are "as low as is reasonably achievable" is typically implemented in four different ways.

1. Shielding of the source holder.
2. Selection of as small of an amount of source material as is needed.
3. Designing facilities to reduce the anticipated exposure.
4. Designing work practices to reduce the anticipated exposure.

Effective implementation of the ALARA principle involves most facets of an effective radiation protection program: education of workers concerning the health risks of exposure to radiation; training in regulatory requirements and procedures to control exposure; monitoring, assessment and reporting of exposure levels and doses; management and supervision of radiation protection activities (including the choice and implementation of radiation control measures).

A comprehensive radiation protection program will also include, as appropriate: properly trained and qualified radiation protection personnel; adequately designed, operated and maintained facilities and equipment; and quality assurance and audit procedures.

Customs and Border Protection Dose Limits

In conformance with ALARA principles, CBP has adopted of its workers the same dose limit as the NRC and the State of Texas prescribe for the general public – i.e. 0.1 rem in a year. As a result, CBP establishes a controlled area around each HEMXRIS as described in the section 3.3.3.1.2.1 (Human Exposure) to equally protect the general public, truck drivers, port personnel and other CBP personnel from radiation emissions in accordance with the maximum dose permitted under federal and state regulations. CBP has taken care to model and explore potential exposure to employees working around these systems, and has even made measurements if someone were to be scanned by this or other NII systems. See "Radiation

Dose Equivalent to Stowaways in Vehicles," Khan, et al, Health Physics Journal, Volume 86, No. 5, p. 483, May 2004.

Health Risks

In their August 2004 revised position statement on radiation risk, the Health Physics Society recommended against the quantitative estimation of health risks below an individual dose of 5 rem in a year or a lifetime dose of 10 rem above that received from natural sources. Doses from natural background radiation in the United States average about 0.360 rem per year. Estimation of health risks associated with radiation doses that are of similar magnitude as those received from natural sources should be strictly qualitative and encompass a range of hypothetical health outcomes, including the possibility of no adverse health effects at such low levels.

The Society further states "While there is substantial and convincing scientific evidence for health risks following high-dose exposures, below 5-10 rem (which includes occupational and environmental exposures), risks of health effects are either too small to be observed or nonexistent."

The Society has concluded that estimates of risk should be limited to individuals receiving a dose of 5 rem in any one year or a lifetime dose of 10 rem in addition to natural background. Below these doses, risk estimates should not be used. Expressions of risk should only be qualitative, that is, a range based on the uncertainties in estimating risk (NCRP 1997) emphasizing the inability to detect any increased health detriment (that is zero health effects is a probable outcome).

Appendix D: Background Information Concerning Risks from Occupational Radiation Exposure

The background material contained in this appendix is excerpted of from the U.S. Nuclear Regulatory Commission Regulatory Guide 8.29, "Instruction Concerning Risks From Occupational Radiation Exposure," February 1996 and the Health Physics Society "Radiation Basics" http://www.hps.org/publicinformation/ate/faqs/radiation.html. This material is intended to provide the user with the best available information about the health risks from occupational exposure to ionizing radiation. Ionizing radiation consists of energy or small particles, such as gamma rays and beta and alpha particles, emitted from radioactive materials, which can cause chemical or physical damage when they deposit energy in living tissue. A question and answer format is used. Many of the questions or subjects were developed by the NRC staff in consultation with workers, union representatives and licensee representatives experienced in radiation protection training.

How Is Radiation Measured?

In the United States, radiation dose or exposure is measured in units called rad, rem, or roentgen(R). For practical purposes with gamma and X-Rays, these are considered equal: 1 R = 1 rad = 1 rem.

Milli (m) means 1/1000. For example, 1,000 mrad = 1 rad. Micro (μ) means 1/1,000,000. So, 1,000,000 μrad = 1 rad, or 10 μR = 0.000010 R.

The International System of Units (SI system) for radiation measurement use "gray" and "sievert."
1 Gy = 100 rad
1 mGy = 100 mrad
1 Sv = 100 rem
1 mSv = 100 mrem

Is It Safe To Be Around Sources Of Radiation?

A single high-level radiation exposure (i.e., greater than 10,000 mrem) delivered to the whole body over a very short period of time may have potential health risks. From follow-up of the atomic bomb survivors, we know acutely delivered very high radiation doses can increase the occurrence of certain kinds of disease (e.g., cancer) and possibly negative genetic effects. To protect the public and radiation workers (and environment) from the potential effects of chronic low-level exposure (i.e., less than 10,000 mrem), the current radiation safety practice is to prudently assume similar adverse effects are possible with low-level protracted exposure to radiation. Thus, the risks associated with low-level medical, occupational, and environmental radiation exposure are conservatively calculated to be proportional to those observed with high-level exposure. These calculated risks are compared to other known occupational and environmental hazards, and appropriate safety standards and policies have been established by

international and national radiation protection organizations (e.g., International Commission on Radiological Protection and National Council on Radiation Protection and Measurements) to control and limit potential harmful radiation effects.

Both public and occupational regulatory dose limits are set by federal agencies (i.e., Environmental Protection Agency, Nuclear Regulatory Commission, and Department of Energy) and state agencies (e.g., agreement states) to limit cancer risk. Other radiation dose limits are applied to limit other potential biological effects with workers' skin and lens of the eye.

Annual Radiation Dose Limits	Agency
Radiation Worker - 5,000 mrem	(NRC, "occupationally" exposed)
General Public - 100 mrem	(NRC, member of the public)
General Public - 25 mrem	(NRC, D&D all pathways)
General Public - 10 mrem	(EPA, air pathway)
General Public - 4 mrem	(EPA, drinking-water pathway)

What Is Meant By Health Risk?

A health risk is generally thought of as something that may endanger health. Scientists consider health risk to be the statistical probability or mathematical chance that personal injury, illness, or death may result from some action. Most people do not think about health risks in terms of mathematics. Instead, most of us consider the health risk of a particular action in terms of whether we believe that particular action will, or will not, cause us some harm. The intent of this appendix is to provide estimates of, and explain the basis for, the risk of injury, illness, or death from occupational radiation exposure. Risk can be quantified in terms of the probability of a health effect per unit of dose received.

When X-Rays, gamma rays, and ionizing particles interact with living materials such as our bodies, they may deposit enough energy to cause biological damage.

Radiation can cause several different types of events such as the very small physical displacement of molecules, changing a molecule to a different form, or ionization, which is the removal of electrons from atoms and molecules. When the quantity of radiation energy deposited in living tissue is high enough, biological damage can occur as a result of chemical bonds being broken and cells being damaged or killed. These effects can result in observable clinical symptoms.

The basic unit for measuring absorbed radiation is the rad. One rad (0.01 gray in the International System of units) equals the absorption of 100 ergs (a small but measurable amount of energy) in a gram of material such as tissue exposed to radiation. To reflect biological risk,

rads must be converted to rems. The new international unit is the sievert (100 rem = 1 Sv). This conversion accounts for the differences in the effectiveness of different types of radiation in causing damage. The rem is used to estimate biological risk. For beta and gamma radiation, a rem is considered equal to a rad.

What Are The Possible Health Effects Of Exposure To Radiation?

Health effects from exposure to radiation range from no effect at all to death, including diseases such as leukemia or bone, breast and lung cancer. Very high (100s of rads), short-term doses of radiation have been known to cause prompt (or early) effects, such as vomiting and diarrhea, skin burns, cataracts and even death. It is suspected that radiation exposure may be linked to the potential for genetic effects in the children of exposed parents. Also, children who were exposed to high doses (20 or more rads) of radiation prior to birth (as an embryo/fetus) have shown an increased risk of mental retardation and other congenital malformations. These effects (with the exception of genetic effects) have been observed in various studies of medical radiologists, uranium miners, radium workers, radiotherapy patients and the people exposed to radiation from atomic bombs dropped on Japan. In addition, radiation effects studies with laboratory animals, in which the animals were given relatively high doses, have provided extensive data on radiation-induced health effects, including genetic effects.

It is important to note that these kinds of health effects result from high doses, compared to occupational levels, delivered over a relatively short period of time.

Although studies have not shown a consistent cause-and-effect relationship between current levels of occupational radiation exposure and biological effects, it is prudent from a worker protection perspective to assume that some effects may occur.

Who Developed Radiation Risk Estimates?

Radiation risk estimates were developed by several national and international scientific organizations over the last 40 years. These organizations include the National Academy of Sciences (which has issued several reports from the Committee on the Biological Effects of Ionizing Radiations, BEIR), the National Council on Radiation Protection and Measurements (NCRP), the International Commission on Radiological Protection (ICRP), and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). Each of these organizations continues to review new research findings on radiation health risks.

Several reports from these organizations present new findings on radiation risks based upon revised estimates of radiation dose to survivors of the atomic bombing at Hiroshima and Nagasaki. For example, UNSCEAR published risk estimates in 1988 and 1993 (UNSCEAR 1988; UNSCEAR 1993). The NCRP also published a report in 1988, “New Dosimetry at Hiroshima and Nagasaki and Its Implications for Risk Estimates” (NCRP 1988). In January 1990, the National Academy of Sciences released the fifth report of the BEIR Committee, “Health Effects of Exposure to Low Levels of Ionizing Radiation,” National Research Council, 1990). Each of these publications also provides extensive bibliographies on other published

studies concerning radiation health effects for those who may wish to read further on this subject.

What Are The Estimates Of The Risk Of Fatal Cancer From Radiation Exposure?

We don't know exactly what the chances are of getting cancer from a low-level radiation dose, primarily because the few effects that may occur cannot be distinguished from normally occurring cancers. However, we can make estimates based on extrapolation from extensive knowledge from scientific research on high dose effects. The estimates of radiation effects at high doses are better known than are those of most chemical carcinogens (NCRP 1989).

From currently available data, the NRC has adopted a risk value for an occupational dose of 1 rem (0.01 Sv) Total Effective Dose Equivalent (TEDE) of 4 in 10,000 of developing a fatal cancer, or approximately 1 chance in 2,500 of fatal cancer per rem of TEDE received. The uncertainty associated with this risk estimate does not rule out the possibility of higher risk, or the possibility that the risk may even be zero at low occupational doses and dose rates.

The radiation risk incurred by a worker depends on the amount of dose received. A worker who receives 5 rems (0.05 Sv) in a year incurs 10 times as much risk as another worker who receives only 0.5 rem (0.005 Sv). Only a very few workers receive doses near 5 rems (0.05 Sv) per year (Raddatz and Hagemeyer 1995).

According to the BEIR V report (National Research Council 1990), approximately one in five adults normally will die from cancer from all possible causes such as smoking, food, alcohol, drugs, air pollutants, natural background radiation and inherited traits. Thus, in any group of 10,000 workers, we can estimate that about 2,000 (20%) will die from cancer without any occupational radiation exposure.

To explain the significance of these estimates, we will use as an example a group of 10,000 people, each exposed to 1 rem (0.01 Sv) of ionizing radiation. Using the risk factor of 4 effects per 10,000 rem of dose, we estimate that 4 of the 10,000 people might die from delayed cancer because of that 1 rem dose (although the actual number could be more or less than 4) in addition to the 2,000 normal cancer fatalities expected to occur in that group from all other causes. This means that a 1 rem (0.01 Sv) dose may increase an individual worker's chances of dying from cancer from 20 percent to 20.04 percent. If one's lifetime occupational dose is 10 rem, we could raise the estimate to 20.4 percent. A lifetime dose of 100 rem may increase chances of dying from cancer from 20 to 24 percent.[5] It is important to understand the probability factors here. A

[5] Given CBP's standard of 0.1 rem (0.001 Sv) exposure in any one year, the risk would equate to 4 effects per 100,000. This means that a 0.1 rem (0.001 Sv) dose may increase an individual workers chance of dying from cancer from 20 percent to 20.005 percent. The average measurable dose for radiation workers reported to the NRC was 0.31 rem (0.0031 Sv) for 1993 (Raddatz and Hagemeyer, 1995). Today, very few CBP employees ever accumulate 100 rem (1 Sv) in a working lifetime, and the average career dose of workers at NRC-licensed facilities

similar question would be, "If you select one card from a full deck of cards, will you get the ace of spades?" This question cannot be answered with a simple yes or no. The best answer is that your chance is 1 in 52. However, if 1000 people each select one card from full decks; we can predict that about 20 of them will get an ace of spades. Each person will have 1 chance in 52 of drawing the ace of spades, but there is no way we can predict which persons will get that card. The issue is further complicated by the fact that in a drawing by 1000 people, we might get only 15 successes, and in another, perhaps 25 correct cards in 1000 draws. We can say that if you receive a radiation dose, you will have increased your chances of eventually developing cancer. It is assumed that the more radiation exposure you get, the more you increase your chances of cancer.

The normal chance of dying from cancer is about one in five for persons who have not received any occupational radiation dose. The additional chance of developing fatal cancer from an occupational exposure of 1 rem (0.01 Sv) is about the same as the chance of drawing any ace from a full deck of cards three times in a row. The additional chance of dying from cancer from an occupational exposure of 10 rem (0.1 Sv) is about equal to your chance of drawing two aces successively on the first two draws from a full deck of cards.

It is important to realize that these risk numbers are only estimates based on data for people and research animals exposed to high levels of radiation in short periods of time. There is still uncertainty with regard to estimates of radiation risk from low levels of exposure. Many difficulties are involved in designing research studies that can accurately measure the projected small increases in cancer cases that might be caused by low exposures to radiation as compared to the normal rate of cancer.

These estimates are considered by the NRC staff to be the best available for the worker to use to make an informed decision concerning acceptance of the risks associated with exposure to radiation. A worker who decides to accept this risk should try to keep exposure to radiation as low as is reasonably achievable (ALARA) to avoid unnecessary risk.

If I Receive A Radiation Dose That Is Within Occupational Limits, Will It Cause Me To Get Cancer?

Probably not. Based on the risk estimates previously discussed, the risk of cancer from doses below the occupational limits is believed to be small. Assessment of the cancer risks that may be associated with low doses of radiation are projected from data available at doses larger than 10 rems (0.1 Sv) (ICRP 1991). For radiation protection purposes, these estimates are made using the straight line portion of the linear quadratic model (Curve 2 in Figure 1). We have data on cancer probabilities only for high doses, as shown by the solid line in 8. Only in studies involving radiation doses above occupational limits are there dependable determinations of the risk of cancer, primarily because below the limits the effect is small compared to differences in

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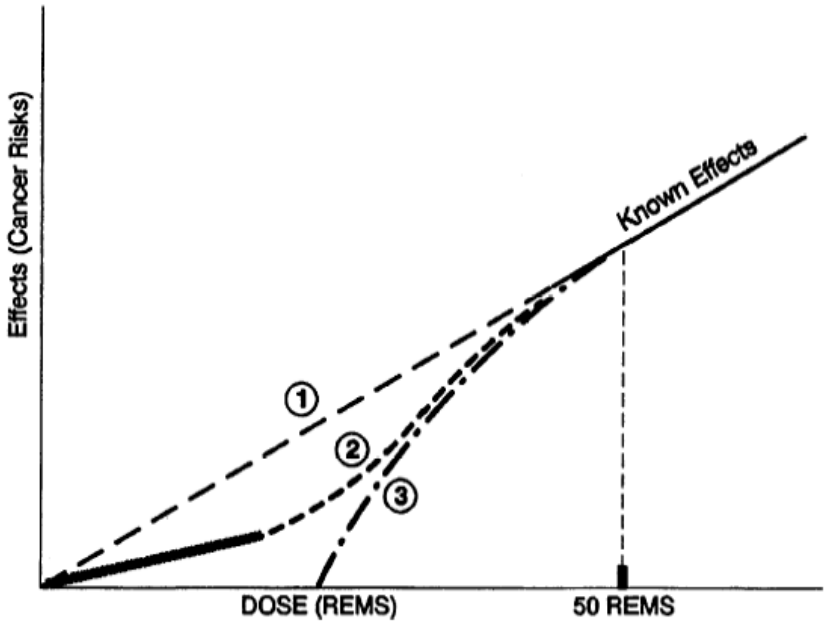
is 1.5 rem (0.015 Sv), which represents an estimated increase from 20 to about 20.06 percent in the risk of dying from cancer.

the normal cancer incidence from year to year and place to place. The ICRP, NCRP and other standards-setting organizations assume for radiation protection purposes that there is some risk, no matter how small the dose (Curves 1 and 2). Some scientists believe that the risk drops off to zero at some low dose (Curve 3), the threshold effect, The ICRP and NCRP endorse the linear quadratic model as a conservative means of assuring safety (Curve 2).

For regulatory purposes, the NRC uses the straight line portion of Curve 2, which shows the number of effects decreasing linearly as the dose decreases. Because the scientific evidence does not conclusively demonstrate whether there is or is not an effect at low doses, the NRC assumes for radiation protection purposes, that even small doses have some chance of causing cancer. Thus, a principle of radiation protection is to do more than merely meet the allowed regulatory limits; doses should be kept as low as is reasonably achievable (ALARA). This is as true for natural carcinogens such as sunlight and natural radiation as it is for those that are manmade, such as cigarette smoke, smog and X-Rays.

Figure 1 Some Proposed Models for How the Effects of Radiation Vary with Doses at Low Levels



How Can We Compare The Risk Of Cancer From Radiation To Other Kinds Of Health Risks?

One way to make these comparisons is to compare the average number of days of life expectancy lost because of the effects associated with each particular health risk. Estimates are calculated by looking at a large number of persons, recording the age when death occurs from

specific causes, and estimating the average number of days of life lost as a result of these early deaths. The total number of days of life lost is then averaged over the total observed group.

Several studies have compared the average days of life lost from exposure to radiation with the number of days lost as a result of being exposed to other health risks. The word "average" is important because an individual who gets cancer loses about 15 years of life expectancy, while his or her coworkers do not suffer any loss.

Some representative numbers are presented in Table 1. For categories of NRC-regulated industries with larger doses, the average measurable occupational dose in 1993 was 0.31 rem (0.0031 Sv). A simple calculation based on the article by Cohen and Lee (Cohen and Lee 1991) shows that 0.3 rem (0.003 Sv) per year from age 18 to 65 results in an average loss of 15 days. These estimates indicate that the health risks from occupational radiation exposure are smaller than the risks associated with many other events or activities we encounter and accept in normal day-to-day activities.

It is also useful to compare the estimated average number of days of life lost from occupational exposure to radiation with the number of days lost as a result of working in several types of industries. Table 2 shows average days of life expectancy lost as a result of fatal work-related accidents. Table 2 does not include non-accidental types of occupational risks such as occupational disease and stress because the data are not available.

These comparisons are not ideal because we are comparing the possible effects of chronic exposure to radiation to different kinds of risks such as accidental death, in which death is inevitable if the event occurs. This is the best we can do because good data are not available on chronic exposure to other workplace carcinogens. Also, the estimates of loss of life expectancy for workers from radiation-induced cancer do not take into consideration the competing effect on the life expectancy of the workers from industrial accidents.

Table 1 Estimated Loss of Life Expectancy from Health Risks

Health Risks	Estimate of Life Expectancy Lost (Average)
Smoking 20 cigarette a day	6 years
Overweight (by 15%)	2 years
Alcohol consumption (U.S. average)	1 year
All accidents combined	1 year
Motor vehicle accidents	207 days
Home accidents	74 days
Drowning	24 days
All natural hazards (earthquake, lightning, flood, etc.)	7 days
Medical radiation	6 days
Occupational Exposure	
0.3 rem/y from age 18 to 65	15 days
1 rem/y from age 18 to 65	51 days

(Cohen and Lee 1991)

Table 2 Estimated Loss of Life Expectancy from Industrial Accidents

Industry Type	Estimated Days of Life Expectancy Lost (Average)
All Industries	60
Agriculture	320
Construction	227
Mining and Quarrying	167
Transportation and Public Utilities	160
Government	60
Manufacturing	40
Trade	27
Services	27

(Cohen and Lee 1991)

What Are The Health Risks From Radiation Exposure To The Embryo/Fetus?

During certain stages of development, the embryo/fetus is believed to be more sensitive to radiation damage than adults. Studies of atomic bomb survivors exposed to acute radiation doses exceeding 20 rads (0.2 Gy) during pregnancy show that children born after receiving these doses have a higher risk of mental retardation. Other studies suggest that an association exists between exposure to diagnostic X-Rays before birth and carcinogenic effects in childhood and in adult life. Scientists are uncertain about the magnitude of the risk. Some studies show the

embryo/fetus to be more sensitive to radiation-induced cancer than adults, but other studies do not. In recognition of the possibility of increased radiation sensitivity, and because dose to the embryo/fetus is involuntary on the part of the embryo/fetus, a more restrictive dose limit has been established for the embryo/fetus of a declared pregnant radiation worker. See Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure."

If an occupationally exposed woman declares her pregnancy in writing, she is subject to the more restrictive dose limits for the embryo/fetus during the remainder of the pregnancy. The dose limit of 500 mrems (5 mSv) for the total gestation period applies to the embryo/fetus and is controlled by restricting the exposure to the declared pregnant woman. Restricting the woman's occupational exposure, if she declares her pregnancy, raises questions about individual privacy rights, equal employment opportunities and the possible loss of income. Because of these concerns, the declaration of pregnancy by a female radiation worker is voluntary. Also, the declaration of pregnancy can be withdrawn for any reason, for example, if the woman believes that her benefits from receiving the occupational exposure would outweigh the risk to her embryo/fetus from the radiation exposure.

Can A Worker Become Sterile Or Impotent From Normal Occupational Radiation Exposure?

No. Temporary or permanent sterility cannot be caused by radiation at the levels allowed under NRC's occupational limits. There is a threshold below which these effects do not occur. Acute doses on the order of 10 rems (0.1 Sv) to the testes can result in a measurable but temporary reduction in sperm count. Temporary sterility (suppression of ovulation) has been observed in women who have received acute doses of 150 rads (1.5 Gy). The estimated threshold (acute) radiation dose for induction of permanent sterility is about 200 rads (2 Gy) for men and about 350 rads (3.5 Gy) for women (National Research Council 1990; Scott et al 1993). These doses are far greater than the NRC's occupational dose limits for workers.

Although acute doses can affect fertility by reducing sperm count or suppressing ovulation, they do not have any direct effect on one's ability to function sexually. No evidence exists to suggest that exposures within the NRC's occupational limits have any effect on the ability to function sexually.

What Are Background Radiation Exposures?

The average person is constantly exposed to ionizing radiation from several sources. Our environment and even the human body contain naturally occurring radioactive materials (e.g., potassium-40) that contribute to the radiation dose that we receive. The largest source of natural background radiation exposure is terrestrial radon, a colorless, odorless, chemically inert gas, which causes about 55 percent of our average, non-occupational exposure. Cosmic radiation originating in space contributes additional exposure. The use of X-Rays and radioactive materials in medicine and dentistry adds to our population exposure. As shown below in Table 3, the average person receives an annual radiation dose of about 0.36 rem (3.6 mSv). By age 20,

the average person will accumulate over 7 rems (70 mSv) of dose. By age 50, the total dose is up to 18 rems (180 mSv). After 70 years of exposure this dose is up to 25 rems (250 mSv).

Table 3 Average Annual Effective Dose Equivalent to Individuals in the U.S.

Source		Effective Dose Equivalent (mrems)	
Natural			
	Radon	200	
	Other than Radon	100	
	Total Natural		300
Nuclear Fuel Cycle			0.05
Consumer Products[b]			9
Medical			
	Diagnostic X-Rays	39	
	Nuclear Medicine	14	
	Total Medical		53
Total			About 360 mrems/year

(NCRP 1987).

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