3.13 Risk Assessment: Radiological

Description

Nuclear/radiological incidents can occur anywhere within the United States, The State of Idaho is not immune to these risks, and consequently must plan and be ready for any radiological or nuclear incident, regardless of the scale or location within the state. Due to the nature of radiological particles, Idaho could also be at risk from a neighboring state's nuclear/radiological incident that is carried into the state via multiple pathways. Incidents may occur for a wide variety of reasons and can range significantly in scope and severity. The following is an introduction to these risks from the FEMA Incident Annex Manual (1).

The most common nuclear/radiological incidents occur because of loss, theft, or mismanagement of relatively minor or low-level radioactive sources or technologically enhanced, naturally occurring radioactive material. Further, natural hazards, such as fires and including severe weather, may impact nuclear or radiological facilities resulting in an incident. The 2011 Fukushima Daiichi nuclear disaster is an example of how this could result in a major international nuclear or radiological incident.

Nuclear/radiological incidents can also result from terrorist attempts to acquire or use nuclear threat devices or the nuclear proliferation. Idaho's nuclear or radiological responses can occur as part as the effort to thwart imminent terrorist threats, or would occur in response to a nuclear or radiological attack.

Nuclear and radiological facilities include fixed facilities that store nuclear material; those that store or use radioactive material that includes commercial nuclear reactors and fuel cycle facilities (uranium enrichment, fuel fabrication, and disposal); some non-fuel cycle industries (such as radiation source and radiopharmaceutical manufacturers); and other facilities and industries involved in the production, refinement, handling, storage, transportation, or use of nuclear/radioactive materials to the environment.

Nuclear threat devices include radiological devices and improvised nuclear devices (IND). Radiological dispersal devices (RDD) and radiation exposure devices (RED) release radioactive material into the environment or emit radiation as part of criminal activity or an act of terrorism. The radiological harm caused by a RDD is principally contamination, and denied use of the contaminated area, perhaps for many years. High radiation exposures are unlikely, but costs associated with remediation and loss of access due to an effective RDD could be significant.

In addition, an IND using lost or stolen special nuclear material or introduced into the United States from a program of a nuclear state can achieve a nuclear yield and result in mass destruction of property and radioactive contamination. Even a relatively small nuclear detonation in an urban area could result in tens of thousands of fatalities, a large number of survivors requiring, medical care, behavioral health and dose assessments given concerns of medically relevant exposure, as well as massive infrastructure damage and hundreds of square miles of contamination.

Response and Recovery Mission Area activities for minor nuclear/radiological incidents are usually managed at the local level with occasional state and federal assistance as required. Generally, increased regulatory control, safeguards, and security accompany larger, more hazardous radioactive sources or materials, as they pose a greater threat to human health and the environment. However, for those incidents involving federal crimes relative to the theft, illegal acquisition, or use of weapons of mass destruction (WMD) or that involves federal crimes, including those concerning terrorism, federal law enforcement will lead and coordinate the related law enforcement, investigative, intelligence, and crime scene activities. This law enforcement response is not specific to the amount of material involved, but rather it is applicable based on whether a federal crime has been committed and the threat the material poses for utilization by terrorists.

It is important to note; even very small amounts of certain radiological sources can cause significant contamination of the environment and do not require the use of explosives to spread the contamination. Whether this release was intentional (criminal) or accidental; the toll environmentally, economically, and socially are significant.

Radiation Basics

Radioactivity is energy emitted as particles or waves from spontaneous nuclear transformations in unstable atoms in the formation of new elements. The potential harm that radiation can impose to living organisms and the environment is the motive for tight Federal control of radioactive sources. Radiation can come in two forms; ionizing and non-ionizing.

Non-Ionizing Radiation. Non-ionizing radiation is electromagnetic radiation (or waves) that lack sufficient energy to ionize atoms or molecules (remove electron bonds from an atom). The danger posed by non-ionizing radiation sources (e.g. lasers, microwave or UV producing machines, and linear accelerators) are injury to the eyes or skin. This type of source can be made inert by shutting off the machine whereby the production of non-ionizing radiation will cease. Emergencies involving non-ionizing radiation are typically confined to the industrial or medical building location of the equipment itself and rarely pose any risk to the general public.

Ionizing Radiation. Ionizing radiation is energetic waves or particles that have sufficient energy to ionize other atoms (break electron bonds). This results in the biological breakdown of DNA and cellular molecules in all living organisms exposed to radioactivity. Biological effects of exposure to ionizing radiation can range from mild skin erythema, to radiation sickness (nausea, vomiting, diarrhea) to death depending on the radiation dose (energy absorbed by the body) received to the individual.

Ionizing radiation comes in following forms:

- Particles
  - Alpha Particles (positively charged helium nucleus)
  - Beta Particles (a free electron)
  - Neutrons
- Electromagnetic Radiation
  - X-Rays
  - Gamma-Rays

The most commonly encountered radioactive isotopes are from the elements; uranium, thorium, cesium, cobalt, iodine, and strontium. These isotopes are commonly found in industrial and medical applications, or occur naturally in our environment. Ionizing radiation can pose either a localized risk or a major risk to large populations depending on many contributing factors.

Exposure. Exposure to ionizing radiation signifies an individual has been exposed to the energy from the radioactive particles or waves. Once that individual moves away from that source or places sufficient shielding material between them and the source, they are no longer being exposed to the radioactivity. The biological damage done by radioactive exposure does not continue, once the exposure has discontinued.

Contamination. Contamination is the uncontrolled deposition of radioactive substances (solids, liquids, or gases) onto people, equipment, or the environment. Contamination signifies the individual is continually being exposed to ionizing radiation until it has been removed; either by various decontamination processes, or when the body flushes it from their system. Ingestion, inhalation, and injection of radioactive particles into the body can result in a permanent dose to that individual if the body fails to excrete it through natural processes.

Natural Background Radioactivity. Natural radioactivity originates from cosmogonic sources as well as from radioactive elements in the earth's crust. About 340 nuclides have been found in nature, of which about 70 are radioactive and are found mainly among the heavy elements. All elements having an atomic number greater than 80 possess radioactive isotopes, and all isotopes of elements heavier than number 83 (Bismuth) are radioactive (Eisenbud 1997).

Man-Made Sources. A small fraction of background radiation comes from human activities. Trace amounts of radioactive elements have dispersed in the environment from nuclear weapons tests and accidents like the one at the Chernobyl nuclear power plant in Ukraine. Nuclear reactors emit small amounts of radioactive elements. Radioactive materials used in industry and even in some consumer products are also a source of small amounts of background radiation (EPA).

Location, Extent, and Magnitude

Location

Radiological materials are found in many locations. The Nuclear Regulatory Commission (NRC) only requires licenses' for sources with activities greater than 10 micro curies. Anyone can go online and purchase industrial button sources (instrument check sources) of multiple isotopes, and have them shipped to their home. While the quantity and activity of the radioactive material in these sources is small, they could still be used for nefarious activities. Also, individuals may be able to acquire naturally occurring materials like ore directly or from online sources.

Thorium and uranium are examples of naturally occurring radioactive elements that are used as nuclear fuels. A variety of industries (e.g., oil/gas extraction industries and community drinking water treatment) that process natural material create the unintended concentration of natural radioactivity – this is referred to as technologically enhanced naturally occurring radioactivity (TENORM). Because TENORM is concentrated natural radioactive material, it can pose a radiological risk to humans and environment, however the risk is small. Incidents using these materials have a high probability of occurrence, but low probability of major impact.

Technologically produced radioactive material is generated by nuclear reactors or high energy particle accelerators, and relatively high levels of ionizing EM radiation are produced using x-ray machines. Nearly all industrial sources are licensed through the NRC. In Idaho, as of a 2017 report, there are 81 NRC licensed sources (see table 5 below). These sources, along with TENORM sources could pose a large risk to the public if the generating facilities mishandles or loses these sources. While there are strict guidelines for the storage and security of these sources; fires, natural disasters, etc. could result in the unintended exposure and contamination of the buildings and surround neighborhoods where these sources are stored.

Table 3.13.A. NRC licensed sources in Idaho

	Industrial	Medical	Academic	Other	Total
Idaho	39	19	3	20	81

Radioactive materials are often encapsulated inside a sealed container so that the radiation they produce may be used with reduced probability of uncontained radioactive contamination. These sealed sources can be manually breached, leading to high contamination and exposure levels.

Technologically produced sources are used extensively in medical and industrial applications. These sources have the highest probability of being involved in a radiological incident, due to the large quantities in medical facilities and the high frequency they are shipped or transported on local roads, and could pose a high risk of overall impact to an area depending on isotope and half-life.

Many of the medical use isotopes have short half-lives, and most produce a high enough dose rate to be hazardous even in the short-term. Industrial uses; like that of a soil density gauge are common for road construction. These devices commonly use a Cs-137 encapsulated source which has a half-life of 30.17 years. This is an example of a highly radioactive source that would stay active for a long time making it a public and environmental hazard.

The Idaho National Laboratory (INL) in eastern Idaho performs many activities involving nuclear technologies and radioactive materials including handling of radioactive waste. As one of DOE's multi-purpose science laboratories, the INL conducts long-term programs for DOE or other funding sources. The INL site covers 890 square miles located in Butte, Bingham, Bonneville, Clark, and Jefferson counties. Work involving radioactive materials is conducted at INL on-site locations as well as in facilities in Idaho Falls. Work at the INL has included evaluation and storage of nuclear fuels, transportation of radioactive nuclear materials, management of radioactive waste, and operation of a wide variety of nuclear reactors like the Advanced Test Reactor which is used for nuclear fuel and materials testing capabilities for military, federal, university, and industry. Butte County is the only local mitigation plan listing historical frequencies of a nuclear incident due to the INL being located within the county boundaries.

While the INL facilities are primarily in the south eastern part of the state of Idaho, there are many other facilities throughout the state that have licensed radioactive sources. Additionally, radiological incidents that happen in surrounding states can also be carried into Idaho through multiple environmental and economic pathways. For these reasons, the risk for radiological emergencies exists throughout the entire state.

Extent and Magnitude

The U.S. Centers for Disease Control and Prevention (CDC) developed the Radiation Hazard Scale as a tool for communication in a radiological emergency. This tool (see Table 3.13.B below) provides a frame of reference for relative hazards of radiation. It is designed for use only in radiation emergencies and is applicable to short-term exposure durations (CDC 2016).

Table 3.13.B. Description of the Radiation Hazard Scale Categories

Category	Description
5	**Category 5** means that radiation doses are dangerously high and potentially lethal. High doses of radiation can cause massive damage to organs of the body and kill the person. The exposed person loses white blood cells and the ability to fight infections. Diarrhea and vomiting are likely. Medical treatment can help, but the condition may still be fatal in spite of treatment. At extremely high doses of radiation, the person may lose consciousness and die within hours. For more information, see https://www.remm.nlm.gov/ars_summary.htm
4	**Category 4** means that radiation doses are dangerously high and can make people seriously ill. Radiation doses are not high enough to cause death, but one or more symptoms of radiation sickness may appear. Radiation sickness, also known as Acute Radiation Syndrome (ARS), is caused by a high dose of radiation. The severity of illness depends on the amount (or dose) of radiation. The earliest symptoms may include nausea, fatigue, vomiting, and diarrhea. Symptoms such as hair loss or skin burns may appear in weeks. For more information about the health effects of radiation, see http://emergency.cdc.gov/radiation/healtheffects.asp For more information about medical treatment of radiation exposure, see http://emergency.cdc.gov/radiation/countermeasures.asp
3	**Category 3** means that radiation doses are becoming high enough where we may expect increased risk of cancer in the years ahead for people who are exposed. Leukemia and thyroid cancers can appear in as few as 5 years after exposure. Other types of cancer can take decades to develop. Studies have shown that radiation exposure can increase the risk of people developing cancer. This increased risk of cancer is typically a fraction of one percent. The lifetime risk of cancer for the population due to natural causes is approximately 40%. The increase in risk of cancer from radiation depends on the amount (or dose) of radiation, and it becomes vanishingly small and near zero at low doses of radiation. For more information, see http://emergency.cdc.gov/radiation/cancer.asp
2	**Category 2** means that radiation levels in the environment are higher than the natural background radiation for that geographic area. However, these radiation levels are still too low to observe any health effects. When radiation levels are higher than what we normally have in our natural environment, it does not necessarily mean that it will cause us harm. For more information about health effects of radiation, see http://www.cdc.gov/nceh/radiation/health.html
1	**Category 1** means that radiation levels in the environment are within the range of natural background radiation for that geographic area. Low amounts of radioactive materials exist naturally in our environment, food, air, water, and consequently in our bodies. We are also exposed to radiation from space that reaches the surface of the Earth. These conditions are natural, and this radiation is called the natural background radiation. For more information about radiation and radioactivity in everyday life and how it can vary by location, see http://www.cdc.gov/nceh/radiation/sources.html

Severity

All sources of energy pose some risk to human health or environmental quality. Radiation protection standards for humans, embodied in regulations that U.S. nuclear facilities must adhere to, exceed ample protection for other species and for ecosystems. Each year, U.S. residents receive an average dose from natural background radiation of about 3.1 mSv (310 mrem). From medical procedures, it adds about another 3.1 mSv for a total of about 6.2 mSv (620 mrem) per year. The NRC is the primary agency for regulating radioactive materials and ensuring public safety. The NRC set a radiation dose limit of 1 mSv (100 mrem) in a year and 0.02 mSv (2 mrem) in an hour for a member of the public from regulated radiation sources; however, the agency excludes natural and medical uses of ionizing radiation (HPS 2017).

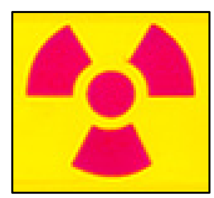
Exposure to high levels of radiation is known to cause cancer and, at very high levels, radiation poisoning and even death. But the effects on human health from very low doses of radiation—such as exposure to varying levels of background radiation does not significantly affect cancer incidence (UNSCEAR 2000).

Nuclear incidents refer to incidents involving (1) release of significant levels of radioactive materials or (2) exposure of workers or the general public to radiation. Primary concerns following a nuclear incident or accident are: impact on public health from direct exposure to a radioactive plume; inhalation of radioactive materials; ingestion of contaminated food, water, and milk; and long-term exposure to deposited radioactive materials in the environment that may lead to either acute (radiation sickness or death) or chronic (cancer) health effects.

The severity of radiological accidents is highly deterministic depending on; the activity level of the isotope, the type of energy released, the quantity of material released, the exposure level to the public and emergency workers, and the environmental and biological pathways affected. The general public's sensitivity to radiological issues can make even the smallest accident seem greater than what it is. The Idaho Department of Environmental Quality INL Oversight Program (DEQ-OP) in Idaho Falls is the state radiological asset. They have the capability to characterize all radiological hazards and environmental/public impact, as well as providing emergency response capabilities statewide.

Warning Time

The warning time for an incident occurring will vary and depends on the nature and scope of the incident. Facilities that handle radioactive material or any place where radiation-producing equipment is used, the radiation tri-foil sign must be displayed. This sign is used as a warning to protect people from being exposed to radioactivity (Radiation Emergency Medical Management 2017).



Relationships to Other Hazards

Secondary Impacts

The secondary impacts associated with radiological incidents include those impacting the health of the community and environment. Depending on the severity of exposure, impacts may include temporary illness or injury, permanent medical conditions, or death. Secondary impacts have the potential to occur regardless of whether naturally occurring or man-made. From a human-caused perspective, it is possible that small or large-scale radiological incidents could initiate civil disturbances.

Past Occurrence

An example of radiological contamination using TENORM occurred in 2014 in Ada County Idaho. An individual was collecting uranium and thorium ore, grinding it up, and trying to chemically activate and produce uranium yellow cake to sell online. This resulted in a multi-million dollar EPA cleanup of this individuals apartment and storage units. Given that these materials were natural occurring, or below NRC license limits, these activities went unnoticed for a long period of time until NRC was notified about this individual attempting to ship a box into another country. This is an example of how small quantities of material can still lead to large cleanup operations and a potential public hazard. While no members of the general public where exposed to these materials, an apartment fire could have drastically changed this scenario and its impact to surrounding neighborhoods.

The use of phosphate ore processing slag as fill material in southeast Idaho required an extensive remedial response, and the Salmon River Uranium Development site also required remediation. Incidents involving manmade radioactivity in industrial applications have been infrequent and generally have had minimal impact to the general public. Improper control of industrial radioactive sources has occurred in several counties in Idaho. Scrap yards and waste disposal facilities are likely places for improperly handled industrial sources to be discovered. Most of these facilities attempt to exclude hazardous/radioactive materials, and some have basic radiation detection instruments. However, detection is not assured, and not all facilities are diligent. To date, these incidents have not resulted in any known exposure of the general public.

The most significant nuclear incident in Idaho occurred at the INL in 1961 at the Stationary Low-Power Reactor Number One (or SL-1), a small Army prototype reactor that had been running since 1958. It is believed that a central control rod was withdrawn beyond the safe limit, causing a large power surge. The resulting explosion destroyed the reactor, released large amounts of radioactivity, and took the lives of three reactor operators. Many industry-wide improvements followed. Exposure limits to individuals were curtailed, the basic design of the reactor was changed to prevent physical rod removal, and additional safety levels were added. (Harker, 2013) There have been no unplanned releases that resulted in measureable radioactivity outside the site boundaries. Past practices have resulted in intentional releases and detection of radioactivity at low levels in the air and groundwater beyond the INL site boundary. Also, past solid waste disposal practices included burial and sub-surface storage of transuranic/mixed transuranic waste, which has been targeted for the ongoing remediation work.

The Department of Environmental Quality Oversight Program (DEQ-OP) monitors radiation levels within the INL, at the boundary locations, and at distant cities. They monitor air, soil, water, and vegetation. Also, they have 9 real-time gamma monitoring stations available for public viewing at www.idahoop.org. The EPA's RadNet system monitors the United States' air, precipitation, and drinking water to track radiation in the environment. In Idaho, there are two RadNet systems, one in Boise and one in Idaho Falls.

FEMA Disaster Declarations

Between 1954 and 2017, FEMA has not included Idaho in any radiological-related disasters (DR) or emergency (EM) declarations. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations as determined by FEMA (FEMA 2017).

Future Occurrence

Probability

Currently, there are no identified TENORM issues in Idaho, although there is a relatively high potential for TENORM generation given the extractive industries operating in the state (and surrounding states) and the occurrence of uranium and thorium ore deposits in the state. Radioactive sources are used in a wide variety of industrial and consumer applications including soil density/moisture gauges, smoke detection, well logging, weld inspection, and radioluminescent devices. Incidents involving manmade radioactivity in these applications have occurred sporadically, so the future rate of occurrence of incidents involving industrial radioactive sources can't be projected on the basis of past experience. However, future incidents should be anticipated. The most prevalent use of radioactive material in Idaho is for nuclear medicine. Hospitals and clinics in every region use radioactive isotopes for diagnostics and treatment. Medical isotopes are typically transported by common carrier either by air or road. Typically, nuclear medical applications involve use of relatively large amounts of short-lived radioactivity. Incidents involving radiopharmaceuticals could result in unintended exposures, but are not likely to pose a long-lasting hazard.

As previously discussed, the INL is a DOE nuclear research and development facility that is managed and operated for DOE by private contractors. The INL Cleanup Project (ICP) is responsible for decontamination, demolition, decommissioning, waste management, and remediation of INL site facilities. Ongoing ICP projects include preparing and shipping remote-handled transuranic waste for disposal, exhuming, preparing, and shipping targeted transuranic waste for disposal, and the Integrated Waste Treatment Unit (IWTU). The IWTU will be used to process the remaining tank farm wastes at INL; however, to date, the IWTU is not in operation (Associated Press 2017). The Advanced Mixed Waste Treatment Project (AMWTP) is also funded through DOE/EM, and is operated to prepare and ship mixed transuranic waste for disposal at the Waste Isolation Pilot Plant (WIPP). The AMWTP may serve as a DOE system-wide resource for processing waste to meet WIPP acceptance criteria. Future laboratory operations are expected to be similar to recent past operations, while ICP and AMWTP operations are expected to be reduced as specific projects are completed. Shipments from these facilities to WIPP pose a low risk for emergency due to the strict requirements for the vessels they are shipped in.

Safe transport will remain a small concern as nuclear spent fuels shipments continue in Idaho. Fuel shipments are transported in massive containment vessels via rail that undergo strict accident proof testing criteria, therefore these shipments pose little to no actual risk to the general public. No accidents have been reported in transporting spent fuel in Idaho.

Environmental Impacts

Environmental impacts of incidents involving radioactive materials are generally similar to impacts caused by other hazardous materials (See Section 3.11). A large release (accidental air emission or spill) that causes soil contamination could result in radiation exposure and uptake of radioactive material into plants and animals living on the contaminated soil or eating the effected vegetation. The environmental and health impacts of a release that is large enough to cause concern for protection of the general public would be evaluated by the Idaho Department of Environmental Quality with help from the Federal Radiological Monitoring and Assessment Center (FRMAC), and other State of Idaho agencies. Cleanup of small releases would avoid environmental impacts that might otherwise occur through the terrestrial environment and food chain, including runoff to surface waters. Monitoring of species is performed periodically to identify any effects in the ingestion pathways.

Snake River Plain Aquifer concerns were addressed and protected through the 1995 Settlement Agreement between the State of Idaho, DOE, and U.S. Navy which prioritized removal of stored fuel. Recycled fissionable materials for the US Navy and liquid radioactive waste from about 100 reactors nationwide were processed into dry, calcined waste. Solid waste – contaminated tools, clothes, trash – stored above ground in containers or buried in trenches posed the greatest threat to the Snake River Aquifer.

Climate Change Impacts

The climate of Idaho is changing. Records have shown that over the past 100 years, the State has seen an increase in temperature of one to two degrees (°F). In the coming years, it is predicted that streams will be warmer, populations of several fish species will decline, wildfires will become more common, deserts may expand, and water may be less available for irrigation (USEPA 2016). In addition to increase in temperature, the stratospheric ozone is depleting. Stratospheric ozone absorbs much of the incoming solar ultraviolet (UV) radiation. A depleting ozone increases the amount of UV-B in the atmosphere, raising concern about the levels of biologically-damaging radiation reaching the ground. Loss of zone may lead to certain or possible human health impacts, effecting the skin, eyes, immunity system and general well-being. Many studies have implicated that solar radiation is a cause of skin cancer and there may be an increase in skin cancer incidence and sunburn severity due to ozone depletion (World Health Organization 2017; Cabrol et al 2014).

Development Trend Impacts

There are no land-use regulations that restrict building around facilities that handle radioactive materials or generate EM radiation. Mobile radiation sources (e.g., radiography sources or soil moisture/density gauges) are designed so that they may be transported, the NRC has strict guidance on the storage of these devices when not in use.

An understanding of population and development trends can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The State considered the following factors to examine previous and potential conditions that may affect hazard vulnerability: potential or projected development; projected changes in population; other identified conditions as relevant and appropriate. The U.S. EPA's Integrated Climate and Land-Use Scenarios (ICLUS) project generated projected population and land use projections for the United States through 2100. The project examined multiple scenarios taking into account various population growth and economic development parameters that have been used as the baseline for the Intergovernmental Panel on Climate Change's (IPCC) Special Report on emissions Scenarios (SRES). Population change took into account assumptions regarding fertility, mortality, and immigration, which was then used to drive the land use projections.

The risk to radiological incidents is expected to remain the same; however, there may be an increase in the population impacted if incident locations are in areas of projected growth. Map 2.F. in Chapter 2 (State Profile) displays the projected population growth expected by 2026. The INL is located in Butte and Bonneville Counties; two counties with projected population growth.

Vulnerability Assessment

The risks of radiological materials incidents in Idaho are high, and could have high consequences depending on the isotope and activity level. As with other hazardous material spills, transportation incident risk may increase through population growth and economic activity in Idaho and surrounding states. The Idaho National Laboratory (INL) site routinely stores, uses, and ships high-activity radioactive materials. Hazard mitigation for the INL is addressed in separate INL and county plans. Counties in the ingestion pathway planning zone, a 69-mile radius of the INL, identify mitigation actions to protect food, water, and animal contamination.

The DOE Hanford facility is the largest United States nuclear remediation site with projects of removing radioactive waste from leaking tanks and soil, and treating groundwater. (Dininny, 2013) Hanford is located in eastern Washington, and while Hanford contains the closest nuclear power plant to northern Idaho, the affected ingestion pathways could encompass Idaho counties in the event of a release. Although Idaho is not located within the facility's 10-Mile Plume Exposure EPZ or 50-Mile IEP, portions of the State may still experience impacts should an emergency occur. Within the State, many industrial, educational, and medical facilities could produce widespread impacts to multiple jurisdictions as a result of an emergency incident/release at the facility.

Potential costs associated with an incident may be for response, health care, restoration, remediation, and post de facto litigation. Direct costs related to transportation accidents could include materials, carrier damage, property damage, response, and remediation/cleanup.

Critical Infrastructure and State Facility Impacts

Highways, aircraft and rail lines are used to move radioactive materials around the State. Transportation of highly radioactive materials is regulated by the Department of Energy, Nuclear Regulatory Commission and the Department of Transportation. Requirements can include use of single purpose licensed shipping casks designed for either truck or rail transport. Casks are designed to withstand extreme forces including drop tests and direct hits from freight trains. The highway routes are preselected and notifications of shipments are provided to DEQ-OP, State Communications, and Idaho State Police (ISP). There is continual waste leaving the INL and all of those shipments are inspected by the ISP prior to leaving the INL facility of origin. Shipments of spent fuel come into the State by rail and truck. Once again, DEQ-OP, State Communications, and ISP are notified regarding the number and timing of shipments. It is difficult to quantify the potential losses to State facilities as a result of a radiological incident. The total replacement cost value for the State facilities provides a total risk exposure.

Loss Estimation

No specific, statewide loss estimation exists for the hazard of a radiological incident. The total economic benefits from the INL can be quantified. Idaho Governor Butch Otter appointed the Leadership in Nuclear Energy (LINE) Commission 3.0 to guide the “continued viability and mission relevance” of the INL. The LINE Commission reports that Idaho’s economy benefits “more than $3.5 billion” annually from the employment and activities connected with the INL (LINE Commission, 2016).

Potential costs could be for response, health care, restoration, remediation, and post de facto litigation. Direct costs related to transportation accidents could include materials, carrier damage, property damage, response, and remediation/cleanup.

Due to the location of the INL within Butte County, Bingham County, Bonneville County, Clark County, and Jefferson County, the southeastern region of the State may be considered more vulnerable to an emergency radiological incident, however there are risks throughout the state.

Consequence Analysis Evaluation

On June 8, 2017, a Consequence Analysis Evaluation was conducted aligning with hazards profiled in the State Hazard Mitigation Plan. The assessment was conducted by a diverse planning team comprised of subject matter experts from across the State. This effort mirrored a similar exercise that occurred during both the 2010 and 2013 State Hazard Mitigation Plan updates.

The exercise is intended to provide another way to assess the State’s vulnerability to its hazards and was conducted as a group exercise. Participants were asked to individually rank the following systems on a scale from 0 (no consequences) to 5 (most severe consequences), separately evaluating both the short-term (0-6 month) and long-term (6+ months) consequences of the scenario.

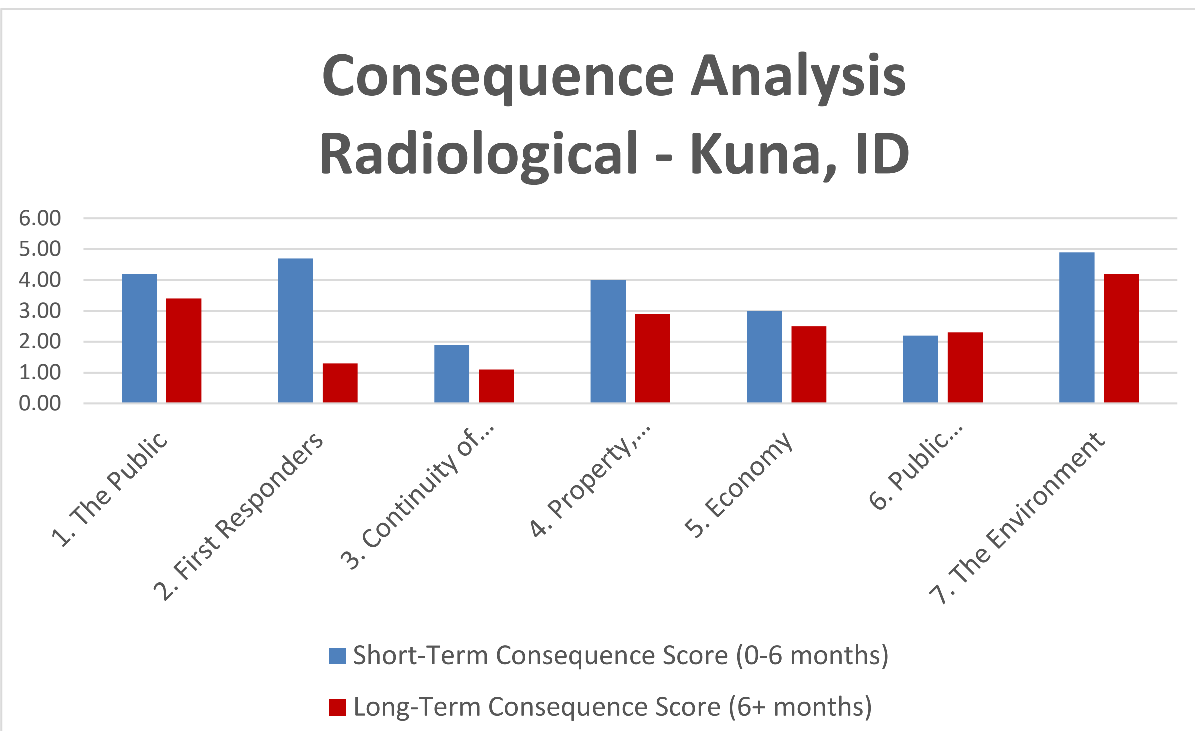
Systems Evaluated:

- The public
- First responders
- Continuity of operations
- Property, facilities, and infrastructure
- Economic conditions
- Public confidence in government

Scenario

A truck versus train crash occurred at a crossing of the Union Pacific Railroad line and Swan Falls Road in Kuna, Idaho. An irrigation creek runs near the road. The truck was carrying radioactive sources from a construction site and was traveling with a radioactive placard and a manifest of sources being carried. It contains the following sources: Twelve Cs-137 gauges that were recovered from an industrial site being demolished and two industrial gamma radiography instruments, each containing approximately 10 TBq Co-60 (300 Ci). The truck is dragged over 100 m and the cargo area is completely destroyed by the collision. The sources are damaged and contents are dispersed. This results in contamination over approximately 20 m × 10 m down the track. Some of that contamination extends to the stream.

Results



Looking at the short-term consequences of this radiological incident, exercise participants felt that the most severe consequences would be felt by the environment, first responders, and the public. From a long-term standpoint, the three systems suffering the most severe consequences (in decreasing order) include the environment, the public, and the built environment. Overall, what stands out is that the short-term impacts of this type of radiological incident are greater than for the long-term, with the exception of the public's confidence in government. Although the short term impacts are greater, the long term impacts are still significant. Some observations of the group to note included:

- This incident impacts a major rail hub and primary rail route which has the potential to inflict major economic impacts.
- Depending on long-term impacts, the public could potentially vacate the city for good.
- Response time to this incident would have the largest impact on the resulting consequences.
- Potential agricultural-sector impacts of this incident could be regional in nature.
- Environmental impacts to the Snake River would have repercussions across a number of sectors, including recreation, power, and agriculture.
- The season and time of occurrence for this incident would greatly vary the resulting consequences.

Mitigation Rationale

Large inventories of radioactive materials are handled at many fixed facilities within the state, and shipments of large quantities of radioactive materials are relatively infrequent as compared to shipments of hazardous materials that pose comparable risks. Operations at fixed facilities and transportation of radioactive material are highly regulated by DOE and NRC to minimize the chance of occurrence of a significant release and provide mitigation if a release occurs. Planning for mitigation of accidental releases is performed to avoid or reduce:

- Death, acute or chronic debilitation, or increased risk of cancer,
- Damage or destruction of agricultural products – animals and crops
- Degradation of environmental resources
- Devaluation or loss of use of public and private property
- Costs associated with emergency response, including cleanup

General Mitigation Approaches

The DEQ-OP evaluates the environmental and public health impacts of DOE activities at the INL, and participates in radiological emergency response functions state-wide. They employ professional Health Physicists and Environmental Scientists for emergency response and environmental impact assessment. Emergency response to INL incidents is generally directed towards mitigating the consequences of accidental or off-normal conditions. Mitigation is performed to manage the consequences during the initial phases of an incident through recovery. Goals for radiological emergency preparedness planning and training include:

- Promoting flexibility in management of emergencies, for efficient use of resources

- Maintenance of full-time capability for immediate response
- Ensuring that responders, plans, facilities, and any necessary inter-organizational coordination are sufficient to provide the desired protection

The current approach for radiological emergency preparedness for large, potentially high-consequence incidents (e.g., a reactor accident or a release in a densely populated area) has been developed using the experience gained during major reactor accidents. Emergency Preparedness programs for DOE and NRC are generally similar, although these organizations operate under different regulations. Significant radiological accidents that could pose a risk to public health and welfare would result in a request from a local authority (the local Incident Commander (IC)) in the activation of the Idaho Hazardous Materials/Weapons of Mass Destruction (WMD) Incident Command and Support Plan which could then result in a request for federal assistance through the FRMAC. This would most likely include support from the Region 6 Radiological Assistance Program (RAP) team which operates from Idaho Falls. If the incident occurs at an INL facility, DOE and its contractor(s) maintain emergency response organizations and DEQ-OP staff coordinate their response with the INL, per a memorandum of understanding between the State and DOE. Since RAP Region 6 members are INL contractor employees and may be involved with on-site response for their employers, the Region 8 RAP team based in Richland, Washington will provide backup support. The INL conducts emergency drills and exercises and the State observes and participates in these activities.

The DEQ-OP Health Physicists actively train first responders in the State of Idaho along transportation routes used for shipments to WIPP. Responders include Regional Response Teams (RRTs), the Idaho State Police (ISP), and health care providers. DEQ-OP also provides radiological instruments to these agencies and provides continued calibration and maintenance.

Mitigating criminal actions concerning radiological materials are coordinated with the “pre-incident prevention protocols set forth in federal, state, and local law enforcement and emergency response protocols to include those described within the Idaho Hazardous Materials/Weapons of Mass Destruction (WMD) Incident Command and Support Plan” and coordinated through the Idaho State Police in cooperation with the FBI through the support of the Idaho Attorney General. (Idaho Bureau of Homeland Security, 2012)

Mitigation planning takes into account actions regarding consumption, food production and processing, sheltering animals and, covering stored water and feed. Self-help measures contribute to public protection such as heeding warnings to shelter in place and maintaining 72-hour kits.

THIS PAGE INTENTIONALLY LEFT BLANK