Miami-Dade County, Florida Emergency Operations Center (EOC)

Nuclear Power Plant Response Course

Student Manual

Delivering Excellence Every Day

Miami-Dade County
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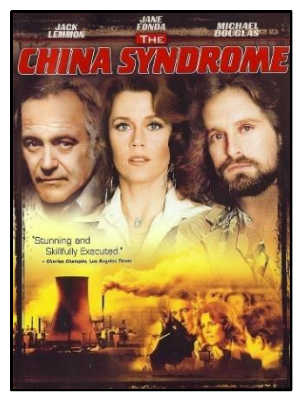
Introduction

By all accounts emergency responders are among the bravest[1] members of a community: routinely exposing themselves to risk with the understanding that equipment, training, and experience reduces their risk to acceptable levels. Day after day responders put on their uniforms and go to work protecting their neighbors and their communities even though hundreds of them die annually[2] as a result of violence, transportation incidents, fires, explosions, falls, and other hazards associated with their work. If any group is familiar with managing risk, emergency responders are it. Yet when faced with the prospect of working in an environment that might include radiation many responders voice uncertainty, hesitancy, and in some cases outright resistance.

One of the biggest challenges to successful delivery of a radiological response course is overcoming the misperceptions that exist with regard to radiation in general and all things nuclear in particular. Unless those misperceptions are addressed early and convincingly many conscientious emergency responders will disconnect and gain little to nothing from the course. Throughout this manual many of the common misperceptions will be contrasted with easily verifiable facts. By doing so, emergency responders will be provided with the opportunity to get past perceptions and instead focus on getting the information they need to do their jobs safely in a radiological environment.



Few of us have formal education in the fields of physics or chemistry. When faced with a situation we have to draw on existing knowledge we revert to information from past experience or other cues we've been exposed to: images and headlines in news stories, conversations with friends and families, as well as direct or indirect messages in movies and news reports.

Consider the headline[3] from April 2014 *Radiation Level in Tuna off Oregon Coast Tripled after Fukushima Disaster*. If only the headline is read, as often occurs, one is left with the impression that tuna off the Oregon coast is highly contaminated. Only when you read through the article do you find that even after tripling the level of radiation is still 1,000 times lower than the safety standards outlined by the US Department of Agriculture. Or the headline[4] from May 2014 *Fukushima: No Radiation Deaths but 'Their Souls are Killed:'* the first image conjured by that headline might be one of zombies. Further reading reveals that the story is about the dramatic and long term mental health implications of the disaster.

Misperceptions due to a lack of evidence are understandable. But in the case of nuclear power plant accidents there is plenty of evidence upon which to establish a clear distinction between perceptions and reality. In the next several pages, students will be presented with a comparison of nuclear power plant disaster planning standards and how they relate to the 3 nuclear plants that have occurred throughout the world. Students will also be presented with the biological effects of radiation under both acute and chronic circumstances and how those effects manifested as a result of the 3 historical nuclear plant disasters. This manual concludes with an overview of the

Miami-Dade Turkey Point Response Plan: with a focus on the key information that responders need to perform their roles. Throughout this manual and the accompanying course, responders will note an emphasis on their safety. A fundamental premise of emergency response planning is that if responder safety is jeopardized no one will be left to serve the community and ensure their safety and security. This manual is dedicated to the selfless commitment of emergency response personnel who place themselves in harm's way to protect the residents that depend on them.

Chapter 1 - Nuclear Power Plant Accidents in Perspective

Three common misperceptions associated with nuclear plant accidents are:

- Nuclear power plants can blow up like nuclear bombs.
- Nuclear plant accidents result in mass fatalities.
- There is no time to react if a nuclear plant accident occurs.

The next several paragraphs analyze each of these in turn:

- A nuclear weapon is a precise instrument that combines specifically engineered components working together with a unique fuel type. A nuclear plant isn't engineered to function the same way and the fuel grade in a nuclear plant is not the type necessary to support a nuclear detonation[5].
- Accidents of any type can and do cause injuries and fatalities. Motor vehicle accidents result in approximately 35,000 annual fatalities in the US alone[6]. Worldwide, there have been 3 significant nuclear plant accidents: Three Mile Island in the US, Chernobyl in the Ukraine, and Fukushima Daiichi in Japan. Of the three, only the Chernobyl[7] accident resulted in fatalities from radiation. The Fukushima Daiichi accident, an extremely severe event, didn't produce any radiation related deaths and isn't expected to do so in the future.[8]
- The number of scenarios that could lead to a nuclear plant emergency are varied so no one can say there will always be a given amount of time between the start of a nuclear emergency and a potential release of radioactive material to atmosphere. That being said, nuclear plants are designed with multiple safety redundancies and backup equipment[9] that would, in most situations, provide at least several hours to implement protective actions.

  The following timeline excerpts are insightful:

Three Mile Island Emergency Timeline[10] (Excerpts)		
3/28	04:00	Feedwater pump fails and the control rods dropped automatically.
3/28	06:30	Radiation levels up to 1R/hr measured in the Unit 2 auxiliary building.
3/28	06:48	High radiation levels measured in several areas of the plant and Site Area Emergency declared shortly before 07:00 due to "uncontrolled release of radioactivity to the immediate environment."
3/28	07:24	General Emergency declared.
3/28	07:48	Radiation along the Island's west shoreline measured at less than 1 mR/hr.

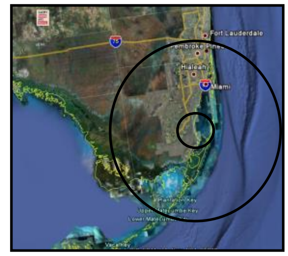
3/28	08:25	WKBO breaks the story on its newscast.
3/28	11:00	Nonessential personnel ordered off the Island.
3/28	~12:00	Auxiliary building radiation levels range from 50 mr/hr to 1,000 R/hr.
3/28	14:47	Radiation readings in Middletown ranged from 1-2 mR/hr.
3/29	14:10	Brief burst of 3 R/hr measured 15 feet above plant's vent.
3/30	08:01	Radiation readings of 1,200 mR/hr are measured 130 feet above vent stack.
3/30	~10:00	Dauphin County broadcasts warning that an evacuation might be called.
3/30	~12:30	Governor recommends that pregnant women and preschool children within 5-mile radius of plant evacuate.

Fukushima Daiichi Emergency Timeline[11] (Excerpts)		
3/11	14:46	Ground motion exceeds seismic sensor setpoint.
3/11	15:27	First wave of tsunami arrives at station.
3/11	20:50	Public evacuation ordered out to 1.9 miles.
3/11	21:23	Public sheltering ordered from 1.9 - 6.2 miles.
3/11	13:00	120 mR/hr measured at front of reactor building.
3/12	02:24	30 R/hr measured in a room of reactor building.
3/12	04:00	0.0069 mR/hr at main gate.
3/12	04:23	0.059 mR/hr at main gate.
3/12	05:44	Public evacuation expanded to 6.2 miles.
3/12	08:03	Venting is ordered to begin at 09:00.
3/12	09:15	Vent valve opened 25%.
3/12	15:36	First explosion
3/12	16:27	101.5 mR/hr measured at site boundary.
3/12	18:25	Public evacuation expanded to 12.4 miles.
3/14	11:01	Second explosion.
3/15	23:05	454.8 mR/hr measured at main gate.

Chernobyl Timeline[12] (Excerpts)		
4/25	01:00	Reactor operators begin reducing power for a test.
4/25	14:00	Emergency core cooling systems switched off.
4/26	00:24	As a result of dramatic drop in power a reactor operator wants to abort the test but is overridden by the deputy chief engineer.
4/26	01:19	Reactor operator blocks automatic shutdown in order to continue the test.
4/26	01:23	Emergency reinsertion of control rods fails and explosion follows and release

		of radioactive material begins.
4/27	14:00	Evacuation of Pripyat begins.

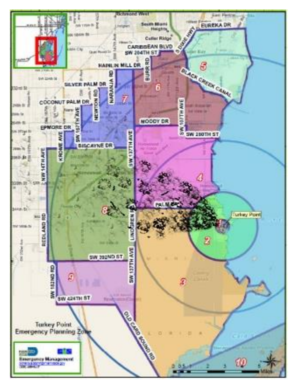
Emergency Planning Zones



One thing that becomes clear from analyzing past nuclear plant incidents is that there are two general areas of concern we have to plan for. The first is the area nearest the nuclear plant and at greatest risk of receiving higher levels of radiological exposure from a release of radioactive material. The second is the area beyond the area nearest the nuclear plant but still susceptible to lower levels of contamination. The two areas, formally known as Emergency Planning Zones (EPZ), generally extend 10 miles and 50 miles around the nuclear plant. Looking back at historical nuclear plant emergencies it's obvious that the most significant amount of radioactive material will deposited within the first few miles around the Plant. In every past nuclear emergency, the higher doses were received at the Plant itself and dropped off significantly as the distance increased. In fact, one of the health problems that developed after the Chernobyl emergency was from milk cows ingesting contaminated food and children drinking contaminated milk from the cows.

The 10-mile EPZ extends roughly from Cutler Bay south to Card Sound Road and from Krome Ave to Elliott Key. The 50-mile EPZ includes all of Miami-Dade and parts of Broward and Monroe Counties as well as several miles of coastal Atlantic waters.

Plume Characteristics



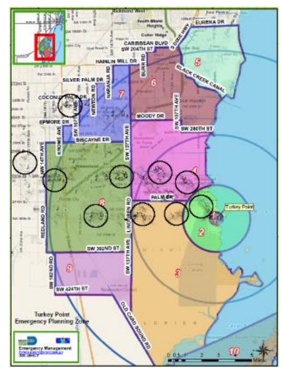
In discussion about plumes, it often helps to think about what happens during a fire. During an airborne release from a Plant, the radioactive material behaves like smoke and ash behave during a fire. As materials burn, particles (smoke and ash) are released. Smoke and ash rise with the heated air and are transported downwind. If the air is humid or it rains the particles travel less distance. Larger, heavier particles also travel less distance. Very close to the source of the fire, the amount of smoke and ash is very large. In the case of the nuclear emergency, the smoke and ash is radioactive. The more smoke and ash the higher the amount of radiation. The combination of deposited radioactive material and exposure from radioactive material in the passing plume can provide doses that exceed the dose limits established by federal regulatory agencies.

Early Phase Priorities

Continuing the fire analogy - when responders first arrive at a fire, one of the early priorities is moving people out of the structure and away from the hazard area. The same is true a nuclear plant emergency. In the case of a fire the hazard is mostly limited to the structure fire and the immediate area around it, unless the fire jumps to another building. In the event of a nuclear plant emergency, the hazard also exists in the plume that is traveling downwind, so in a sense, the hazard is moving. You might relate this to a fire at a chemical plant. It is common to evacuate or shelter people that are downwind from a chemical plant fire. In some cases, a hazardous materials expert may be able to go downwind and, using specialized equipment, measure or calculate how much of the hazardous product is in the air and that will guide the extent of the immediate protective measure. In most cases, they implement public protective actions further than necessary to add a safety buffer. In a nuclear plant emergency the process is comparable and the buffer zone is the 10-mile EPZ.

However, because the hazard is moving and some particles will travel further it is part of the nuclear safety strategy to initiate temporary food embargoes at about the same time we start moving people to safety.

Intermediate Phase Priorities



Once the release stops, specialized teams will go into the field and measure where the particles settled. These areas will be secured so the hazard is contained. If those areas have already been evacuated the people aren't allowed to return until the area can be made safe.

As previously mentioned, some areas may be outside the 10-mile EPZ. If the levels are such that chronic exposures will lead to doses above the federal dose limits, those people will be relocated until the area can be made safe.

Other areas that had been evacuated during th early phase may be safe and people can begin to return. In some areas, the problems may be strictly limited to preventing ingestion of contaminated foodstuff. If we continue the fire analogy - this would be the period when the owners and the contractors look at the damage and determine what can be salvaged, what can be repaired, and what has to be replaced.

Late Phase Priorities

As we've seen from past nuclear emergencies, the recovery can last years. The areas and structures that are contaminated have to be cleaned. Everyone will have their own priority so there will be a lot of negotiation and prioritization. During this phase, state and federal agencies become much more active. Responders as well as civilians that might have been exposed will undergo long term health monitoring.

Lessons from Fukushima – Dose Rates at Plant

As mentioned earlier, we have data from Fukushima that provides great insight. The U.S. D.O.E conducted fly-over surveys and measures were taken right about the time that power was restored to reactor control rooms. As the fly-over data is analyzed, it is important to remember that water had been pumped into reactor buildings for a few days by the time the measures presented in the class were conducted. It seems reasonable that rates were higher during the period after the hydrogen explosions and before the water pumping started. Nonetheless, it is clear that dose rates decreased exponentially with distance from the reactor buildings. A person could receive a potentially lethal dose rate if they stood near the reactor buildings for several hours. However, step away just a few hundred feet away and the dose rates drop dramatically.

If we apply the lifesaving dose limit, which will be introduced in a later chapter, to these dose rates; the result is that a responder could work right next to the reactor building for about 2 hours. Yet they could work in areas away from the reactor building multiple shifts before reaching federal routine operations dose limit.

The data demonstrates that the greatest hazard is in close proximity to large quantities of nuclear fuel.

Lessons from Fukushima – Dose Rates Away from Plant

DOE data from areas away from the Plant also support the EPZ planning priorities. Measurements were taken approximately 1 week three weeks after the accident indicate that the highest dose rate (43 mR/hr) is quite close to the Plant. We also see that the rates generally drop off with distance but not in a linear fashion. There are observed dose rates at 18.6 miles that are lower than at 2 miles. This is consistent with our previous discussion about the effects of weather and topography on contamination deposits. If we apply the national responder dose limit for routine operations, we see it would take several days' of constant exposure to reach that value.

Lessons from Chernobyl – Dose Rates Away from Plant

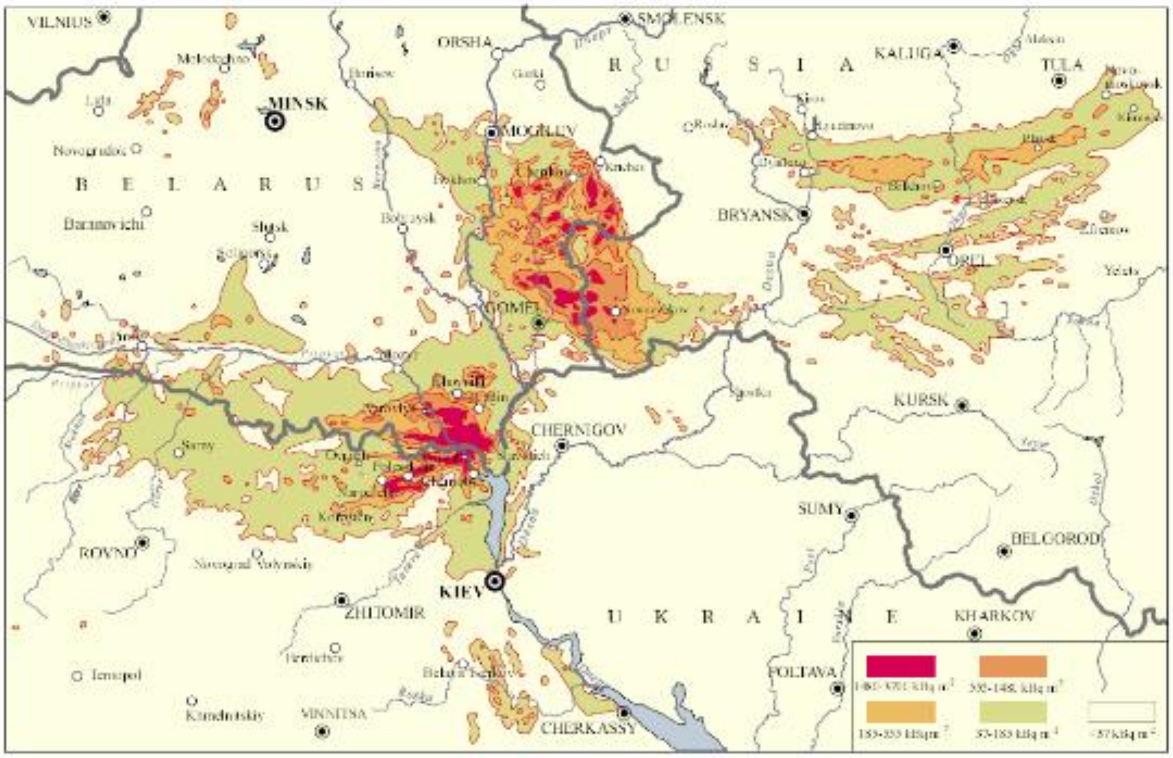
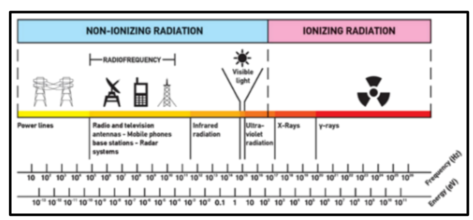


Figure VI. Surface ground deposition of caesium-137 released in the Chernobyl accident [11, 13].

Chapter 2 - Biological Effects of Radiation

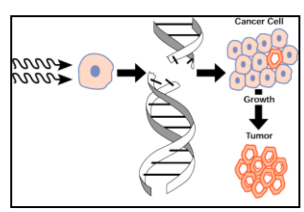
Ionizing Radiation



Most responders recognize that "radiation" is part of the package when it comes to equipment like microwaves, X-rays, radios, etc. A few can define radiation as "energy moving through space." Fewer can speak in terms of wave frequency. Almost none can distinguish between ionizing and non-ionizing radiation. Yet only ionizing radiation is known to alter or damage cells.

There are studies that suggest an increased incidence in some cancers among cell phone users and people that live near power lines but there are other studies that suggest the relationship is not causal. While the hazards of non-ionizing radiation cannot be disregarded, the hazards of ionizing radiation are well documented.

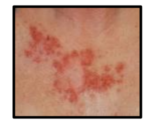
Cancer and Radiation



Increased risk of cancer is well documented among populations receiving high or chronic exposures to radiation. A very high dose of radiation can kill cells but lower doses may cause damage to cells. The damage may be in the form of an alteration of the DNA which is like the blueprint or instruction manual for the cell. In most cases, the body itself destroys those cells and replaces them with new undamaged cells. But in some cases the cell goes on to become what is referred to as a cancer cell and then multiplies until it becomes a tumor. Interestingly, sometimes cancer treatment consists of radiation therapy. The reason: high doses of radiation kill cells. If the cells getting the high dose are cancer cells, they will die.

UV radiation straddles the boundary between ionizing and non-ionizing radiation. Most people recognize that sun exposure increases cancer risk. As skin cells are exposed there is cell destruction (burned skin) and cell damage that may or may not be visible. The dead cells are replaced and usually, but not always, the damaged cells are repaired or replaced. Sometimes the result is skin cancer.

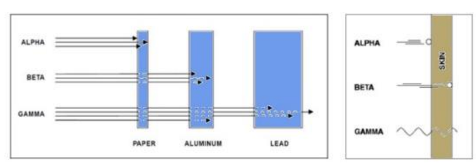




Contrast sun exposure injury with other types of injuries (e.g., bruises, cuts, scrapes, breaks, etc.). In every case of injury there is cell damage and destruction and in most cases we know from experience that the body repairs and replaces those cells and we recover from the injury. We also know it takes longer to heal from more severe injuries than from minor injuries. Think about how long it takes to recover from a paper cut versus an open fracture. We also know that if the injury is severe enough (e.g., an amputation), the body cannot heal itself. Most injuries we typically sustain don't include alteration of DNA. Radiation exposure injury can include DNA alterations. That is why we not only have an injury but also an increased risk cancer.

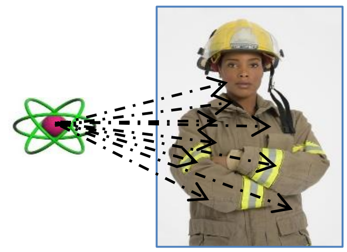
Just as sun exposure increases risk of skin cancer, radiation exposure increases risk of other types of cancer. But just as every sun exposure does not lead to skin cancer, every radiation exposure does not lead to cancer. Protection is the same in both cases: reduce exposure (i.e., dose) and the risk is also reduced.

Dose Reduction



Most radiation classes include a mention of the 3 common types of radiation: alpha, beta, & gamma. Although their properties (i.e., physical characteristics and penetrating ability) have applicability under certain circumstances, different radioisotopes release different radiation types (i.e., alpha, beta, and gamma) and in most cases the responders won't be able to identify the radioisotope. In fact, most isotopes from a nuclear plant emit at least two types of radiation: a) Cs-137 emits beta & gamma; b) I-131 emits beta & gamma; c) Sr-90 only emits beta; d) U-235 only emits alpha. As such, the focus in this manual is on keeping doses low as opposed to trying to determine what type of radiation a particular radioisotope emits. The big takeaway is that alpha and beta are primarily internal hazards so efforts should be on keeping radioactive material from entering the body. Gamma radiation is a whole body hazard and may deliver a deep tissue dose even when kept outside the body. From a radiation protection stand point, the goal is to keep radioactive material outside the body and use the dosimeter to measure gamma doses and remove yourself from the hazard area when the dose is near or above the authorized dose limit. By keeping exposures (i.e., doses) low responders minimize the risk of acute injury as well as chronic illness.

Contamination -vs- Exposure



Contamination with radioactive material can lead to an increase in the radiation absorbed dose. However, you don't have to be contaminated for the dose to rise. Continued proximity to a source of radiation will result in an increasing dose even if the source (i.e., the radioactive material) isn't contaminating the individual. Although not desirable, radioactive material contamination in and of itself is not an immediate threat. As long as the contamination is external, it is easy to remove. The focus should remain on overall dose. The takeaways are:

- try to avoid becoming contaminated if possible but don't over react if you do become contaminated;
- if you do become contaminated have the contaminant removed as soon as reasonably possible;
- don't lose focus of the overall dose; but
- as long as your dose remains below the authorized limit the contaminant is not a cause for immediate alarm

Measuring Radiation

Radiation is invisible, doesn't have a smell, and can't be felt so specialized equipment is needed to detect and measure it. When measuring radiation, there are two commonly used units of measure: one for the detection of contamination and another for the measurement of absorbed doses. Contamination is measured in counts per minute (CPM). Responders that have to check people or things for contamination will be issued instruments called survey meters and measure in CPM. When a hand held survey meter detects radiation it typically makes a clicking sound and the faster it clicks the more contamination present.

Doses are measured in units of roentgen (R) or milliroentgen (mR). Each R is the equivalent of 1,000 mR. Because dose is the key aspect of radiation safety, every responder will be issued instruments called dosimeters to measure their own dose. Depending on the organization, supervisors may choose to designate someone to document a group's doses or they may decide it is more effective for the individuals to document their own doses and submit the dose record to the supervisor at the end of the mission or shift. There are pros and cons to both methods. But the bottom line is that doses have to be tracked and documented on a regular basis. Dose limits

apply to the incident so a dose received during the first day of the response has to be added to the dose received the second day and together the total has to remain below the authorized dose limit.

Radiation affects cells that have a high division rate more than it does mature cells. That is why doctors always ask women if they are pregnant when they are considering an X-ray (cell division in fetuses is extremely high). Children are more susceptible to radiation than adults for the same reason: more cell division occurring in kids than in adults. Recall that Chernobyl resulted in numerous injuries and fatalities to children and youngsters; much more so than adults. Just as a traumatic injury to the hand or arm isn't as bad as the same injury to the torso, a dose of radiation is less significant if it is to an extremity rather than to the torso. As a general rule, there is more cell division in the vital organs of the torso than elsewhere so we want the dosimeter to measure the dose to that part of the body.

Direct Reading Dosimeters (DRD) are turned in at the end of the mission or shift. The Permanent Record Dosimeter (PRD) stays with the responder for the entire event and is sent to a lab for reading after the event. The result becomes part of the responder's permanent dose of record and is used for subsequent health monitoring. The Florida Health Bureau of Radiation Control (BRC) uses PRD data for epidemiological studies as well as treatment in the unlikely instance of higher than anticipated doses.

Dose Limits

To keep responders and the public safe, the Environmental Protection Agency has established limits on the amount of radiation that people can be exposed to under different circumstances. Here we see everything from routine medical doses to lethal doses.

If we place a series of doses along a scale we see that effects become severe at the high doses but are not identifiable at lower doses.

- Doses greater than 350 R result in a 5% fatality rate if no medical support is given.
- Doses of 100 R typically result in symptoms (e.g., nausea, vomiting). The symptoms are those typically associated with radiation therapy.
- Doses of 50 R result in a change to blood cell count. The change is NOT accompanied by symptoms and can only be detected through blood analysis in laboratory.

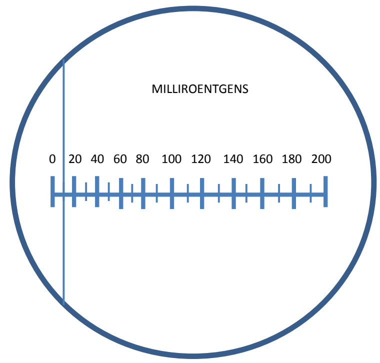
Responder dose limits fall at the lower end of the scale.

- Doses of 25 R is the dose a responder may receive if engaged in a lifesaving activity. Responders may volunteer to exceed a dose of 25 R if they are fully aware of the hazards.
- Doses of 10 R is the maximum dose a responder may receive and only for the protection of large populations or critical infrastructure.

- Doses of 5 R is the maximum dose a responder may receive for routine emergency operations.

Dose Tracking

Responders can track their own exposures by reading a dosimeter and documenting their exposures on an *Incident Radiation Exposure Record* card. When reading a dosimeter, it is important to note that the scales can vary. In some cases, the range of the scale is 0 – 20, in others it might be 0 – 200, and others still may be 0 – 500. Accordingly, the hash lines along the scale represent different values. Responders must carefully observe dosimeter scales to make sure they understand:



- whether it measures in mR or R;
- the maximum range of the dosimeter; and
- the value represented by each hash mark along the dosimeter scale.

INCIDENT RADIATION EXPOSURE RECORD
Name: Jon Smith
S. S. #: 123 45 6789
Dosimeter #: 6789 Type: mR

TIME	READING	TOTAL EXPOSURE	LOCATION
Depart	10	0	
0+30			
1+00			
1+30			
2+00			
2+30			

The exposure record is initiated prior to entering a hazard area. Responders receive one card per DRD. The top of the form includes space for the responder's name, social security number, dosimeter serial number and dosimeter type. The dosimeter serial number is stamped on the side of the dosimeters. The dosimeter type refers to the type of radiation measured by the dosimeter (e.g., R or mR) and can be found above the scale of the dosimeter. It is important that responders correctly match each exposure record card to the appropriate dosimeter and document doses accordingly.

Personal Protective Equipment (PPE)

The key to PPE is to match the PPE to the hazard. Most people intuitively recognize that it doesn't make sense to use a bomb suit to perform traffic control; or wear SCBA to a routine medical call. But when the hazard is less well understood (e.g., radiation) responders frequently assume the PPE requirements are much higher than typically necessary. Except in few specific cases, covering the skin, protecting respiratory system from particles, and most importantly monitoring the doses absorbed is the best protection for responders performing routine missions at locations away from the source of the radioactive release (e.g., the nuclear plant). On the other hand, if you are performing decontamination and are likely to be splashed with contaminated water then a higher level of protection would be appropriate. Likewise, if you are responding to the Plant during a significant release a higher level of protection (e.g., SCBA) would likely be appropriate. But when you are 5, 10, or more mile away the hazard is limited and PPE that makes

decontamination easy (i.e., covers the skin), includes moderate particulate filtration, and includes dose tracking will allow responders to remain safe and do most any job reasonably comfortably. While SCBA and a hazardous material suit may look like an attractive PPE choice to the novice, the limitations of such PPE and the physical stress they produce is likely to pose a greater risk to the responder than the radiation hazard they are trying to protect themselves from.

Potassium Iodide (KI)

Various news reports have referred to KI as an anti-radiation pill: it is not. KI only protects one organ (the thyroid) from one radioisotope (radioactive iodine) and only when that radioisotope is internal. It provides no protection from any other radioisotope and it doesn't protect the thyroid from radiation emanating from radioactive iodine that is outside the body.

Although most people with iodine allergies are aware of the allergy, a very small percentage aren't. As such, even though a KI tablet is provided early during the event, and responders undergo a brief medical evaluation to try to identify people who may be susceptible to iodine, responders are instructed to take KI only when told to do so.

One dose of KI is good for about 24 hours. If the dose is taken at noon on Fri but iodine isn't a concern until Fri at midnight the dose taken at noon is protective for only 12 hours. A responder that worked from 08:00-20:00 on Fri and comes back for Saturday's shift will be unprotected for most of the second shift.

Safety Officers

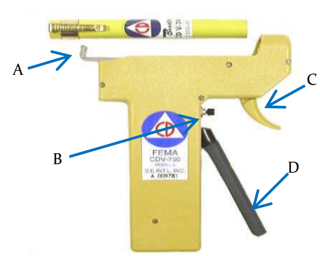
The BRC will have a radiation safety officer (RSO) providing advice and guidance to leadership during this type of incident. Additionally, each agency is asked to identify its own safety officer to be the link between the BRC RSO and the responders. Safety Officers will be responsible for:

- Briefing responders on the known hazards;
- Monitoring dose limit enforcement and dose trends;
- Ensuring proper use of PPE; and
- Developing and implementing safety strategies.

Zeroing of Dosimeters

Prior to use, dosimeters have to be checked to make sure they are ready for use. One of the requirements is that dosimeters are reading at or near zero. If not, the dosimeter can be zeroed (sometimes referred to ask charged). Practicing dosimeter zeroing will familiarize responders with the procedure but a few key points to remember are:

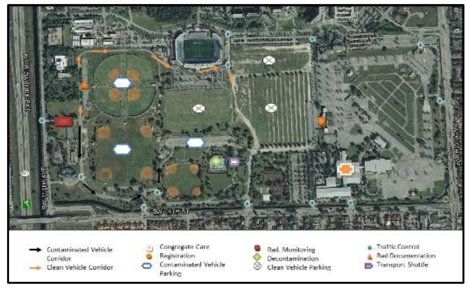
- Trigger C must be squeezed and held to insert and remove the dosimeter from the charger.
- Slide A is adjustable. It has to be raised to slide easily along its guide bar.
- Dosimeter hairlines frequently disappear when the dosimeter is first inserted in the charger.



- Dosimeter hairlines frequently jump as the dosimeter is removed from the charger.
- Trigger D moves the hairline across the scale. Even if the hairline is missing from the scale, repeated squeezing of trigger D will cause the hairline to reappear and move from the high end of the scale to the low end of the scale.
- Button B moves the hairline from the low end of the scale to the high end of the scale.

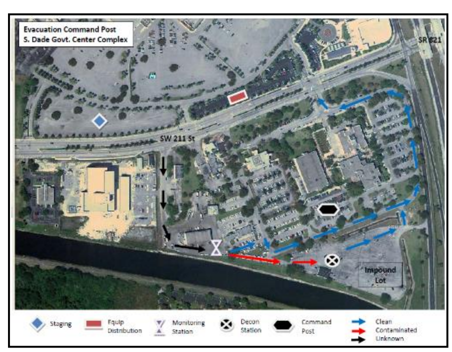
Chapter 3 – Plan Overview

Emergency Facilities



Several facilities are used to support emergency operations in the event of a nuclear plant emergency. Some facilities are for public services and others are for public safety staging and operations. The Emergency Reception Center (ERC) is located at Tamiami Park. It is the primary facility where evacuees can access emergency services like radiological monitoring and decontamination, family reunification, medical assistance, and insurance vouchers for temporary accommodations. Evacuees can drive themselves to the ERC or be transported there by Miami-Dade Transit buses making evacuation runs from the EPZ. The facility perimeter is secured to manage the flow of evacuees and minimize cross contamination.

The Marine Reception Center (MRC) is located at Matheson Hammock Marina. It is the facility where evacuees coming from Biscayne Bay, or boaters unable to return to their home port in within the 10-mile EPZ can access emergency services like radiological monitoring and decontamination, and medical assistance before being transported to the Emergency Reception Center. Boaters would anchor up near shore at a secure anchorage near the MRC and be shuttled to shore by public safety vessels. This facility perimeter would also be secured to manage the flow of evacuees and minimize cross contamination.



The Evacuation Command Post is located at the south Miami-Dade Government Center in Cutler Bay. It is the facility where public safety personnel working within the 10-mile EPZ would stage, receive PPE, receive safety briefings and assignments, and process through radiological monitoring and decontamination after assignments within the hazard areas. This facility would be secured and traffic around it would be redirected to facilitate public safety operations. Public safety personnel reporting to this facility would follow an established flow through the facility to minimize cross contamination.

Emergency Classifications

All emergencies at nuclear plants are categorized according to severity. The Turkey Point Response Plan is geared toward pre-loading resources and public protective action so by the time a General Emergency occurs responders are ready and the major obstacles to response have been removed or minimized.

An *Unusual Event* is a minor incident (e.g., severe weather) that meets NRC criteria and must therefore be classified. Unusual events don't pose a release threat and the county's response posture is one of notification and monitoring by key personnel.

An *Alert* is a minor incident that affects or could potentially affect reactor safety. There may, under some circumstances, be a small limited release of radioactive material that is below federal safety guidelines. The county's response posture is contingent of the specifics of the incident. In some cases the plans may call for the recall or alerting of response forces, staging personnel and equipment, distributing PPE, and briefing responders on their specific assignments should conditions deteriorate.

A *Site Area Emergency* is a more serious incident such as a coolant leak from a reactor coolant system. There may, under some circumstances, be a release of radioactive material that would not exceed federal safety guidelines beyond the site boundary. In addition to sounding the public warning sirens located throughout the 10-mile EPZ and pushing emergency information to the community, the county would conduct all the tasks previously mentioned at the *Alert* classification and may also deploy responders to staff traffic control points or to set up emergency facilities. Although there would be no public danger from radiation at a *Site Area Emergency* and emergency information would urge people to monitor news stations for possible changes in plant conditions before taking protective measures some people may choose to leave the area around the plant of their own volition.

A *General Emergency* is the most severe emergency classification. Radioactive material releases above federal safety guidelines and affecting areas beyond the plant site are expected or may already be underway during a *General Emergency* classification. In addition to sounding the public warning sirens located throughout the 10-mile EPZ, the emergency information would be expected to include some component of public protective measures. Those could include sheltering in place,

Unusual Events - only require monitoring		
Alert	**Site-area Emergency**	**General Emergency**
Recall	Public alert	Evacuate
Stage	Set-up	Shelter
Equip	Deploy	
Assign		
In general terms: 1 barrier = Alert; 2 barriers = SAE; 3 barriers = GE		

evacuation, or a combination of the two for different areas of the EPZ.

Roles & Responsibilities

An incident at a nuclear power plant will require the collaboration and coordination of several local, state, and federal agencies. The Miami-Dade Turkey Point Response Plan describes the county's overall strategy as well as the variety of tasks that would be necessary to support a response of this type. Most of the tasks described herein will be performed at the emergency facilities previously mentioned. Below is a breakdown of key tasks by agency.

Miami-Dade Police Department

The primary functions of MDFR are:

- Traffic control for the purpose of evacuating areas of the 10-mile EPZ.
- Establishment of security perimeters around evacuated areas.
- Traffic and crowd control at emergency facilities.
- Securing of critical infrastructure and public safety command facilities.

Other law enforcement agencies (e.g., FHP, Homestead, Cutler Bay) are tasked with supporting MDPD in the completion of their responsibilities.

Traffic Control

The Turkey Point Traffic Control plan includes two phases. Phase 1 prepares the Turnpike for evacuating the 10-mile EPZ by assigning officers at all on and off ramps of the Florida Turnpike (SR821) from Florida City to the Dolphin Expressway (SR836). Initially, the focus of efforts would be the facilitation of northbound traffic flow by closing northbound on-ramps between SW 184 St and SR836. As more resources become available, access to northbound SR821 on-ramps within the 10-mile EPZ will be facilitated and southbound traffic on SR821 will be redirected off the turnpike at SW 152 St.

Phase 2 of the plan identifies that traffic control points that would be needed to secure evacuated areas of the 10-mile EPZ. Although contraflow of SR821 between FL City and SR836 is possible, it is not the primary option.

The Traffic Control Plan also lists the minimum law enforcement officers needed to implement each phase of the plan and the agency identified for the staffing.

Route Alerting

There are several pole-mounted sirens throughout the 10-mile EPZ that would be used to alert people that an emergency exists at the Plant. The purpose of the sirens is to alert people to tune to local media outlets for instructions and information. The siren system provides feedback on siren failures. In the event that one or more siren fails law enforcement officers will be deployed to perform route alerting in the area of the failed siren(s). A map of the siren coverage area will be provided by the Emergency Operations Center (EOC).

Traffic and Crowd Control

Emergency facilities set up to support nuclear power plant incident response will need to be secured so that traffic enters and exits via designated points and flows through the facility via a designated route.

Likewise, people accessing emergency services at these facilities may need direction and in some cases benefit from a law enforcement presence to help resolve conflicts and keep the peace in what could be a stressful environment.

Security

Command posts, critical infrastructure, and other support facilities may need to be secured to prevent unauthorized access.

Miami-Dade Fire Rescue (MDFR)

The primary functions of MDFR are:

- Radiological monitoring of public safety personnel exiting the 10-mile EPZ.
- Radiological monitoring of public safety equipment and vehicles used within the 10-mile EPZ or other areas potentially contaminated.
- Decontamination of public safety personnel found to be contaminated.
- Decontamination of evacuees found to be contaminated.
- Routine firefighting and medical calls both within and outside the 10-mile EPZ.

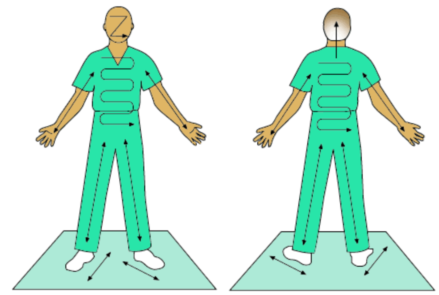
Survey Technique

Radiological surveys for a nuclear plant emergency are typically geared toward ruling out contamination on a person or surface. If that is the case, the level of radioactivity in mR or R per hour provides little value because we are only interested in meeting a minimum threshold in order to meet the criteria for decontamination. The important value is the action level that will be applied to categorizing something as contaminated. In cases where responders are processing hundreds or thousands of people quickly a higher action level may be applied than in cases where only one or a few people are being processed. The Incident Commander will determine the appropriate action level for the specific situation. If the survey is done using a portal monitor, the device is designed to alarm if a previously programmed action level is exceeded: typically 200 counts per minute (CPM) above background. Once the portal monitor is assembled and powered on it will perform a self-check and determine the background rate. All that is required then is for a person to step on the activation base and wait for the instrument to perform the survey

Determining Background Rate

1. Listen and count number of clicks in a period of 3 minutes (example).
   - Minute 1 – 25 CPM
   - Minute 2 – 45 CPM
   - Minute 3 – 30 CPM
2. Add the total count and divide by 3 (example).
   - 25+45+30=100 100/3=30
   - Background rate is 30 CPM.

and provide its findings in the form of a lighted silhouette and/or alarms.



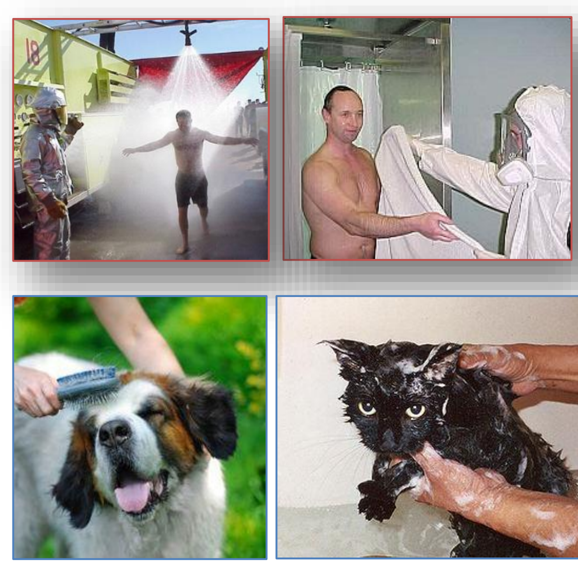
If a hand held survey meter is used the meter operator must listen to the clicking sound of the device for clues to increased levels of contamination. The meter operator holds the meter's survey probe approximately 1" from the surface being surveyed and moves the probe across the surface at a rate of approximately 1" per second. When the click rate is above background levels, the meter operator will check the face of the meter to see if it reads above the action level established by the Incident Commander: typically 300 CPM above background for processing mass casualties. Responders should focus their eyes on the survey probe and the surface while listening for changes in the CPM tone to determine if contamination is present.

<u>Decontamination</u>

Radiological decontamination for a nuclear plant emergency is designed to remove particulate contaminants from the clothing, skin, or equipment.

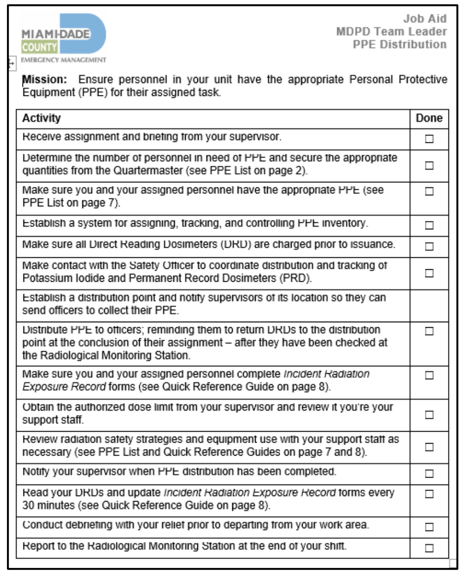
For personnel decontamination, removal of clothing frequently removes the majority of external contamination; particularly if the person is wearing long sleeves and slacks. Responders wearing the personal protective equipment mentioned previously rarely need to be decontaminated beyond external attire removal.

In instances where the skin or hair is contaminated, removal of the contaminant can be achieved by washing with soap and water. Decontamination staff should focus their efforts on directing the victim through self-decontamination and supervising to make sure they follow procedures. Decontamination should be performed from top to bottom in order to minimize leaving any contaminants behind. Whenever possible, decontamination should take into account the privacy needs of the victim.



Evacuees that bring pets to monitoring and decontaminations stations will be asked to perform decontamination on their pets. The job of the responder is to supervise decontamination and perform post-decontamination surveys of the pet. Pets must remain under the physical control of their owner at all times. Pets that show any aggressiveness may be placed under the control of Animal Services until it can be safely handled.

Chapter 4 – Job Aid Overview



MIAMI-DADE COUNTY EMERGENCY MANAGEMENT

Job Aid
MDPD Team Leader
PPE Distribution

Mission: Ensure personnel in your unit have the appropriate Personal Protective Equipment (PPE) for their assigned task.

Activity	Done
Receive assignment and briefing from your supervisor.	☐
Determine the number of personnel in need of PPE and secure the appropriate quantities from the Quartermaster (see PPE List on page 2).	☐
Make sure you and your assigned personnel have the appropriate PPE (see PPE List on page 7).	☐
Establish a system for assigning, tracking, and controlling PPE inventory.	☐
Make sure all Direct Reading Dosimeters (DRD) are charged prior to issuance.	☐
Make contact with the Safety Officer to coordinate distribution and tracking of Potassium Iodide and Permanent Record Dosimeters (PRD).	☐
Establish a distribution point and notify supervisors of its location so they can send officers to collect their PPE.	
Distribute PPE to officers; reminding them to return DRDs to the distribution point at the conclusion of their assignment – after they have been checked at the Radiological Monitoring Station.	☐
Make sure you and your assigned personnel complete *Incident Radiation Exposure Record* forms (see Quick Reference Guide on page 8).	☐
Obtain the authorized dose limit from your supervisor and review it you're your support staff.	☐
Review radiation safety strategies and equipment use with your support staff as necessary (see PPE List and Quick Reference Guides on page 7 and 8).	☐
Notify your supervisor when PPE distribution has been completed.	☐
Read your DRDs and update *Incident Radiation Exposure Record* forms every 30 minutes (see Quick Reference Guide on page 8).	☐
Conduct debriefing with your relief prior to departing from your work area.	☐
Report to the Radiological Monitoring Station at the end of your shift.	☐

Job Aids (JA) are checklist type documents intended to guide responders through the completion of a specific task or set of tasks. The JAs created by Miami-Dade Emergency Management for nuclear power emergency response are usually one but no more than two pages in length and frequently supplemented by one or more attachment. JAs may be designed for use by Team Leaders or be specific to a position within a team.

The Title and Mission Statement are at the top of the JA so the responder can quickly get an idea of the general purpose of the task or role being assigned.

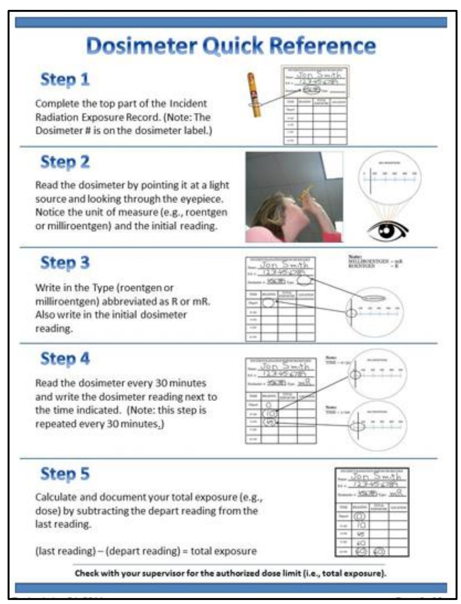
The first few rows of the JA provide guidance for obtaining information about the details of the assignment, the location where the task will be performed, and the resources typically needed to complete the task.

The rows in the middle of the JA typically provide guidance specific to the primary task to be performed.

The last few rows of the JA are associated with the closing out of the responder's assignment or shift.

References to specific attachments are included throughout the JA. The attachment reference will be included when the attachment is critical to a line item on the JA.

Attachments can take several forms but are an important part of the JA. Attachments are generally very specific and best used after being referred to it.



In the example shown here, the attachment is a quick reference on the use and documentation of dosimeter readings. It is a 5 step guide intended to accomplish a specific part of the overall job assigned to the responder.

Attachments to JAs can include:

- Maps
- Scripts for directing people
- Site plans
- Supply lists
- Process charts
- Sample forms
- Station setup plans

- Other products that help support the use of the JA

Summation

Emergency responders are a community's first line of defense in time of disaster. This student manual is intended to help bridge the gap between facts and perceptions, and provide emergency responders with the knowledge they need to safely do their job in the unlikely event of a nuclear power plant emergency.

Every responder knows that additional risks come with the job, but they rely on their equipment and training to minimize and manage that risk so it is within acceptable limits. Nonetheless, thousands of responders are injured or killed annually due to falls, collisions, physical attacks, and more. The radiation protection concepts and radiation safety strategies contained in this manual and corresponding training will help responders understand where radiation lies along the hazard spectrum so they can focus their attention on the hazards that pose the greatest threat.

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[3] RT Question More, *Radiation Level in Tuna Off Oregon Coast Tripled after Fukushima Disaster*, http://rt.com/usa/155692-oregon-tuna-radiation-tripled-fukushima/

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