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Emergency Preparedness and Response for Research Reactors
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RADIOLOGICAL EMERGENCY AT RESEARCH REACTOR

**Irradiated tellurium dioxide case rupture inside the reactor pool
irradiation channel**

EXERCISE MANUAL



INTERNATIONAL ATOMIC ENERGY AGENCY

IAEA

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1 GENERAL INFORMATION AND GUIDE FOR PARTICIPANTS

1.1 Introduction

This manual contains information for the participants (Section 1) and for the controllers (Sections 2 and 3) of the tabletop exercise. Section 1 contains information on the background and situation for the scenario; **it should be distributed to all participants**, who should familiarize themselves with its content prior to the exercise. Sections 2 and 3 contain the scenario and exercise team instructions; **it should be distributed ONLY to the controllers and exercise organizers**.

1.2 Aims and Objectives

The aim of this exercise is to put into practice the theoretical lessons learned during a course on emergency planning for research reactors. The specific objectives are to:

- i. familiarize the participants with the practical aspects of emergency assessment and decision-making;
- ii. allow the participants to exercise the concepts learned in a course on emergency planning and procedures
- iii. emphasize the need for emergency planning.

1.3 General Conduct of the Exercise

This is a tabletop exercise. The participants will be divided into groups with distinct roles and responsibilities covering on-site and off-site response. Inputs will be presented to each group and the participants will be asked to respond while considering all aspects of the response and all possible resources at their disposal.

Each group will designate a leader. The leader will lead the discussions and make a final decision on the response actions required after each input

1.4 References Required

TECDOC 955
TECDOC 1162

1.5 Context

The scenario takes place at a research reactor facility.

The reactor facility is located inside a concrete building with dimensions 40 × 40 m and 30 m height hall, named the main reactor hall. The building cannot be treated as containment but it is a semi-tied confinement.

In the central part, inside the hall, a heavy concrete reactor block has been located. The block is a water filled pool divided into two parts by a water gate: the first one is an 8 m deep the reactor core location and the second is a 6 m deep storage and operational pool. On one side, outside the storage pool, there are four hot cells each equipped with pair of tele-manipulators master-slave type and with the protected windows.

The reactor has also three horizontal beam tubes for experimentation in neutron physics. Inside the reactor hall there is a 10 Ton crane.

The reactor core consists of an MTR (Material Testing Reactor), 60 cm high plate type, nuclear fuel and 20 cm side beryllium reflector in which there are vertical channels (vertical holes) to put into aluminium irradiation cases with target materials to irradiate them for isotope production and for experimentation. The reactor is operated at 10 MW thermal power.

The main reactor hall is ventilated (6 air exchanges per hour) and some 0.8 milibar under-pressure in comparison to the outside atmospheric pressure.

There are two entrance/exits with the vent-sluices one to personnel the second to tracks. The main reactor hall is equipped with the radiation protection systems consisting of a gamma dose-rate meters, with acoustic signals thresholds on 25 µSv/h and air control (gases and aerosols). Outside the main reactor hall there is a reactor control room with a window to the hall.

1.6 Background to the simulated accident

Rupture of an irradiated tellurium dioxide case poses a risk to the reactor staff and to the environment in the vicinity: the area and the staff can become contaminated with I-131 and I-131 intake can become a serious problem.

Such an incident is taken as an example of potential radiological emergency at research reactor facility.

This emergency response exercise on an irradiated tellurium dioxide case rupture during irradiation incident will be conducted as a field exercise, which means that the players will have to implement their procedures as in the real case.

1.7 Exercise specifications

1.7.1 Exercise objectives

The exercise objectives are to verify the ability of the exercise emergency response organization to perform the following response functions:

Objective	Description
1	Activate promptly
2	Take immediate actions to protect on-site personnel
3	Take appropriate mitigating actions
4	Assess the off-site impacts
5	Make recommendations to and communicate effectively with off-site authorities
6	Make appropriate decisions regarding media communications

1.7.2 Exercise scope

The exercise will last 3-4 hours. It will involve the participation of all workshop attendees. No outside organisation will participate.

1.8 Exercise organisation

The players will be divided into four groups with responsibilities as described in Table 1.

Table 1: Exercise group responsibilities

Group	Responsibilities
Operators	<ul style="list-style-type: none"> • mitigation actions • initial on-site and outside surveys, until relieved by the specialists • source recovery • recovery planning • emergency workers protection
Managers	<ul style="list-style-type: none"> • decisions • co-ordination of the group • overall accountable for the effectiveness of the emergency response • media communications • co-ordination with off-site group
Specialists	<ul style="list-style-type: none"> • assessment of the potential on-site and off-site consequences • survey strategy and actions • recommendations to managers for the protection of on-site and off-site staff • radiation protection support for emergency workers
Off-site	<ul style="list-style-type: none"> • assessment of the on-site information • decisions on off-site protective actions • media communications • public health

.Each group should assign functions and responsibilities to its members.

1.9 Exercise management

The exercise will be conducted by an exercise team that consists of controllers and evaluators.

Exercise controllers are responsible for ensuring that the players receive appropriate inputs in accordance with the exercise scenario and objectives. They are allowed to interact with the players to the extent required to keep the exercise running smoothly. The chief controller is responsible for the co-ordination of all controllers and is the only one authorised to start, interrupt or stop the exercise.

Evaluators are responsible for recording facts during the exercise and for carrying out a performance evaluation of the organisation against the exercise objectives. This evaluation will be results-oriented, i.e. will focus on the achievements rather than on the procedures. Nevertheless, exercise players are required to apply standard procedures to the best of their ability. Deviations from the procedures may be acceptable and appropriate provided that the circumstances justify them.

1.10 Exercise rules

All players must demonstrate a professional attitude throughout the exercise. This is particularly important for personnel who may come into contact or be observed by members of the public.

As for any exercise, some of the data needs to be simulated. It is the role of the controllers to provide the simulated data. However, players must well understand this information, i.e. the simulated data will only be provided to the players if appropriate actions are taken to obtain the data (e.g. contamination data will not be provided if the instrument is turned off). Players must ensure that the appropriate controller is aware of the actions taken.

1.11 Safety

Safety is paramount. All players, evaluators and controllers are responsible to ensure that actions taken do not pose real safety concerns. Players shall not deviate from normal safety procedures under any circumstances. If a play event causes safety concerns to the players, they must notify the appropriate controller. The exercise may then be allowed to proceed by simulating response actions, may be interrupted temporarily by the controller or may be stopped. In case of a real emergency, players must immediately notify the appropriate controller. The chief controller will then decide how to proceed with the overall conduct of the exercise.

1.12 Simulation

The controllers will simulate outside regulatory organisations. If you need to contact or get information from an outside agency, contact the simulation cell.

1.13 Communications

Communications between players will take place through standard communication channels unless otherwise directed by the controllers. Due to the risk of those communications being inadvertently intercepted by members of the public or the media, and to avoid the perception that a real emergency is taking place, all communications between players must start with **“THIS IS AN EXERCISE”**.

1.14 Media

The media will be simulated for this exercise. In case of real media questions, refer the questions to the controllers.

1.15 Exercise briefing and debriefing

An exercise briefing will be held in the morning at the day of the exercise. An exercise debriefing (exercise evaluation) will be held after the exercise. All players, controllers and evaluators must attend.

1.16 Exercise contact list

The contact list to be used during the exercise can be found in the attachment. It includes the following persons and organizations:

- Managers
- Operators
- Specialists
- Off-site
- Media
- Medical clinic
- Simulation cell

2 EXERCISE TEAM INSTRUCTIONS

2.1 Exercise organisation

The exercise team members and assignments are shown in Table 2. In this case, to keep the exercise organization to a reasonable size, the controllers will also act as evaluators.

Table 2: Exercise team

Position	Assigned to
Chief controller	
Manager group controller-evaluator	
Operator group controller-evaluator	
Specialist group controller-evaluator	
Off-site group controller-evaluator	
Simulation cell	
Video operator	

Badges will be prepared for all positions. See Attachment for the actual names during the exercise.

2.2 Roles and responsibilities

The chief controller is responsible for the overall conduct of the exercise.

The controllers are responsible for ensuring that the scenario inputs are provided in accordance with the exercise scenario, for ensuring that the scenario stays on track and for monitoring the safety of the actions taken. In case of safety concerns, the controllers will stop the exercise, notify the chief controller and wait for safe conditions to be re-established before resuming.

The evaluators are responsible for recording facts during the exercise and assessing the performance of the players against the exercise objectives after the exercise.

The video operator is responsible to prepare video materials of the exercise to be presented at the exercise evaluation session.

2.3 Exercise schedule

Exercise will be conducted on October 25, 2001

Briefing:	1100
Exercise start time:	1300
Exercise end time:	1600
Exercise debrief:	1630

2.4 Instructions for chief controller

Instructions in [...] are only for a field exercise and will not be required if this exercise is conducted as a tabletop.

Day before the exercise

- Assign all the players to the various groups.
- Assign them separate rooms for the exercise.
- Review the scenario with the controllers and assign roles (see Table 2).
- Make required adjustments to the times on the injects.
- [Identify the radiation protection measurement instruments required and make sure they are available for the exercise.]
- [Identify the location where the damaged tellurium case will be located.]
- Prepare several copies of the following worksheets for the participants:

Group	Forms required
Managers	TECDOC 1162 A1, A2, B1
Operators	TECDOC 1162 D1
Specialists	TECDOC 1162 A1, B1
Off-site	TECDOC 1162 A1, A2, B1

- [Assign a role to the controllers for the demonstration preceding the exercise: one controller for the management group and one controller for the radiological assessor group.]
- Complete the exercise contact list (see attachment at the end of this document)
- Ensure that all equipment is available for the next day (see logistics list in section 2.6)

[Demonstration before the exercise (1 hour maximum) NOT REQUIRED FOR TABLETOP

Controllers take each group and go through the main procedures for the response. To keep this demonstration under one hour, it may be necessary to summarise the procedures and NOT go into details.

Management group controller

- Go through TECDOC 1162 procedure B1 (Accident with radiation source)
- Take the group to a simulated hot cell
- Go through TECDOC 1162 procedure C1 (On-scene controller response)
- Go through TECDOC 1162 procedure C6 (Personal protection guide)

Radiological assessor group controller

- Go through TECDOC 1162 procedure D1 (Source removal or radioactive material)
- Go through TECDOC 1092 procedure A0 (Radiation instrument quality control check)
- Go through TECDOC 1092 procedure A8a (Personal dosimetry, external)
- Go through TECDOC 1162 C1 (On-scene controller response), to be used in case they are the first on the scene
- Go through TECDOC 1162 A5, steps 1 to 6 (Surface contamination survey)
- Go through TECDOC 1092 procedure A8c (Personal contamination monitoring)]

Briefing and preparation

- ❑ Give the PowerPoint presentation for this module. Then, give the team at least 30 (preferably 45) minutes to get organised.
- ❑ Distribute the exercise contact list
- ❑ [One controller gets the sources and places them at the selected locations.]
- ❑ One controller ensures that all the required equipment, instruments, dosimeters, containers, etc. are available to the participants.

During the exercise

- ❑ Synchronize the controllers' times. Inform all controllers of the time T₀, from which the inject times will be calculated.
- ❑ Start the exercise only when you feel that the participants are about ready. Do not delay too much.
- ❑ Make sure that all controllers know the exact start time and, if required, make last minute adjustment to the exercise timing.

2.5 Instructions for controllers-evaluators during the exercise

Prior to the exercise

- ❑ Review the scenario timeline and objectives.
- ❑ Review the applicable evaluation criteria and checklist.
- ❑ Think about what player's actions are required to demonstrate their performance objectives.

During the exercise

Control

- ❑ Arrive at the assigned location prior to the beginning of the exercise.
- ❑ Identify yourself as controller-evaluator to the organisation being evaluated at the start of the exercise.
- ❑ Confirm you have reached an exercise participant before delivering scripted messages.
- ❑ Begin each message with "THIS IS EXERCISE" and the name of the organisation/individual being simulated.
- ❑ Begin and end hard copy messages with "EXERCISE, EXERCISE, EXERCISE".
- ❑ Closely follow the instructions in the Master Event List.
- ❑ If the scenario gets off track, immediately report the problem to the chief controller.
- ❑ Do not provide additional information unless requested by the organisation being evaluated, and then, only within the limits of the scenario.
- ❑ Do not accelerate the exercise by providing information ahead of schedule, unless directed by the chief controller.
- ❑ Immediately halt an activity that is unsafe and report the action to the chief controller.
- ❑ Report to and ask permission from the chief controller to terminate the exercise when a real emergency occurs; and
- ❑ Monitor exercise play and make minor adjustments only when necessary to keep the exercise on track or to maintain a safe environment.

Special considerations for the operators group

The operators group will be quite busy in the beginning of the exercise and will progressively have less and less to do. Initially, they will be kept busy with injects and discussions about mitigation and remedial actions. However, should they finish early, after having extensively discussed mitigation, remediation and emergency workers protection, and after having developed a clear plan for these actions, then the controller will inform the chief controller, who may ask that group to report to the specialist group for support. If this is considered, the chief controller must inform the specialist group controller before.

Evaluation

- Record facts, not impressions.
- Identify specific occurrences with time, date, location and organisation involved.
- Record occurrence of repetitive actions.
- Record the time of major scenario events and actions.
- Listen to all communication that affects your area of evaluation.
- Ask questions only for clarification, if absolutely necessary. Do not become involved in discussions with players or other evaluators or controllers;
- Observe but do not correct. Let the players solve the problem; however, ensure they understand the data they are given.
- Do not change the scenario or give spontaneous data.

After the exercise

- Collect all forms and records.
- Make sure the place is left in proper order.
- Review each exercise objective with all evaluators present.
- Note strengths as well as weaknesses and substantiate your judgement.
- Prepare a short briefing for the players.

2.6 Logistics

The following equipment will be required (only those items in **bold** are required for the tabletop):

- General purpose survey meters (2)
- Contamination meters (2)
- Al-27+Na-24 powder source (Al powder activated in the reactor)
- TLDs
- Direct reading dosimeters for all members of the Radiological Assessor Group
- Protective clothing
- Shielded container
- Tongs
- Tissue
- Alcohol
- Small plastic bags
- Radioactive waste container
- Labels and warning signs
- Rope
- Log books**
- Communications for the participants (telephone or radios)**
- Communication for the controllers**
- Communications simulation cell**

3 SCENARIO

3.1 Narrative

During the irradiation of a TeO₂ packages in an aluminium irradiation cases, one case was overfilled and closed by cold welding. The case contained 180 g of TO₂ and was irradiated in a reactor channel where the thermal neutron flux density was 2×10^{14} n/cm² sec and the heat generation was 5 W/g of TO₂

After a 200 hour-irradiation period, just before reactor shut down, the ambient dose rate above the reactor increase sharply to about 1 mSv/h, causing an alarm and the evacuation of three persons who were in the reactor building. One of the technicians slips as he runs out and suffers a serious head injury. Two of the three are slightly contaminated.

The containment is isolated. However, there has been a very small release to the environment.

3.2 Start state

Reactor operating power	20 MW th
Average irradiation channel flux	2×10^{14} n/cm ² .sec
Maximum irradiation channel flux	3×10^{14} n/cm ² .sec
Average irradiation channel heat generation	5 W/g TO ₂
Irradiation in progress	Yes
Package irradiated	180 g TO ₂
Irradiation time	200 h
Other factors	The minister of science and technology is expected for a visit at 1100 with three journalists and his media staff. He is supposed to announce extra funding for the institute and to praise the contribution of the staff to the overall safety management of nuclear technology in the country.

3.3 Master events list (MEL)

(Adjust the times as required. Reflect all timing changes in the inject forms in the following section.)

Injunct #	Time from exercise start (h:mm)	Input	To	Discussion items
0	-0:10	Start state. Give a summary of operations at the time.	All	
10	0:00	High radiation alarm in the reactor building, increasing.	Operators	<input type="checkbox"/> Automatic actions <input type="checkbox"/> Notification <input type="checkbox"/> Reactor status: shut down or keep operating?
20	after action taken	Reactor shutdown and containment isolated.	Operators	<input type="checkbox"/> What is your initial assessment? <input type="checkbox"/> How can you find out what happened? <input type="checkbox"/> What are the priorities?
30	0:10	One operator and two technicians evacuate the reactor building. One of the technicians falls and hits his head. He is seriously injured and unconscious.	Operators	<input type="checkbox"/> What contamination control measures should be in place? <input type="checkbox"/> How can you be sure that everyone has evacuated the building?
40	0:15	Both technicians are found to be contaminated by RP staff.	Operators	<input type="checkbox"/> Contamination control <input type="checkbox"/> What are the contaminated casualty response procedures?
50	0:20	The dosimeters for the three persons who evacuated the reactor building indicate 50, 40 and 30 microSv.	Operators	<input type="checkbox"/> What is the significance of these readings? <input type="checkbox"/> What would be their committed dose? <input type="checkbox"/> You can analyze the contamination to find out what was released
60	0:30	The minister's executive assistant arrives early, without journalists, to prepare the visit.	Managers	<input type="checkbox"/> How do you deal with outside interference? <input type="checkbox"/> How can you take advantage of this person's presence at the institute?
70	0:35	Small contamination measured outside the reactor building, near the main entrance	Operators	<input type="checkbox"/> What is the significance of this information? <input type="checkbox"/> Could this indicate leakage from the containment? <input type="checkbox"/> How do you deal with a possible spread of contamination? <input type="checkbox"/> How can you confirm if this is a release or just contamination propagation? <input type="checkbox"/> What do you tell the managers?
80	0:40	Ambulance arrives but ambulance staff not prepared	Managers	<input type="checkbox"/> Importance of involving outside services in the planning

Inject #	Time from exercise start (h:mm)	Input	To	Discussion items
		to deal with a contaminated casualty. They request assistance and delay transport to the hospital.		<ul style="list-style-type: none"> <input type="checkbox"/> process <input type="checkbox"/> If there was a fire, could this also be a problem with the fire fighters?
90	0:50	The hospital refuses to admit the patient because he is contaminated.	Managers	<ul style="list-style-type: none"> <input type="checkbox"/> Importance of involving outside services in the planning process <input type="checkbox"/> What can you do if there is no other hospital with the capability to treat this patient?
100	0:50	The off-site authorities are informed that there is a contaminated patient at the hospital.	Off-site	<ul style="list-style-type: none"> <input type="checkbox"/> Is this the first you hear of an accident at the institute? If so, what should you do?
110	1:00	Several personnel from the institute hear about the incident and are worried that they may have been exposed by the release from the reactor. Ten people report to the on-site clinic with various symptoms including fatigue and slight nausea	Managers	<ul style="list-style-type: none"> <input type="checkbox"/> Psychosocial dimension of radiological emergencies. <input type="checkbox"/> Importance of communicating with the staff early on <input type="checkbox"/> Medical screening protocols
120	1:15	Media call and want to know if there is a risk to the public.	Managers	<ul style="list-style-type: none"> <input type="checkbox"/> Risk perception issues <input type="checkbox"/> Rumour control
130	1:15	Slightly elevated ambient radiation levels are detected outside the facility, just at the reactor building outside wall (20 microSv/h).	Specialists	<ul style="list-style-type: none"> <input type="checkbox"/> Does this mean there is a release? <input type="checkbox"/> How do you confirm if there is or not a release? <input type="checkbox"/> What do you tell the managers <input type="checkbox"/> There should be some cooperation with the operators
140	1:30	Air sample taken at 100 m downwind shows very small radioactivity in air using activated charcoal filter (app. 100 Bq/m3).	Specialists	<ul style="list-style-type: none"> <input type="checkbox"/> Is this significant? <input type="checkbox"/> If the assessment is that there is leakage, how do you communicate this? <input type="checkbox"/> Is there a need for public protective actions?
150	1:35	Surveyor reports that a journalist approached him.	Specialists	<ul style="list-style-type: none"> <input type="checkbox"/> Media guidelines for emergency workers. What should an emergency worker do when approached by the media? <input type="checkbox"/> Do you inform someone?
160	1:40	Media call and ask if there is contamination in the environment.	Managers	<ul style="list-style-type: none"> <input type="checkbox"/> Is this true? <input type="checkbox"/> How do you explain to the public that there may be radioactivity in the environment but that this is not necessarily dangerous?

Inject #	Time from exercise start (h:mm)	Input	To	Discussion items
				<ul style="list-style-type: none"> <input type="checkbox"/> What is the worst case scenario in the present situation? <input type="checkbox"/> Do an assessment of the potential worst case off-site consequences
170	2:00	Media reports that there may be small quantities of radioactivity released to the environment. Media report that there has been a nuclear reactor accident.	Managers	<ul style="list-style-type: none"> <input type="checkbox"/> Rumour control. This is not a reactor accident.
180	2:00	Family of injured worker wants to know where he is and what they have done to him. They also want to know if it is safe for him to return home after (they are afraid of radiation and contamination and all that stuff).	Operators	<ul style="list-style-type: none"> <input type="checkbox"/> Importance of notification of next of kin. <input type="checkbox"/> Importance of following up on emergency casualties. As managers, you carry the responsibility for what happens to your staff.
190	2:10	The hospital finally informs the off-site authorities that it will accept the patient on the conditions that 1) a senior RP staff is present, 2) dosimeters are provided to the hospital staff; 3) the institute provides staff to set up the emergency area; 4) the institute is prepared to decontaminate the patient; 5) the institute decontaminates the hospital after; 6) the institute agrees to provide financial compensation to the medical personnel that will be exposed; and 7) the institute agree to take care of all the contaminated waste.	Off-site	<ul style="list-style-type: none"> <input type="checkbox"/> Is this acceptable? <input type="checkbox"/> Would you negotiate? <input type="checkbox"/> Develop an action plan to implement these conditions
200	2:20	Water treatment plant wants to know if they should shut down water intakes into river that is close to the institute.	Off-site	<ul style="list-style-type: none"> <input type="checkbox"/> What is the actual risk to the water supply? <input type="checkbox"/> How can you find out about this risk? <input type="checkbox"/> Should the facility's expert assistance be sought? <input type="checkbox"/> If so, how?
210	2:25	Medical officer of health wants to know about Cs contamination and need for food interdiction.	Off-site	<ul style="list-style-type: none"> <input type="checkbox"/> There is confusion about the nature of the accident. How do you control this confusion and prevent rumours?
220	2:30	People living within 500 m of the facility spontaneously evacuate.	Off-site	<ul style="list-style-type: none"> <input type="checkbox"/> Could this have been foreseen? <input type="checkbox"/> Is this a problem? <input type="checkbox"/> What are the potential implications? (Loss of control,

Injct #	Time from exercise start (h:mm)	Input	To	Discussion items
				emergency becomes a crisis, rumours, discrepancies in the message to the public, i.e. authorities say it is safe but people are leaving, so it must be dangerous.
230	2:35	Medical officer of health issues a precautionary directive for people living within 1 km of the facility to shelter and a food embargo within 5 km.	Off-site Managers	<ul style="list-style-type: none"> <input type="checkbox"/> Importance of coordinating the various authorities to avoid mixed messages and confusion. <input type="checkbox"/> How can you avoid this in the future?
240	2:45	Media report about an IAEA/WHO meeting that highlighted the vulnerability of children to radioiodine and stated that stable iodine tablets were the most effective quick method of protecting children.	ALL	<ul style="list-style-type: none"> <input type="checkbox"/> Should there be a stable iodine distribution plan? <input type="checkbox"/> What could this statement lead to? (Panic, rumours, anger at the authorities, who had not provided such a simple protective action means.
250	2:50	Pharmacies get overwhelmed with people who want stable iodine tablets.	Management	<ul style="list-style-type: none"> <input type="checkbox"/> What actions must you take to control this issue in the future?
260	3:00	ENDEX	ALL	

4 EXERCISE INJECTS

Inject #	0	Inject time	-0:00
Injected by	Chief controller		
Injection method	Written		

MESSAGE

Reactor	Pool
Reactor operating power	20 MW th
Average irradiation channel flux	2×10^{14} n/cm ² .sec
Maximum irradiation channel flux	3×10^{14} n/cm ² .sec
Average irradiation channel heat generation	5 W/g TO ₂
Irradiation in progress	Yes
Package irradiated	180 g TO ₂
Irradiation time	200 h
Other factors	The minister of science and technology is expected for a visit at 1100 with three journalists and his media staff. He is supposed to announce extra funding for the institute and to praise the contribution of the staff to the overall safety management of nuclear technology in the country.

Inject #	10	Inject time	0:00
Injected by	Operators controller		
Injection method	Written		

**HIGH RADIATION ALARM IN THE
CONTAINMENT**

**AMBIENT RADIATION IN REACTOR
BUILDING**

0.5 mSv/h

RISING

Inject #	20	Inject time	After appropriate actions taken
Injected by	Operators controller		
Injection method	Written		

MESSAGE

The reactor has been successfully shut down. Containment isolation indicators show containment isolation complete.

Inject #	30	Inject time	0:10
Injected by	Operators controller		
Injection method	Written		

MESSAGE

From: Radiation protection technician
To: Operators

Three people evacuated the reactor building: one operator and two technicians. One of the technicians, Rob Blue, fell and has a concussion. He is unconscious. We better call an ambulance. I don't think that there is anybody else in the building. But I can go and check.

Inject #	40	Inject time	0:15
Injected by	Operators controller		
Injection method	Written		

MESSAGE

From: Radiation protection technician
To: Operators

Rob Blue and the other technician, Raf Green, are both contaminated. I am getting readings of about 20 times background on their shoes and clothes. That's a problem for the ambulance. I hope someone told them about this.

Inject #	50	Inject time	0:20
Injected by	Operators controller		
Injection method	Written		

MESSAGE

From: Radiation protection technician
To: Operators

Dosimeter readings of people who evacuated the containment building:

Rob Blue 0.05 mSv
Raf Green 0.04 mSv
Rick White 0.03 mSv

Inject #	60	Inject time	0:30
Injected by	Managers controller		
Injection method	Written		

MESSAGE

The minister's executive assistant just arrived and wants to meet with the manager to discuss the minister's visit later today.

Inject #	70	Inject time	0:35
Injected by	Operators controller		
Injection method	Written		

MESSAGE

From: Radiation protection technician
To: Operators

We have found some slight contamination outside the reactor building. Our readings are about 100 time background on the contamination meter. This could simply be contamination from the people who evacuated the building. We are checking elsewhere.

Inject #	80	Inject time	0:40
Injected by	Managers controller		
Injection method	Written		

MESSAGE

From: Security personnel
To: Managers

There's an ambulance here to pick up the casualty, but they heard that there was radioactivity involved and they refuse to enter the facility, or take the patient. They say that they are not equipped or trained to deal with radioactive patients.

Inject #	90	Inject time	0:50
Injected by	Managers controller		
Injection method			

MESSAGE

From: Hospital
To: Managers

Hi, this is Doctor Doolittle from the general hospital. I hear that you are sending us a contaminated casualty. Well, I have a bit of a problem with this. We don't have the right equipment or the right training to deal with radioactivity. My staff refuses to treat that patient because they are afraid that they will get irradiated. I am afraid that you are going to have to try some other hospital.

Inject #	100	Inject time	0:50
Injected by	Off-site controller		
Injection method	Written		

MESSAGE

From: Hospital
To: Off-site authorities

This is to inform you that the institute wants to send us a radioactively contaminated patient and that are not in a position to treat this patient. Looks like they had a bad nuclear accident there and I believe that there may be more coming this way. We are not able to deal with such accidents.

Inject #	110	Inject time	1:00
Injected by	Managers controller		
Injection method	Written		

MESSAGE

From: Medical clinic of the institute
To: Managers

We are receiving a lot of personnel who claim that they have been affected by the radiation accident. I wish you had told us before. The clinic is overwhelmed. We now have ten people who claim to be affected by the radiation. Some of them are quite pale, low pulse and blood pressure and I have 2 or 3 who started vomiting. I can't treat them here so I am going to have to send them to the hospital. However, when I do that, I know that they will most likely refuse to treat them before they are afraid of radiation there. Please provide instructions.

Inject #	120	Inject time	1:15
Injected by	Simulation cell		
Injection method	Verbal by phone		

MESSAGE

From: Adrian Pestucola, Daily newspaper
To: Managers

The Daily Newspaper would like to have information on the accident at the nuclear institute.

INSTRUCTIONS

Act as a real journalist. Do not forget to start by saying “Exercise”. Keep the manager on the line for about 5 minutes. Ask questions about the accident itself, the injuries, the risk to the public, how can this radioactivity affect the public, etc.

Inject #	130	Inject time	1:15
Injected by	Specialists controller		
Injection method	Written		

MESSAGE

From: Surveyor
 To: Specialists

Measurement results:

<i>Location</i>	<i>Measurement (microSv/h)</i>
<i>Outside wall, 1 m from the ground</i>	<i>3</i>
<i>Downwind, 50 m</i>	<i>0.22</i>
<i>Downwind, 100 m</i>	<i>0.20</i>
<i>Upwind, 50 m</i>	<i>0.21</i>

Inject #	140	Inject time	1:30
Injected by	Specialists controller		
Injection method	Written		

MESSAGE

From: Surveyor
 To: Specialists

Air sampling results (only provide if the specialists asked for them).

Location	Measurement (cps)
<i>Outside wall, 1 m from the ground</i>	<i>50</i>
<i>Downwind, 50 m</i>	<i>10</i>
<i>Downwind, 100 m</i>	<i>15</i>
<i>Upwind, 50 m</i>	<i>8</i>

Normal background: 8 cps

Inject #	150	Inject time	1:35
Injected by	Specialists controller		
Injection method	Written		

MESSAGE

From: Surveyor
To: Specialists

A journalist named Gary Brown met me when I was doing my measurements and asked me what I was doing. He wanted to know what was happening. I told him nothing. I told him that we do this all the time. I was not sure what I could and could not tell him. He is still out there. I can see him talking on his mobile phone. What should I do?

Inject #	160	Inject time	1:40
Injected by	Simulation cell		
Injection method	Verbal by phone		

MESSAGE

From: Gary Brown, Radio News
To: Manager

I understand that you are experiencing a nuclear accident at your facility and that there is a release to the environment.

- *Is it true?*
- *Why have you not told the public?*
- *What is the risk?*
- *How far will the contamination be?*
- *What should we do to protect ourselves?*

INSTRUCTIONS

Keep the manager on the phone for about 5 minutes.

Inject #	170	Inject time	2:00
Injected by	Managers controller		
Injection method	Written		

This was just heard on the radio news:

We interrupt this program to bring you some breaking news. Radio News has just learned that there has been a major nuclear accident at the nuclear research institute. The details are still sketchy, but it appears that there has been a malfunction with the nuclear reactor and that some quantities of radioactivity have escaped. At least two persons are in critical condition and the hospital has so far been unable to help. Although not confirmed by the managers of the institute, it would appear that the radioactive contamination is outside the building and may be affecting the areas in the near vicinity of the facility. Emergency teams are monitoring the streets around the site with radiation detectors and we have been told that radioactivity is present in the air and on the ground. Public authorities have so far not issued any directives to the public for their protection. However, Radio News has also learned that radioactivity, even in very small quantities, is a carcinogenic agent and that exposure to even low levels can increase the risk of radiation illness and cancer.

Radio News will continue to update you as more information becomes available.

Inject #	180	Inject time	2:00
Injected by	Operators controller		
Injection method	Written		

MESSAGE

From: Rob Blue's wife
To: Operator

Rob Blue's wife has just heard the news about the accident and can't reach her husband. She is an old friend and she is asking you what is going on. Is he part of the injuries that the radio has talked about?

Inject #	190	Inject time	2:10
Injected by	Off-site controller		
Injection method	Written		

MESSAGE

From: Hospital
To: Managers

The hospital finally informs the off-site authorities that it will accept the patient on the conditions that 1) a senior RP staff is present, 2) dosimeters are provided to the hospital staff; 3) the institute provides staff to set up the emergency area; 4) the institute is prepared to decontaminate the patient; 5) the institute decontaminates the hospital after; 6) the institute agrees to provide financial compensation to the medical personnel that will be exposed; and 7) the institute agree to take care of all the contaminated waste.

Inject #	200	Inject time	2:20
Injected by	Off-site controller		
Injection method	Written		

MESSAGE

From: City water treatment plant
To: Off-site authorities

The water treatment plant would like to know if it is necessary to shut off the intake of water from a river that is nearby the institute.

Inject #	210	Inject time	2:25
Injected by	Off-site controller		
Injection method	Written		

MESSAGE

From: Medical officer of health
To: Off-site authorities

The medical officer of health want to know:

- *How bad is the contamination?*
- *Is there radioactive caesium?*
- *If so, that means that the food supply is at risk.*

Furthermore, the medical officer of health is quite concerned about the public health and would like to recommend that the public be sheltered, just in case, or even evacuated unless someone can make a convincing case that there is no risk. The problem right now is that no one seems to know exactly how much caesium and other radioactive products are in the environment. Unless we do something, we are going to repeat a Tokaimura right in our neighbourhood.

Inject #	220	Inject time	2:35
Injected by	Off-site controller		
Injection method	Written		

MESSAGE

From: Local police
To: Off-site authorities

It looks like people are leaving their houses in a radius of about 500-600 m from the institute. We have some small traffic problems. Nothing serious. However, I wonder if we should block the roads?

Inject #	230	Inject time	2:35
Injected by	Off-site controller AND managers controller		
Injection method	Written		

MESSAGE

Latest news from Radio News:

The medical officer of health, interviewed a few minutes ago, gave a warning that, unless something was done quickly, the health consequences could be serious. He informed us that he was going to recommend a full evacuation within a 1 km radius of the institute.

Inject #	240	Inject time	2:45
Injected by	All controllers		
Injection method	Written		

MESSAGE

From Radio News...

Radio News is continuing its investigation of the accident at the nuclear research institute. Contrary to earlier reports, it now appears that the radiation accident was not caused by a malfunction of the reactor, but was rather the result of mishandling of nuclear material that was purposely introduced in the reactor. This material, called iodine, is a highly radioactive substance that, when exposed to the air, vapourizes into the atmosphere. Radio News has heard that this radioactive iodine is highly toxic, particularly for children. In a recent conference of the World Health Organization and the IAEA, the international nuclear watchdog, international experts have agreed that children exposed to radioactive iodine have a significant chance of developing cancer and that the only effective protection is the administration of something called iodine prophylaxis. This iodine prophylaxis is usually available in small pills from the pharmacy. Countries with nuclear power have stockpiles of these pills available for just such a situation. However, the local authorities admit to not having such stockpiles in this country. The medical officer of health, who earlier recommended that people living near the institute should evacuate, has informed us that these pills can probably be found from the local pharmacies. There is no word from the authorities yet on whether iodine prophylaxis pills will be distributed to children or not.

Inject #	250	Inject time	2:50
Injected by	Off-site controller		
Injection method	Written		

MESSAGE

From: Media office
To: Off-site authorities

We have been informed that the pharmacies have been swamped with people who want to get these iodine pills. This is starting to be a problem as people are demanding these pills and pharmacies do not have enough or cannot give them out without prescription.

Inject #	260	Inject time	3:00
Injected by	All controllers		
Injection method	Verbal		

END OF THE EXERCISE

5 EXERCISE DATA

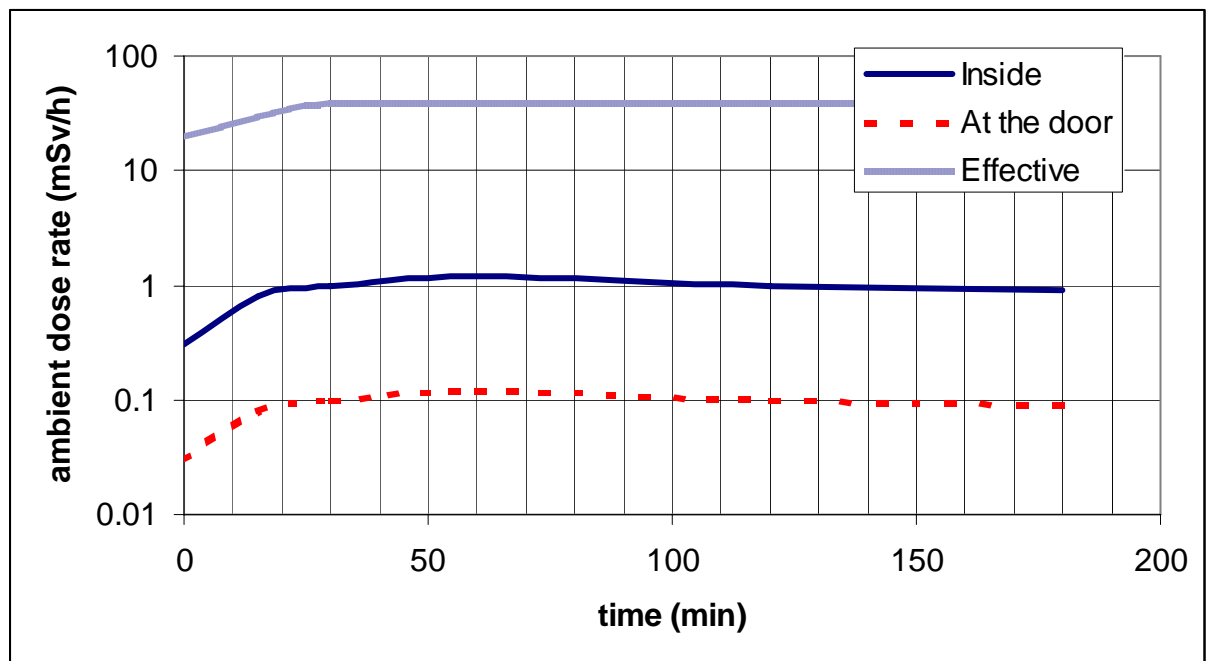
5.1 Source data

I-131 beta-gamma radioactive, generated in the reactor neutron irradiation from tellurium dioxide powder: $\text{Te-130} (n,\gamma) \text{Te-131} \rightarrow \beta^- T_{1/2} 30 \text{ min} \rightarrow \text{I-131} \rightarrow \beta^- T_{1/2} 8 \text{ days}$
Opened source, different chemical forms, mainly aerosol.

180 g of TeO_2 .

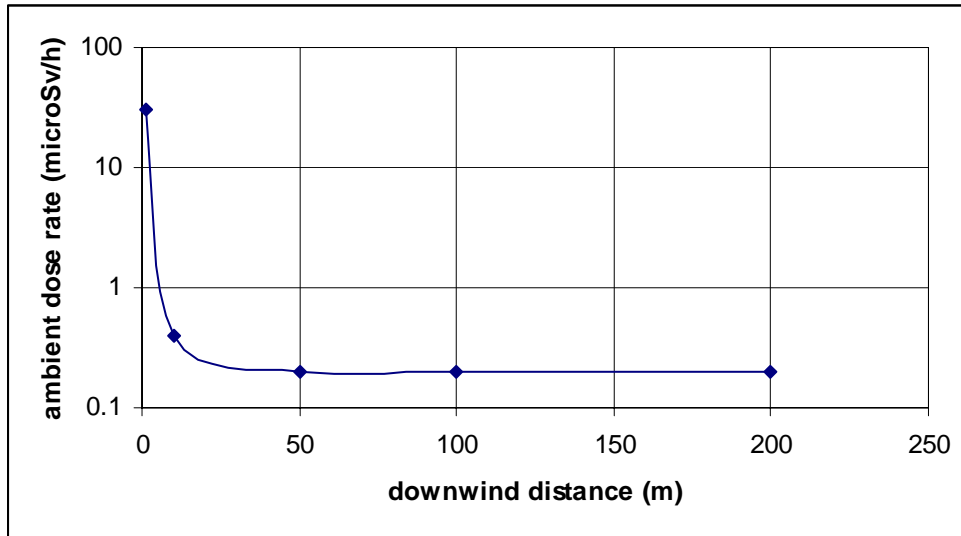
The aluminium case with TeO_2 powder had completely failed.. About 0.5 TBq (5×10^{11} Bq, 15 Ci) of I-131 have been released to the reactor pool and later about 0.16 TBq (5 Ci) to the main reactor hall.

5.2 Ambient dose rate in the facility

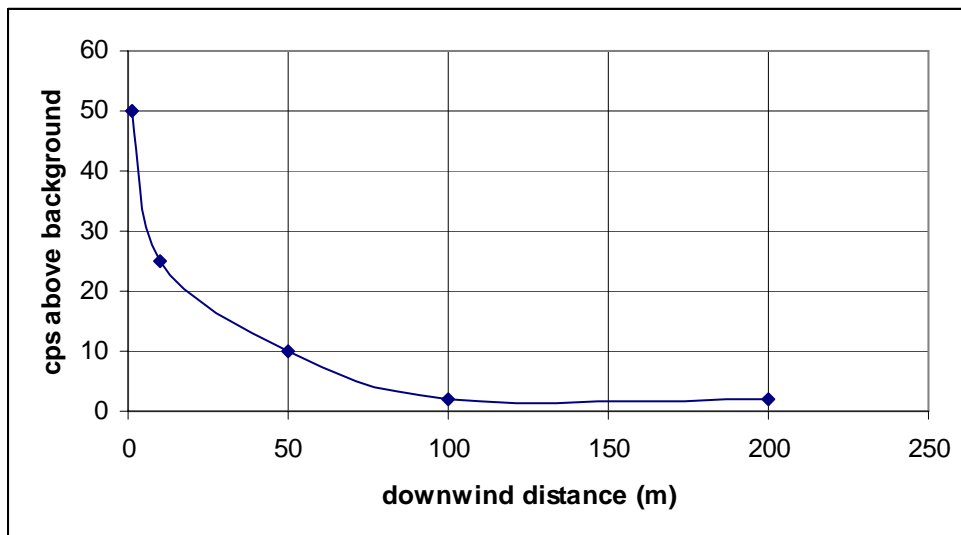


5.3 Outside survey data

5.3.1 Ambient dose rate



5.3.2 Air sample readings



6 EXERCISE EVALUATION

The following are the exercise objectives and evaluation criteria that will be used in this evaluation.

1 **Activate promptly**

- The operators promptly declare an emergency.
- The operators promptly notify the managers and specialists.
- The operators promptly organize themselves to deal with the emergency functions.

2 **Take immediate actions to protect on-site personnel**

- The order to evacuate the building is promptly given.
- Actions are taken to verify that everyone has been evacuated.
- Contamination of evacuated personnel is checked.
- Dose information for the evacuated personnel is requested.
- Dosimeter readings are converted into effective dose readings.
- If personnel is asked to re-enter the building, then appropriate precautions are put in place to protect them, including electronic dosimeters, respiratory protection, full suit, radiation meters, dose monitoring and management process.
- The decision is made to survey the personnel assembly points.

3 **Take appropriate mitigating actions**

- The reactor is shut down.
- The containment is isolated.
- Discussions take place on the hazards and the best way to reduce it.

4 **Assess the off-site impacts**

- The potential source term is calculated.
- Dose projections (even simple ones) are carried out for the present accident.
- Dose projections (even simple ones) are carried out for the worst potential situation.
- Measurements, when available, are used to estimate the potential off-site impact.

5 **Make recommendations to and communicate effectively with off-site authorities**

- The off-site group is promptly notified.
- The frequency of calls is agreed upon.
- The information provided is clear and well structured (best if there is a format used).
- The recommendations made are clear and appropriate considering the information known at the time.
- The concerns of the off-site group are addressed in a timely fashion.
- Assistance to the off-site group is provided when requested.
- Liaison officers are exchanged.

6 Make appropriate decisions regarding media communications

- Managers formulate media communications promptly.
- Off-site also formulates media communications promptly.
- Managers and off-site coordinate together for media communications.
- All media communications are signed by the respective group leader.
- Media communications are complete and accurate.
- Media requests are answered as promptly as possible.
- Steps are taken to control rumours.
- Media requests are recorded.
- There is a designated spokesperson for each of the managers and off-site groups.

7 ATTACHMENT: ACTUAL POSITIONS IN THE EXERCISE

Controllers/evaluators

Position	Assigned to
Chief controller	
Manager group controller-evaluator	
Operator group controller-evaluator	
Specialist group controller-evaluator	
Off-site group controller-evaluator	
Simulation cell	
Video operator	

Group composition

Group	Names
Operators	
Managers	
Specialists	
Off-site	

Exercise contact list

Managers	
Operators	
Specialists	
Off-site	
Media	
Medical clinic	
Simulation cell	