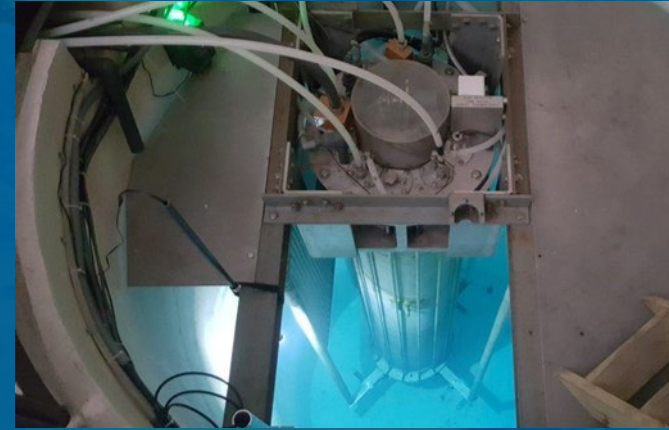


IGORR22/IAEA TM ON INTEGRATED MANAGEMENT SYSTEMS FOR THE
SUSTAINABLE SAFE OPERATION AND EFFECTIVE UTILIZATION OF
RESEARCH REACTORS, JUNE 16-19, 2025, MITO, JAPAN

IMPLEMENTING AN INTEGRATED MANAGEMENT SYSTEM AT THE JM-1 RESEARCH REACTOR



HAILE DENNIS, JOHN PRESTON

ICENS, University of the West Indies

ACKNOWLEDGING JOHN PRESTON

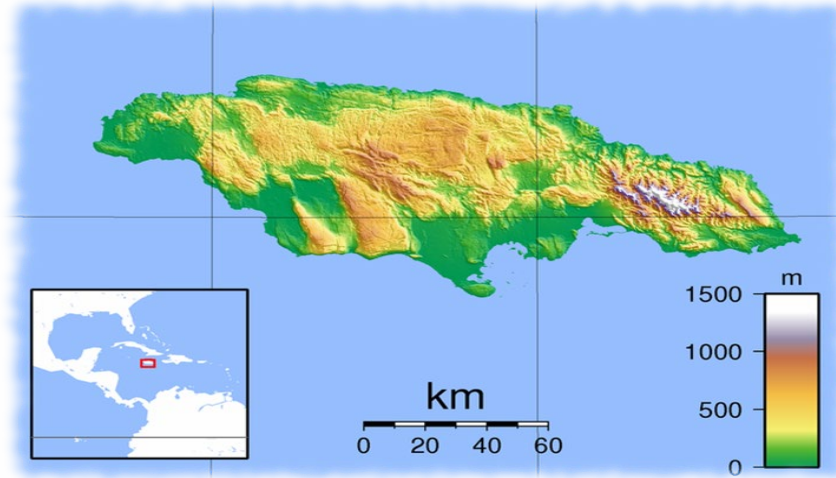


PRESENTATION OUTLINE

- The JM-1 Research Reactor
- IMS Objectives
- IMS Implementation
- Computer-based tool (NURIMS)
- Impressions
- Lessons learnt

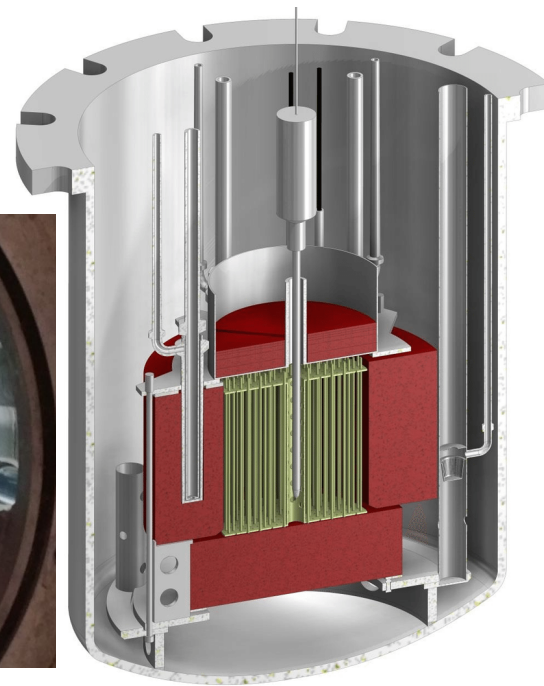
THE JM-1 RESEARCH REACTOR

- The JM-1 research reactor is the only nuclear reactor in the English-speaking Caribbean.
- Commissioned with HEU fuel (93% ^{235}U) in 1984.
- Of the seven SLOWPOKE reactors, JM-1 is the only one commissioned outside of Canada and the last one commissioned with HEU fuel.
- Successfully converted to LEU fuel in 2015 via collaboration between the US DOE, through the Argonne National Laboratory and ICENS within the framework of the NNSA's M³ program with the assistance of the IAEA.

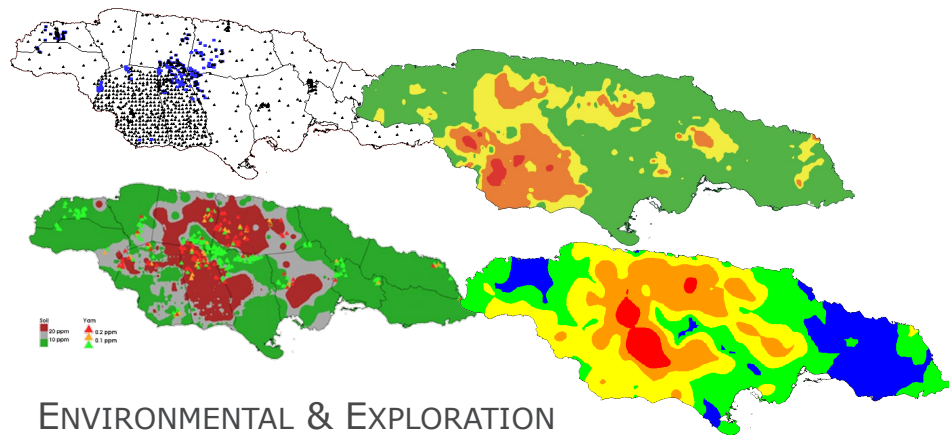


THE JM-1 RESEARCH REACTOR

Commissioned :	March 1984
Power :	~20 kW
Maximum Excess Reactivity :	+ 4.0 mK
Flux :	$1 \times 10^{12} \text{ n.cm}^{-2} \text{ s}^{-1}$
Core:	UO ₂ pellets 19.9% ²³⁵ U Zircaloy cladding
Reflector:	Primary: Beryllium metal Secondary: Light water
Moderator :	Light Water
Cooling :	Natural convection
Irradiation Sites :	5 inner and 1 outer



THE JM-1 RESEARCH REACTOR



ENVIRONMENTAL & EXPLORATION
GEOCHEMISTRY

HEALTH



AGRICULTURE, SOILS & FOOD SECURITY

IMS OBJECTIVES

In 2015 a decision was made to integrate the management of the reactor operations to ensure that strategic decisions were not made in isolation. Specific objectives of the IMS are to:

- Develop a **process-based** approach to ensuring the safe and sustained operation of the JM-1 Research Reactor facility in all stages of its life;
- Ensure a **safe environment** for the facility staff, the public and the environment by fostering a systematic approach to managing its operations;
- Ensure **systems and infrastructure are maintained** (modified, refurbished, upgraded) over the lifetime of the facility;
- Assist the facility in complying with its **regulatory requirements**;
- Assist the facility in **maximizing the safe utilization** of the research reactor;
- Assist in **knowledge management** over the life of the reactor;
- Foster a **data-driven approach** to managing all aspects of the operation of the reactor and facility.

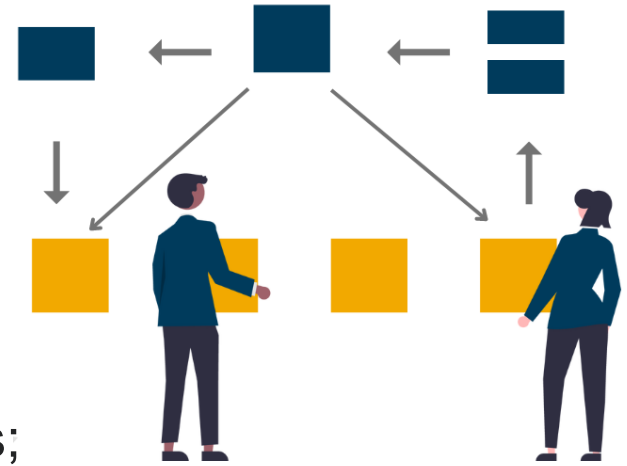
IMS IMPLEMENTATION STRATEGIES

- Engage **management and staff** at all stages of the implementation
- Utilize a **graded approach** to ensure a fit-for-purpose system
- Determine **process/activities/tasks** constructs for all activities related to reactor operation on a step-by-step basis
- Implement **real-time monitoring** of operating parameters to provide the basis for a data driven approach to the management and operation of the reactor
- Establish clearly defined **acceptance criteria** for all surveillance activities
- Utilize a **computer-based** information management system.
- **'Not let the perfect be the enemy of the good'**

IMS IMPLEMENTATION

Step 1 – Process Mapping

- Identify all processes including scope & purpose;
- Identify process owners;
- Identify and verify all process inputs and outputs;
- Identify the various process activities and tasks (what work is done, who carries it out and how it is performed);
- Identify the resource needs (roles, responsibilities, training needs and equipment);



IMS IMPLEMENTATION

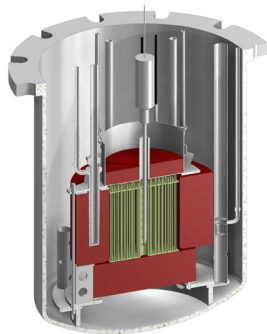
Process Map

MANAGEMENT

- ☐ DOCUMENTATION
- ☐ REGULATORY COMPLIANCE
- ☐ OPERATIONS REVIEW
- ☐ SELF ASSESSMENTS
- ☐ PROCESS AUDITS

CORE

- ☐ REACTOR OPERATION
- ☐ SAMPLE IRRADIATION



SUPPORT

- ☐ RADIATION PROTECTION
- ☐ EMERGENCY RESPONSE
- ☐ CONTROLLED MATERIALS
- ☐ HUMAN RESOURCES
- ☐ MAINTENANCE
- ☐ SAFETY/SECURITY

IMS IMPLEMENTATION

Step 2 – Identify Activities and Tasks

Identify process activities and tasks. These were taken from the following existing documents:

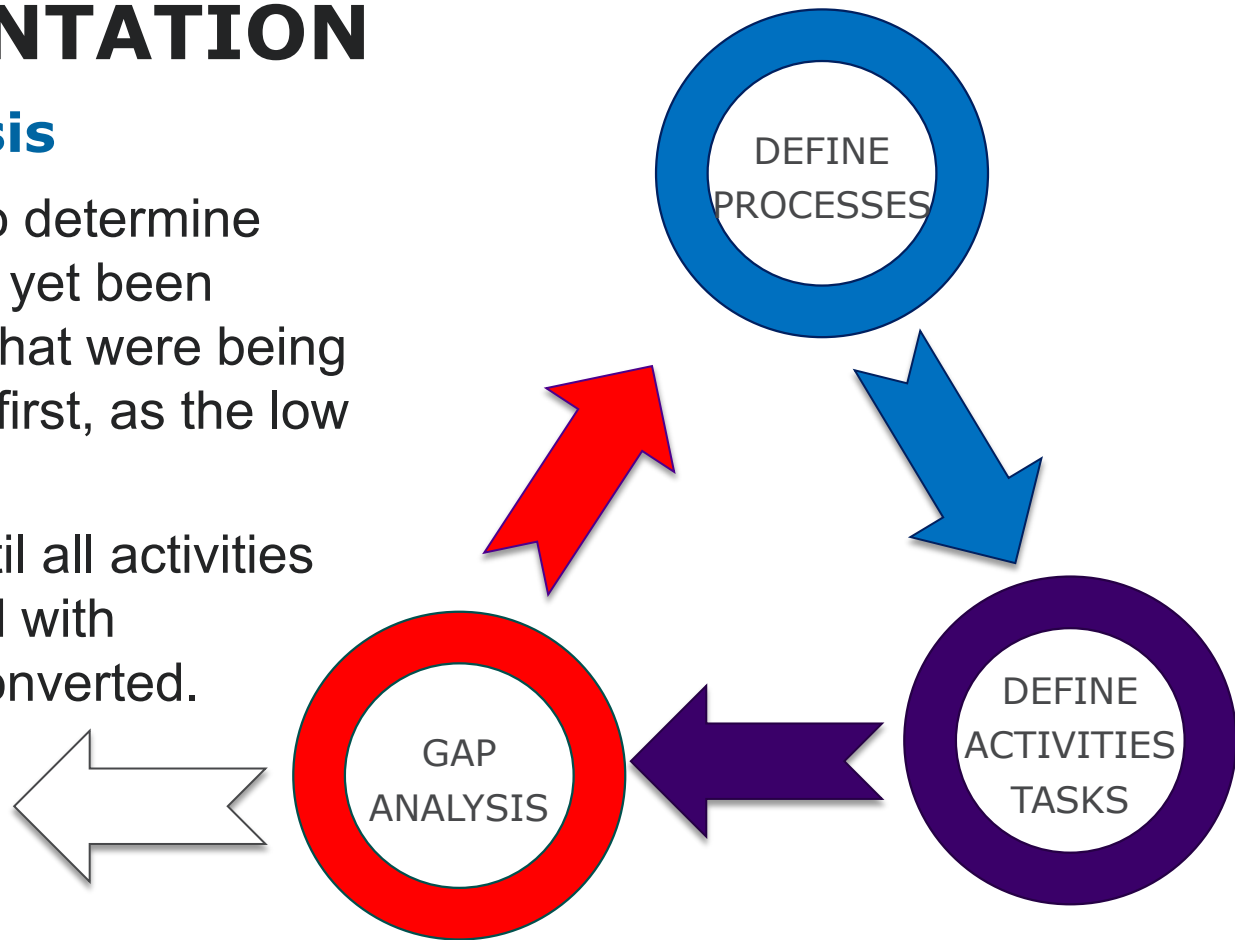
- SAR
- OLCs
- Reactor Operation and Maintenance Manual
- Quality Manual
- Physical & Computer Security Policies
- Emergency Preparedness & Response Policy
- Radiation Protection Policy
- Radioactive Waste Management Policy
- Standard Operating Procedures for Sample Analyses
- Training Manual

IMS IMPLEMENTATION

Step 3 – Gap Analysis

Perform a gap analysis to determine what processes have not yet been defined. Consider those that were being managed by procedures first, as the low hanging fruit.

Go to step 1 and loop until all activities that were being managed with procedures have been converted.



PROCESS OBJECTIVES (EXAMPLES)

RADIATION PROTECTION

- To establish a system for **monitoring** occupational **exposure** of **personnel** and the **environment** in supervised and controlled areas;
- To establish a system for **monitoring** the radiation exposures in **public areas** in and around the facility;
- To establish a system of **assessment and review** of occupational exposures;
- To **report** the findings of exposures to all interested parties.

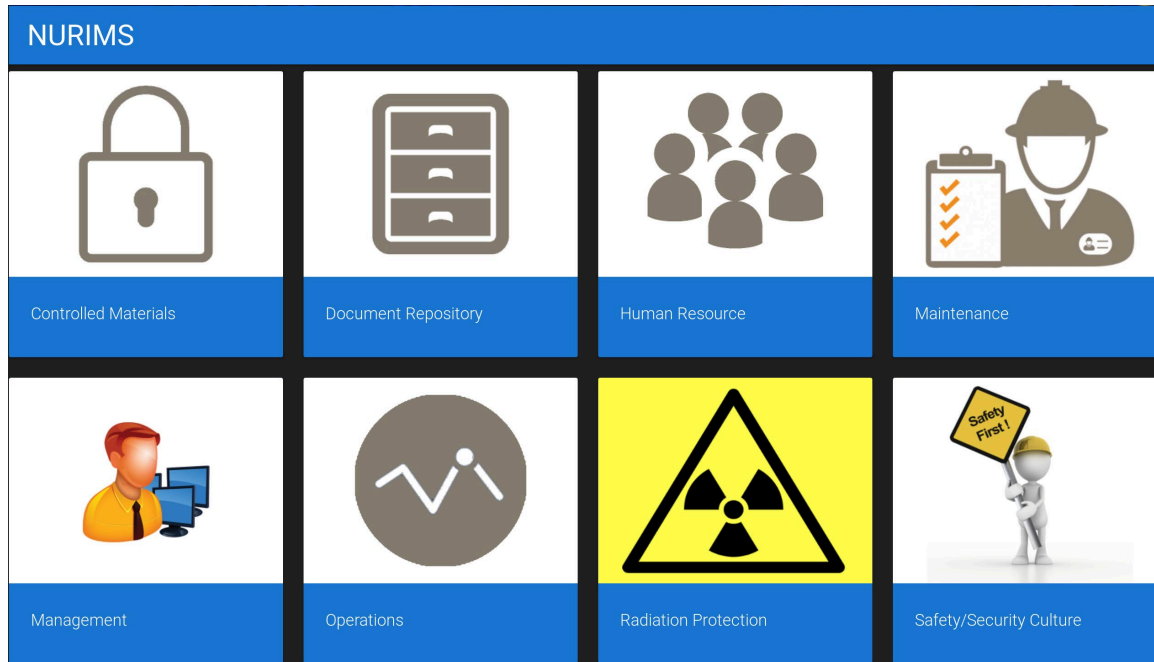
CONTROLLED MATERIALS

- To implement a system of **control** over **radioactive sources** and devices in which the sources are incorporated;
- To implement a **categorization** of **sources** based on the potential injury to people and the environment that could result if those sources are not safely managed or securely protected;
- To implement a system for the safe and secure storage of **radioactive waste**;
- To implement a system of **assessment and auditing** of the process activities and results to improve the process.

COMPUTER-BASED TOOL

NURIMS

NUCLEAR AND
RADIOLOGICAL
INTEGRATED
MANAGEMENT
SYSTEM

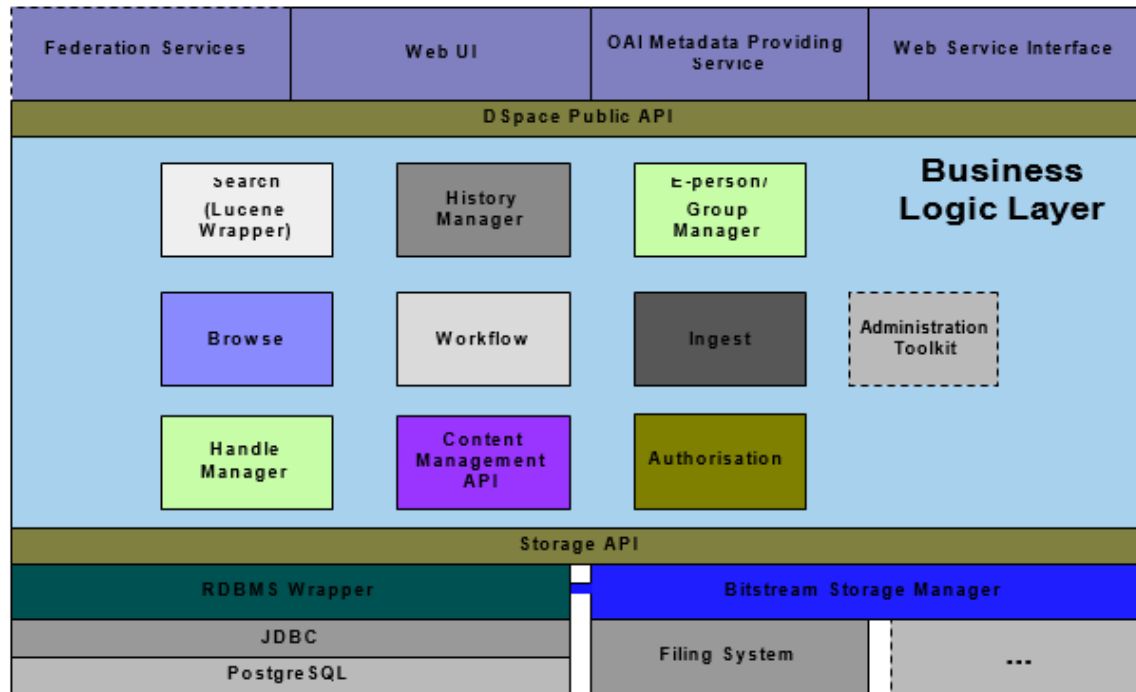


COMPUTER-BASED TOOL

NURIMS

The base system is a digital library DSPACE, which:

- captures items in any format,
- indexes digital items so they can be easily retrieved,
- preserve the digital content over the long term.



MAINTENANCE/ISI PROCESS – ADD SSC

NURIMS

SSC's

Add SSC

Edit SSC

View SSC' List

Task Action Records

View Schedules

Reports

Maintenance > Add SSC

NURIMS Administrator

✓ SSC
Step 1

2 Details
Step 2

3 Ageing
Step 3

4 Finish
Step 4

SSC Description

Comm. Date

SSC ID

SSC Type
Select the SSC type

SSC Classification
Select the SSC classification

SSC Safety Category
Select the SSC Safety category

SSC Safety Function
Select the SSC safety function

SSC Maintainability
Select the maintainability

Scope

Acceptance Criteria

Surveillance Freq.
None

Not found

CONTINUE

BACK

MAINTENANCE/ISI PROCESS – ADD SSC

NURIMS

SSC's

Add SSC

Edit SSC

View SSC' List

Task Action Records

View Schedules

Reports

Maintenance > Add SSC

NURIMS Administrator

✓ SSC
Step 1

✓ Details
Step 2

3 Ageing
Step 3

4 Finish
Step 4

Material	Mechanisms	Effects	Detection Method	Ageing Degradation	Mitigation Steps	Acceptance Criteria	Surveillance Freq.
Stainless Steel	No ageing mechani	No ageing effects	No ageing detection	No ageing degradat	No ageing mitigatic	No acceptance criti	None
Not found							

CONTINUE

BACK

MAINTENANCE/ISI PROCESS – GENERATE PLAN

NURIMS

SSC's

Task Action Records

View Schedules

Maintenance Schedule

Ageing Management Schedule

Reports

Maintenance > Maintenance Schedule

NURIMS Administrator

1 Maintenance Schedule Period

Step 1

Maintenance Plan Year

Select the maintenance schedule year

SSC Classification

Select the SSC classification

January

December

January

February

March

April

May

June

July

August

September

October

November

December

CONTINUE

2 Finish

Step 4

MAINTENANCE/ISI PROCESS – GENERATE PLAN

JM-1 SLOWPOKE Maintenance Plan JANUARY - DECEMBER 2025

NURIMS
2025

Page: 3

Table of Contents

Tables	
Structures, Systems and Components (SSC)	
Maintenance Schedule	
Weekly schedule	
Monthly schedule	
Quarterly schedule	
Biannual schedule	
Annual schedule	

Maintenance Schedule

Weekly schedule

Week Dec 31 - Jan 4					
SSC	Maintenance Scope	Acceptance Criteria	Completed	Accepted	Initials
POOLCHILLER	water temperature control	10C to 15C chilled water	<input type="checkbox"/> MONDAY <input type="checkbox"/> TUESDAY <input type="checkbox"/> WEDNESDAY <input type="checkbox"/> THURSDAY <input type="checkbox"/> FRIDAY	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	chilled water flow rate	6-7 GPM	<input type="checkbox"/> MONDAY <input type="checkbox"/> TUESDAY <input type="checkbox"/> WEDNESDAY <input type="checkbox"/> THURSDAY <input type="checkbox"/> FRIDAY	<input type="checkbox"/> Yes <input type="checkbox"/> No	

CONTROLLED MAT. PROCESS– ADD MAT.

NURIMS

Controlled Material's

Add Storage Location

Edit Storage Location

Attach Location Image

Add Material Manufacturer

Edit Material Manufacturer

Add Material

Edit Material

Attach Material Image

Attach Material Document

Task Actions

Search

Lists, Reports & Schedules

Controlled Material > Add Material

NURIMS Administrator

1 Material
Step 1

Material Name

Material ID

Material Type
Select the Material type

CONTINUE

2 Details
Step 2

3 Nuclear
Step 3

4 Surveillance
Step 4

5 Finish
Step 5

ICENS INTERNATIONAL CENTRE
FOR
ENVIRONMENTAL AND NUCLEAR SCIENCES

20

CONTROLLED MAT. PROCESS– ADD MAT.

NURIMS

Controlled Material's

Add Storage Location

Edit Storage Location

Attach Location Image

Add Material Manufacturer

Edit Material Manufacturer

Add Material

Edit Material

Attach Material Image

Attach Material Document

Task Actions

Search

Lists, Reports & Schedules

Controlled Material > Add Material

NURIMS Administrator

1 Material
Step 1

2 Details
Step 2

3 Nuclear
Step 3

4 Surveillance
Step 4

5 Finish
Step 5

Material Description

Material Classification
Select the Material classification

Reg. Date

Material Manufacturer
Select manufacturer

Inventory Status
Select inventory status

Material Physical Form
Select physical form

Location
Select location

CONTINUE

BACK

CONTROLLED MAT. PROCESS– ADD MAT.

NURIMS

Controlled Material's

Add Storage Location

Edit Storage Location

Attach Location Image

Add Material Manufacturer

Edit Material Manufacturer

Add Material

Edit Material

Attach Material Image

Attach Material Document

Task Actions

Search

Lists, Reports & Schedules

Controlled Material > Add Material

NURIMS Administrator

Material
Step 1

Details
Step 2

3 Nuclear
Step 3

4 Surveillance
Step 4

5 Finish
Step 5

Material Nuclide(s)

Quantity

Units

Date

2019-06-20

Material Nuclide(s)

Quantity

Units

Date

2019-06-20

ADD

UPDATE

DELETE

CONTINUE

BACK

Nuclide	Activity/Quantity	Units	Ref. Date
Not found			

CONTROLLED MAT. PROCESS– ADD MAT.

NURIMS

Controlled Material's

Add Storage Location

Edit Storage Location

Attach Location Image

Add Material Manufacturer

Edit Material Manufacturer

Add Material

Edit Material

Attach Material Image

Attach Material Document

Task Actions

Search

Lists, Reports & Schedules

Controlled Material > Add Material

NURIMS Administrator

✓ Material
Step 1

✓ Details
Step 2

✓ Nuclear
Step 3

4 Surveillance
Step 4

5 Finish
Step 5

Leak Testing Surveillance Frequency

Inventory Surveillance Frequency

Activity Surveillance Frequency

② Select surveillance frequency

② Select surveillance frequency

② Select surveillance frequency

CONTINUE

BACK

CONTROLLED MAT. PROCESS– GENERATE LIST

Report Date: 2025-01-29

International Centre for Environmental and Nuclear Sciences
2 Anguilla Crescent
Kingston 7, Jamaica

Page: 1

Controlled Materials List

Abstract

This report lists the radioactive and nuclear materials and associated nuclear items under control at the ICENS.

Summary	2
Material Types	3
Sealed Radioactive Source	3
Unsealed Radioactive Source	31
Controlled Nuclear Item	32
Nuclear Material	36

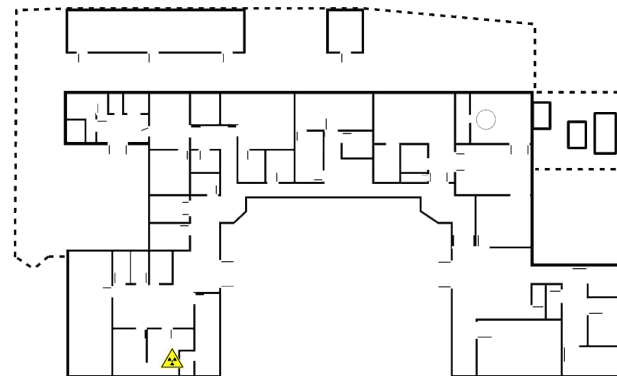
23650-HC-8507 : Cs-137 Industrial Source

Record :	nurims/1572
Name :	Cs-137 Industrial Source
ID :	23650-HC-8507
Description :	Cs-137 Industrial Source
Manufacturer :	Unknown
Registration Date :	2022-02-04
Form :	Solid
Classification :	Category 5, Most unlikely to be dangerous to the person
Inventory Status :	DisUsed
Storage Location :	-
Surveillance :	Inventory: Annual Leak Testing: Annual Activity Testing: None
Nuclides :	
	Nuclide
	Activity/Quantity
	Ref. Date
	Cs-137
	-
	2022-02-04



TLD Reader 0

Harshaw 6600 TLD reader



RADIATION PROTECTION – DOSE OPTIMIZATION

Reactor Ceiling

ID : 971098

From : 2019-03-01T07:51:26

To : 2019-03-24T10:03:14

Count : 423523

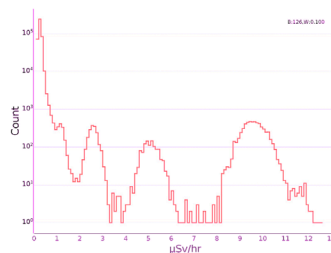
Minimum : 0.10 $\mu\text{Sv/hr}$

Maximum : 12.70 $\mu\text{Sv/hr}$

Mean : 0.37 $\mu\text{Sv/hr}$

Median : 0.2 $\mu\text{Sv/hr}$

Std. Deviation : 1.15 $\mu\text{Sv/hr}$



Reactor

ID : 971073

From : 2019-03-01T07:51:24

To : 2019-03-24T10:03:13

Count : 419822

Minimum : 0.10 $\mu\text{Sv/hr}$

Maximum : 37.90 $\mu\text{Sv/hr}$

Mean : 0.72 $\mu\text{Sv/hr}$

Median : 0.2 $\mu\text{Sv/hr}$

Std. Deviation : 3.78 $\mu\text{Sv/hr}$



IC1

ID : 973014

From : 2019-03-01T07:51:24

To : 2019-03-24T10:03:14

Count : 426132

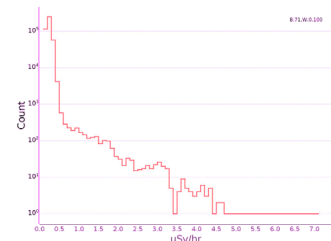
Minimum : 0.10 $\mu\text{Sv/hr}$

Maximum : 7.20 $\mu\text{Sv/hr}$

Mean : 0.19 $\mu\text{Sv/hr}$

Median : 0.2 $\mu\text{Sv/hr}$

Std. Deviation : 0.12 $\mu\text{Sv/hr}$



ID : 971070

From : 2019-03-01T07:51:22

To : 2019-03-24T10:03:12

Count : 422344

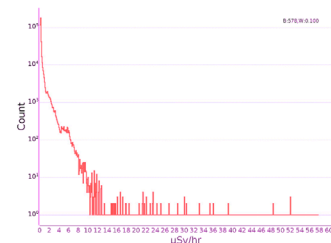
Minimum : 0.10 $\mu\text{Sv/hr}$

Maximum : 57.90 $\mu\text{Sv/hr}$

Mean : 0.45 $\mu\text{Sv/hr}$

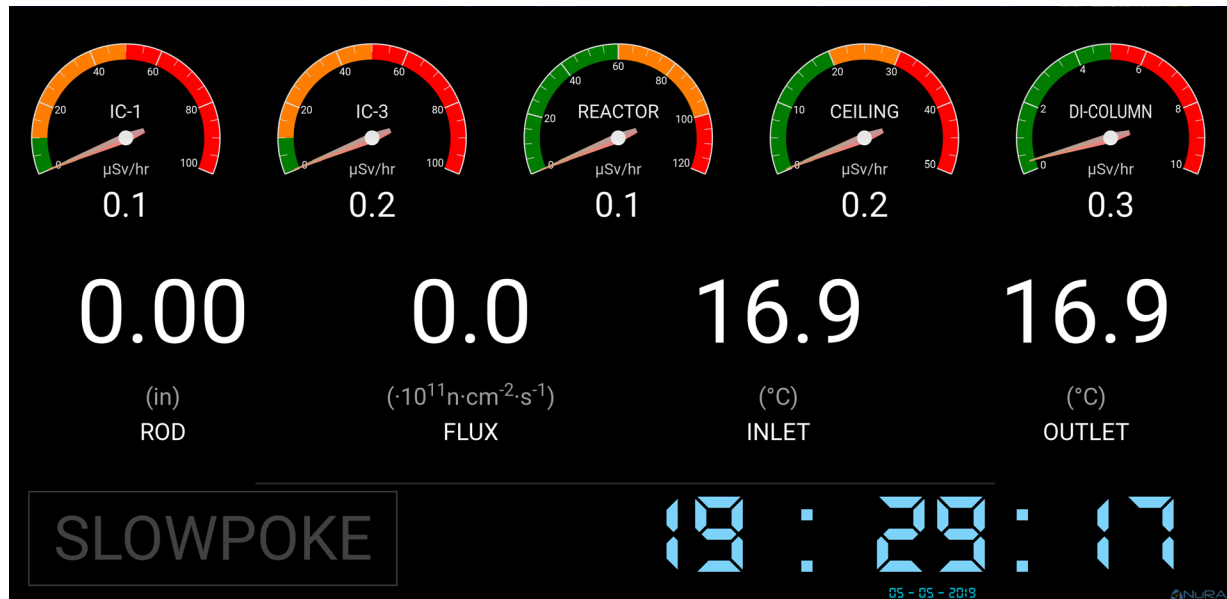
Median : 0.2 $\mu\text{Sv/hr}$

Std. Deviation : 0.99 $\mu\text{Sv/hr}$



REACTOR OPERATION DASHBOARD

PROVIDES REAL TIME
STATUS OF RADIATION
AREA MONITORS AND
REACTOR OPERATING
STATUS TO ALL AREAS
OF THE FACILITY.



IMPRESSIONS

- Implementation of the IMS has been instrumental in re-evaluating and re-establishing the bases for all aspects of the reactor and facility operations.
- The adoption of an integrated process-based approach to managing the operations of the research is aimed at enhancing reliability and availability of the reactor.
- The use of computer-based tools is key to realizing efficiencies especially in situations of small staff numbers and high staff turnover.
- The use of the IMS in relation to reactor utilization has provided new insights into the multiple factors that must be managed to enhance reactor utilization.

LESSONS LEARNT

- Engage all stakeholders early in the process.
- Solicit feedback periodically during development and implementation.
- Moving from a procedural management system towards a process-based one should be considered in the same realm as a change in culture and thus will require a high level of effective and consistent communication.

THANK YOU FOR YOUR ATTENTION