Legal and Regulatory Framework on Decommissioning of Research Reactors

A Presentation of Brazil for the Research Reactor Decomissioning and Demonstration Project (R^2D^2P)

Radioactive Waste Management, Treatment & Disposal Framework

by
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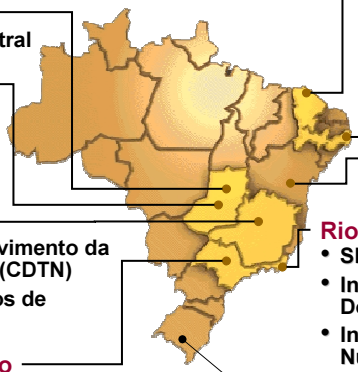
Radioactive Waste Division

Brazilian Nuclear Energy Commission (CNEN)

Manila, June 2006

- **The largest and most populous country in Latin America**
- **Population: 185 million**
  - **80% living in the urban areas**
  - **41 million households**
  - **Population Growth: 1.38% (1991-96)**
  - **3.3 million square miles**

CNEN OFFICES IN BRAZIL



Distrito Federal
- Distrito do Planalto Central

Goiás
- Centro Regional de Ciências Nucleares em Abadia de Goiás (CRCN-CO)

Minas Gerais
- Centro de Desenvolvimento da Tecnologia Nuclear (CDTN)
- Laboratório de Poços de Caldas (COLAB)

São Paulo
- Instituto de Pesquisas Energéticas e Nucleares (IPEN)

Ceará
- Distrito de Fortaleza (DIFOR)

Pernambuco
- Centro Regional de Ciências Nucleares em Recife (CRCN-NE)

Bahia
- Distrito de Caetité

Rio de Janeiro
- SEDE
- Instituto de Radioproteção e Dosimetria (IRD)
- Instituto de Engenharia Nuclear (IEN)
- Distrito de Angra dos Reis (DIANG)

Rio Grande do Sul
- Distrito de Porto Alegre

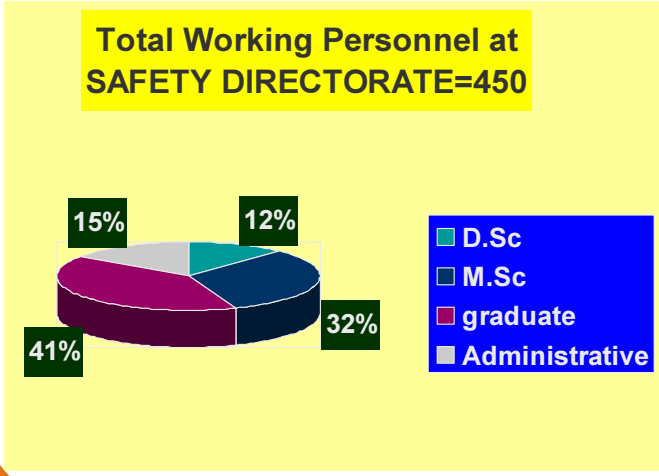
Brazilian Nuclear Energy Commission

- In Brazil, the Brazilian Nuclear Energy Commission (CNEN) is the governmental body responsible for promulgation and enforcement of regulations concerning radioactive waste management and disposal.

National Programme

- According to the law, CNEN is entitled to receive radioactive wastes and select a site for their final emplacement, as well as construct (directly or through contractors) (Technical-operational issues) and license for operation the repository for such wastes (Regulatory-Safety issues)

THE BRAZILIAN NUCLEAR ENERGY COMMISSION
Radiation Protection and Nuclear Safety Directorate



Previous AIEA envolvement-DRS

- A strong effort has been made by CNEN (DRS), over the last 8 years, towards the development of a national capability for radioactive waste disposal assessment. Personnel have been trained in modeling radioisotope migration in soil and groundwater and in radiological impact assessment.

Previous AIEA envolvement-DRS

- Development of in-house safety assessment computer codes (DRS) for different purposes and with diverse capabilities:
- a. MIGRAD Code – One-dimension screening Model;
- b. Homogeneous Two-dimension Screening Model;
- c. Heterogeneous Two-dimension Screening Model;
- d. General Two-dimension Model;
- e. Homogeneous Three-dimension Screening Model.
- For the accomplishment of these tasks, the previously established IAEA Project BRA 04-046, carried out for the period 1997-1999, has provided significant support in terms of scientific visits, fellowships and expert missions.

Nuclear and Radioactive Installations

- Two Nuclear Power Plants
- Four research reactors
- One Pilot Scale Fuel Cycle Facility, including conversion U → UF_6 and U enrichment
- One Fuel Element Assembly Facility
- One Monazite Sand Processing Facility
- Two Uranium Mine and Milling Facilities
- Mineral-industrial activities (Niobium, tantalum, zirconium etc.)
- Petroleum exploitation (NORM)
- 3500 Medical, Industrial and Research Facilities

Radioactive Waste Classification

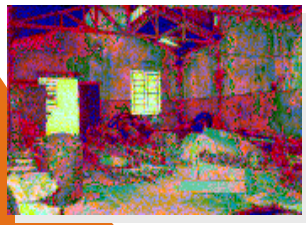
- Follows IAEA classification

Categories	Description
I - Exempt Waste	Activity levels at or below clearence levels, which are based on an annual dose to members of the public of less than 0.01 mSv.
II - Low and Intermediate Level Waste	Activity levels above clearence levels and thermal power below about 2 kW/m^3.
II.1 - Short Lived Waste	Restricted long lived radionuclide concentration (limitation of long lived alpha emitting radionuclides to 4000 Bq/g in individual waste packages and to an overall average of 400 Bq/g (per waste package).
II.2 - Long Lived Waste	Long lived radionuclide concentrations exceeding limitations for short lived waste.
III-High level Waste	Thermal Power about $2kW/m^3$ and long-lived radionuclide concentrations exceeding limitations for short-lived waste.

Decommissioning Experience

- Monazite processing industry (SP)
- Totally decommissioned (1998)






Waste from Nuclear Power Plants

- Angra I & Angra II



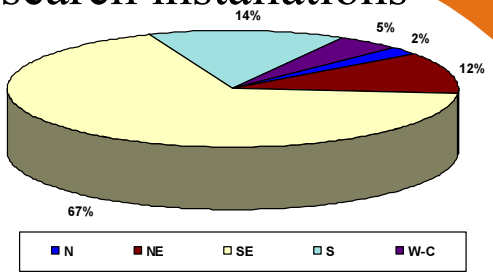
Waste from uranium mining and milling

- Poços de Caldas

- Caetité

Radioactive waste from medical, industrial and research installations

- Regional distribution



- Waste collection

Petroleum Exploitation

- Contaminated pipes and equipment

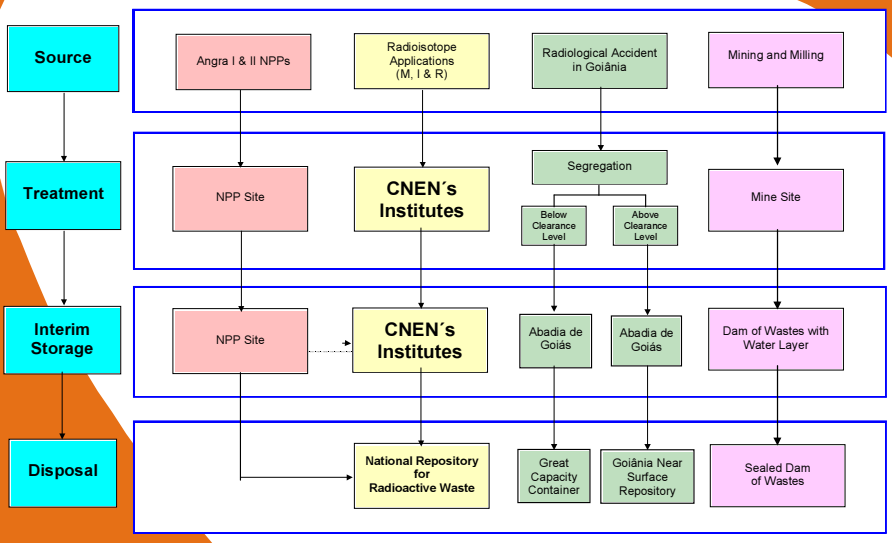
Mineral-Industrial Facilities

LOCALIZAÇÃO DAS INSTALAÇÕES MÍNERO-INDUSTRIAIS

- Borborema (RN/PB) - pegmatitos
- Bunge Fertilizantes - Araxá (MG)
- Cambuí (carvão) - Figueira (PR)
- Cia. Ind. Fluminense - CIF - S.J.Rey (MG)
- CBL - Araçuai (MG)
- CBMM - Araxá (MG)
- Extrativa Manganês - S.J.Rey (MG)
- Fosfértil - Tapira (MG)
- MIBRA - Nazareno (MG)
- Millennium - Mataraca (PB)
- Min. Catalão - Catalão (GO)
- Min. Mamoré - P. do Bom Jesus (SP) e S. Tiago (MG)
- Min. Taboca - Pitinga (AM)
- Min. Serra do Sossego (PA) - CVRD
- Projeto 118 (PA) - CVRD
- Ultrafértil - Cubatão (SP)

Goiânia accident waste

Strategy for Low and Intermediate-Level Radwaste Management in Brazil



Brazilian regulations

BRAZILIAN REGULATIONS	PUBLICATED	IAEA REGULATIONS	SITUAÇÃO ATUAL
NE - 1.10 :: SEGURANÇA DE SISTEMAS DE BARRAGEM DE REJEITOS CONTENDO RADIONUCLÍDEOS (SAFETY OF MINING WASTE DAM)	D.O.U. 27 DE NOVEMBRO DE 1980	NO	
NE - 5.01 :: TRANSPORTE DE MATERIAIS RADIOATIVOS (TRANSPORT OF RADIOACTIVE MATERIAL	D.O.U. 01 DE AGOSTO DE 1988	ST-R-1	BEEING REVISED ST-R-1 DA AIEA
NE - 5.02 :: (SPENT FUEL STORAGE AND TRANSPORTATION)	D.O.U. 17 DE FEVEREIRO DE 2003	ST-R-1	
NE - 6.05 :: GERÊNCIA DE REJEITOS RADIOATIVOS EM INSTALAÇÕES RADIATIVAS WASTE MANAGEMENT	D.O.U. 17 DE DEZEMBRO DE 1985	111-F , 111-G-1.1, DS292, WS-G-2.7, DS336	BEEING REVISED 111-F , TECDOC 1000, E 111-G-1.1

Brazilian regulations

NE - 6.06 :: SELEÇÃO E ESCOLHA DE LOCAIS PARA DEPÓSITOS DE REJEITOS RADIOATIVOS SITE SELECTION LLW	D.O.U. 24 DE JANEIRO DE 1990	D334, 111-G-4.1	
NE-6.09-CRITÉRIOS DE ACEITAÇÃO PARA DEPOSIÇÃO DE REJEITOS RADIOATIVOS DE BAIXO E MÉDIO NÍVEIS DE RADIAÇÃO WASTE ACCEPTANCE CRITERIA	D.O.U. 23/09/2002		
NE-4.01 REQUISITOS DE SEGURANÇA E PROTEÇÃO RADIOLÓGICA PARA INSTALAÇÕES MÍNERO-INDUSTRIAIS SAFETY OF MINERAL-INDUSTRIAL FACILITIES		WS-G-1.2	

Brazilian regulations

DESOMISSIONING DONT HAVE		WS-G-2.1. WS-G-2.2, WS-G-2.4	
CONTAMINATED SITES DONT HAVE		DS332	
SPECIFIC FOR EFFLUENTS DONT HAVE		WS-G-2.3	PARTE IN CNEN-NE-6.05 AND CNEN-NE-3.01
COMODITIES DONT HAVE		RS-G-1.7	
PRÉ-DISPOSAL OF HLW,LILW		WS-G-2.5, WS-G-2.6 DS353	PART ON CNEN-NE-6.09 AND PART IN THE DRAFT ALREADY MADE

Brazilian regulations

BOREHOLES DONT HAVE		DS335	
MONITORIG FINAL DISPOSAL SITES (CASE BY CASE)		DS357	
NORM DONT HAVE		DS352	
OPERATION OF DEEP GEOLOGICAL DISPOSAL DONT HAVE		DS356, 111-G-3.1	

Waste management policy in Brazil

- CNEN is responsible for the reception and final disposal of radioactive waste
- Waste management and disposal regulation is also a responsibility of CNEN
- Single national repository
- LASER (Radiological Safety Laboratory)
  - Conceptual → integrated installation for treatment and storage of L&ILW awaiting final disposal

Present radwaste disposal policy in Brazil comprises the main guidelines presented below:

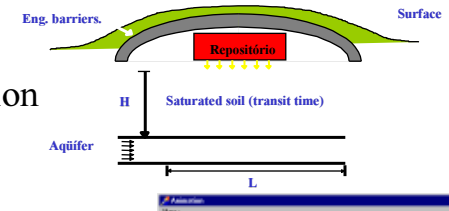
- Low and intermediate-level wastes (L&ILW) from NPP´s to be stored (interim storage) at NPP´s site;
- Final disposal of L&ILW from NPP´s at National Repository for Radioactive Wastes yet in the planning phase;
- L&ILW from radioisotope applications in industry, medicine and research to be collected, treated and stored at CNEN´s Institutes, awaiting final disposal;
- Goiânia accident waste already disposed of at Goiânia Repository (closed and undergoing institutional control for 300 years);

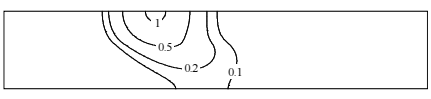
Present radwaste disposal policy in Brazil, comprises the main guidelines presented below:

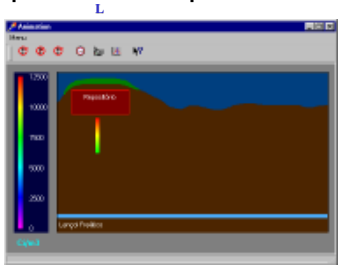
- Waste from mining and milling installations to be stored on site and disposed of on site at sealed waste dams;
- Final disposal installation (national repository) still in the planning phase. Present work pace considers a horizon of 10 years to make it operational.

Safety assessment

- Safety assessment models developed by CNEN:
  - Polutantf program
  - Migrad one dimension
  - 2-d screening
  - Decay chain model







Column experiments

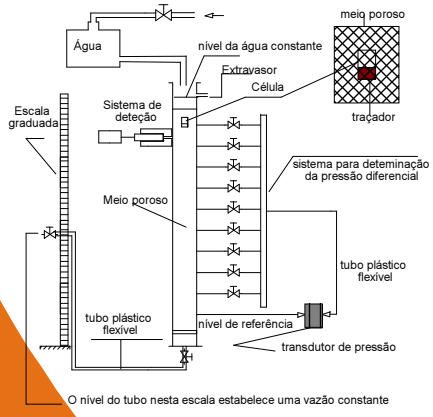


Figura 1 Diagrama esquemático da montagem experimental

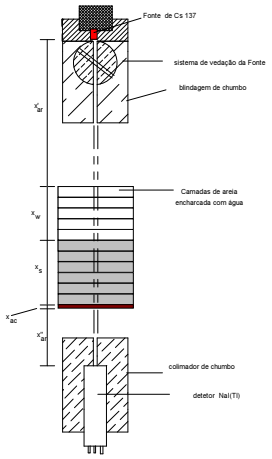


Figura 2 Sistema utilizado na calibração para determinação da porosidade da coluna

Thank you