Brazilian Nuclear and Radioactive Facilities and Assessment of Dose

Dejanira da Costa Lauria

dejanira@ird.gov.br

Brazilian Nuclear and Radioactive Facilities and Assessment of Dose

- Duties and rights of the Brazilian Regulatory Authority and licensees.
- The types and location of nuclear facilities in Brazil;
- The methodologies adopted to assess the dose for each site;

Brazilian Nuclear Commission (CNEN)

- CNEN-Regulatory Authority in Brazil-
  - It follows the international trend, especially the IAEA.
  - It set standards that all nuclear and radioactive facilities in the country must comply;
  - It grants license for operation of facilities

Monitoring and Discharge Limits

Based on standards that every nuclear facility has to comply with:

- The primary annual dose limit to members of the public is 1 mSv /y from all sources.
- The dose constraint from all routine effluent releases and exposure pathways due to a single practice must be ≤ 0.3 mSv to individuals of the critical group.
- The assessment shall consider the worst case scenario.

Policy on Discharge Limits

- Limit is intended to be applied during the licensing stage and used as a ceiling in the optimization process.
- For the nuclear power plants, the discharge limits shall comply with 0.25 mSv/y that represents design objective of the Radioactive Effluents Treatment Systems.
- Activity Concentration Levels for the most important radionuclides are derived to control effluent releases.

Regulatory Authority

The Regulatory Authority is in charge of:

- Reviewing of Licensee Applications to Permit Discharge Radioactive Materials
- Approval the Discharge Limits and Conditions presented by licensees.
- Conducting Effluents and Environmental Monitoring Programs or Checking Licensee Self Monitoring
- Conducting Periodic Inspections to Verify Compliance
- Reassessing Dose to Critical Group

Licensee

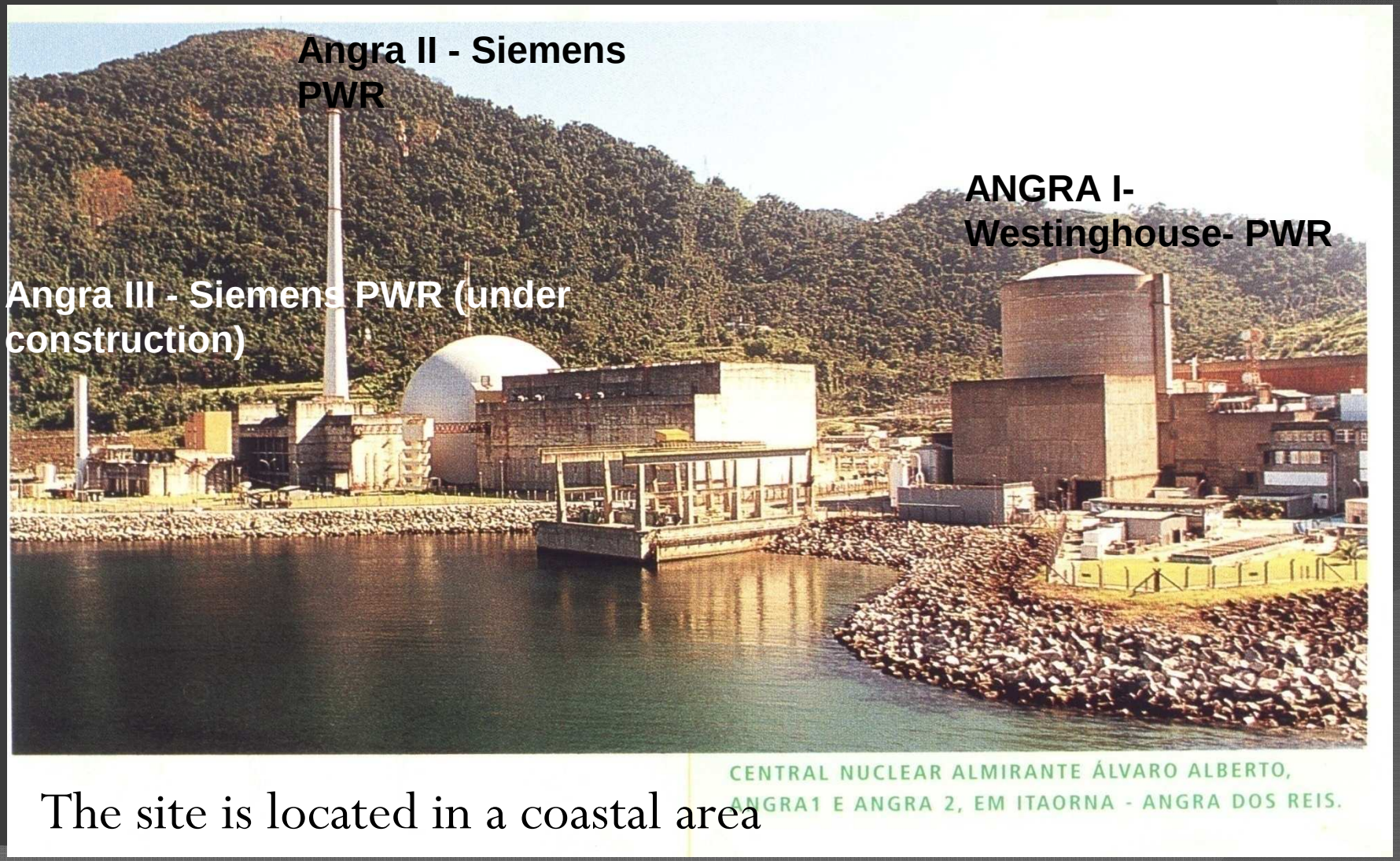
- Must provide information about technical specifications related to radioactive effluent releases and environmental monitoring;
- Must provide systems to control and limit radioactive releases into air and water;
- Must establish and carry out appropriate monitoring programs;
- Effluent releases accounting, dose calculations and environmental monitoring results shall be registered and made available for further inspections;

Brazilian Nuclear facilities

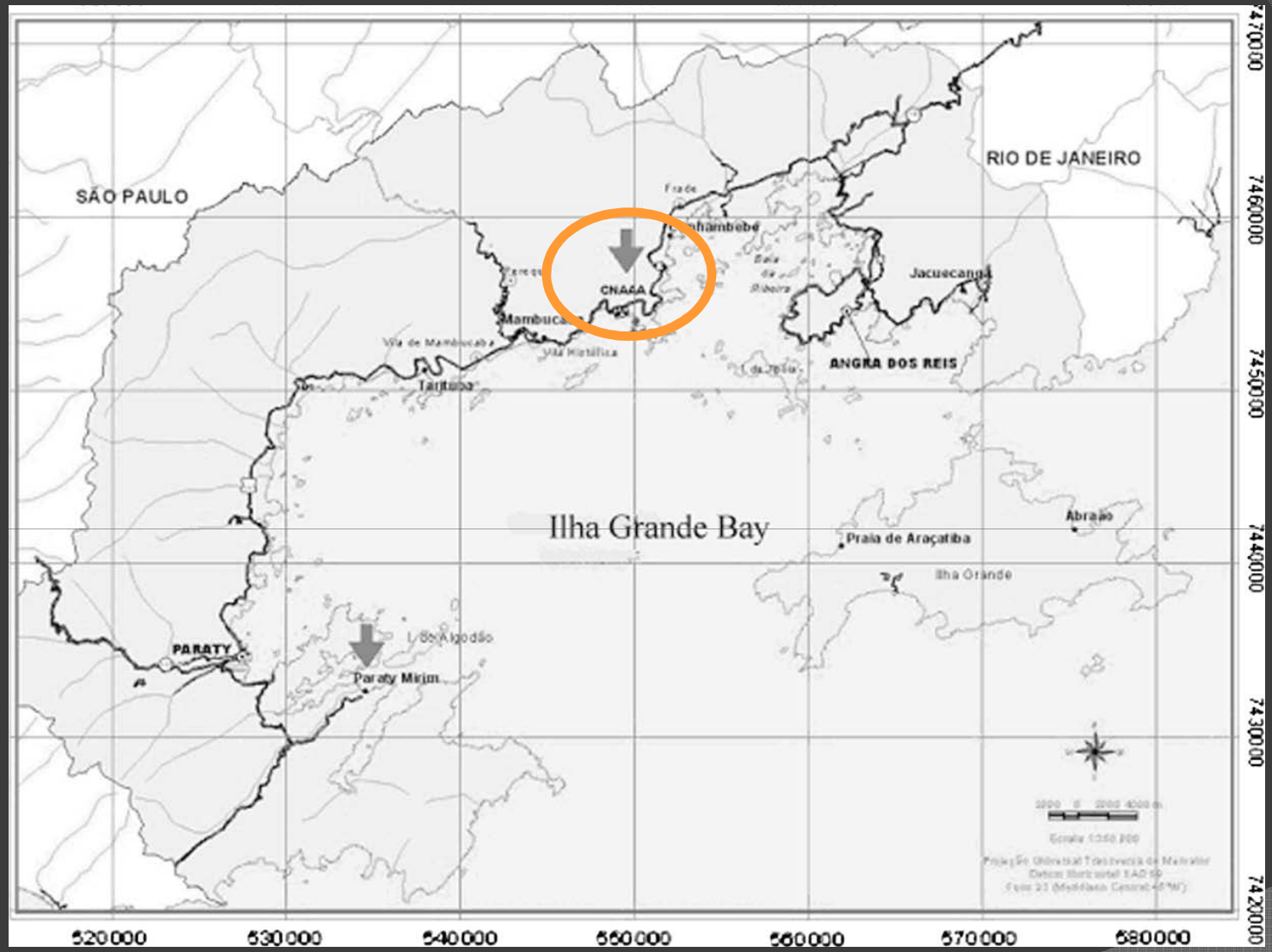
- Two nuclear power plants and a new one under construction;
- Two uranium mine and milling, one of them ceased its activities and its decommissioning is in phase of planning. In addition an uranium mining is under commissioning;
- Three fuel cycle facilities

BRAZILIAN NUCLEAR POWER PLANTS

AT ANGRA DOS REIS, RIO DE JANEIRO



The site is located in a coastal area



The power plants use the water of the Ilha Grande Bay, afterward the water is returned to the Bay.

Dose Assessment

- Aquatic and atmospheric effluents are released into environment.
- A dose model was specially developed to the site by ETN/COPPE which is based on Safety Series 57
- The main exposure pathways are:
  - External exposure: from clouds, radioactivity deposited on the ground and sand beach (sea sediments)
  - Internal exposure: Inhalation and Sea food ingestion;

Dose Assessment

- Representative person concept was adopted, since a Critical Group could not be identified
- There were chosen representative persons from three age ranges (0 to 5;6 to 15;16 to 70 years)
- The parameters of food consumption and land use were assessed by local surveys;
- Some local parameters, e.g. wind velocity and direction, bioacumulation and soil to plant transfer factors, were used in the model

Brazilian mine and milling facility at Caetité-Bahia

- It has been under operation since the year 2000;
- Located in a semi-arid region;
- Perennial river does not exist in the region, however during the rainy seasons the rivers present high flow rates;
- The main water supply is from groundwater;
- Natural high levels of uranium can be found in groundwater

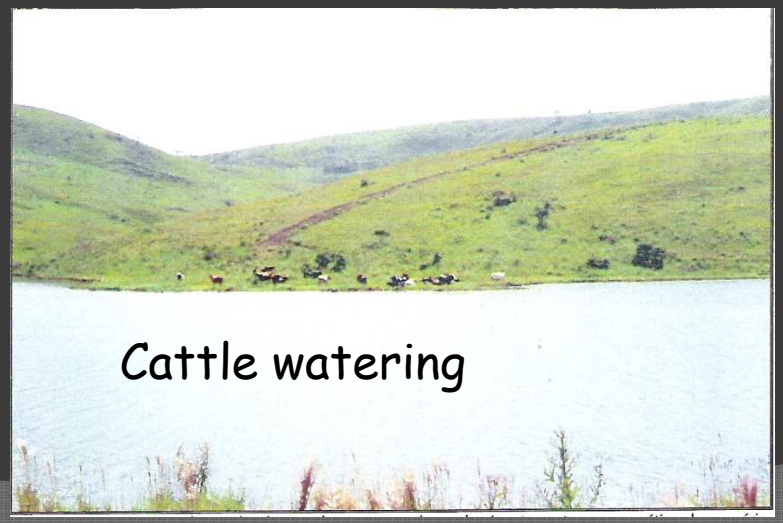
Brazilian mine and milling facility at Caetité-Bahia

- Minimal impact due to aerial transportation of aerosols and radon
- During rainy period the liquid effluent may overflow to a pond and then to a river;
- A hypothetical critical group was considered based on worst case scenario;
- Main exposure pathway is drinking water.
- For the establishment of the effluent limits , the transport of radionuclides in a river were assessed based on Safety Series 57.

Mine and Milling of Poços de Caldas

- The mining and milling operations ceased in 1997;
- However, due to an acid drainage problem, a chemical plant treatment is still active ;
- After the neutralization of acid mine drainage and the solid settlement in tailing dams the liquid overflow is released into two rivers.

Mine and Milling of Poços de Caldas



- Main release to environment: Liquid effluent discharge to rivers:
- Water uses: irrigation of crops; cattle watering;
- Model based on Safety Series 57
- Hypothetical critical group was considered (two groups: 0 to10 years and 17 to 70 years)
- Local parameters , e.g. bioacumulation and transfer factors , were used.

BRAZILIAN NUCLEAR FUEL CYCLE FACILITIES AT RESENDE, RIO DE JANEIRO

FCN Reconversão, Pastilhas e enriquecimento

FCN Componentes e Montagem

- One unit for conversion of enriched uranium hexafluoride into UO_2 pellets;
- A second unit for the manufacture of PWR fuel assemblies;
- A third unit for uranium enrichment;
- Only radionuclide discharge by atmospheric pathway was foreseen from these facilities.;
- Dose modeling based on Safety Series 57 ;
- A critical group was considered;

RADIOACTIVE FACILITIES IN BRAZIL

Facilities / Year	1999	2002	2005
Medical	1161	1261	1248
Industrial	877	984	1147
Research	607	694	701
Distribution	61	61	76
Services in the Nuclear Field	117	248	247
TOTAL	2823	3247	3419

Radiopharmaceutical usage release practices: Dilution to 75 Bq/g (Total Activity) and release to sewage systems

The main Nuclear Medicine Hospital- Rio de Janeiro city

Cancer Hospital
I^{131}-750 mCi/week

Hospital Marcílio Dias
I^{131}-600 mCi/week

University of Rio de Janeiro Hospital
(I^{131}-300 mCi/week)

- At least 1650 mCi of I^{131} /week is released in the sewage systems.
- An outfall sewer carries the effluents which are discharged into Guanabara Bay
- No assessment of the significance of the release of radionuclides from the hospitals was performed.

Summary

- Most *models used* in dose assessements of Brazilian facilities are based on Safety Series 57;
- The critical group concept is included in Brazilian standards, but in some facilities the concentration limits are derived considering representative person;
- Hypothetical critical groups and worst case scenarios are constantly used for limit establishments;
- The authorized limit values are fixed in concentrations of radionuclides;
- Site specific parameters , mainly bioacumulation factors and soil-plant transfer factors, are usually employed ;
- Site specific data of intake rates of foodstuffs and land use are used in the models;
- The release of medicine radionuclides from hospitals and consequent environmental impact is not evaluated;

Thanks for your attention

dejanira@ird.gov.br