The Brazilian Nuclear Program

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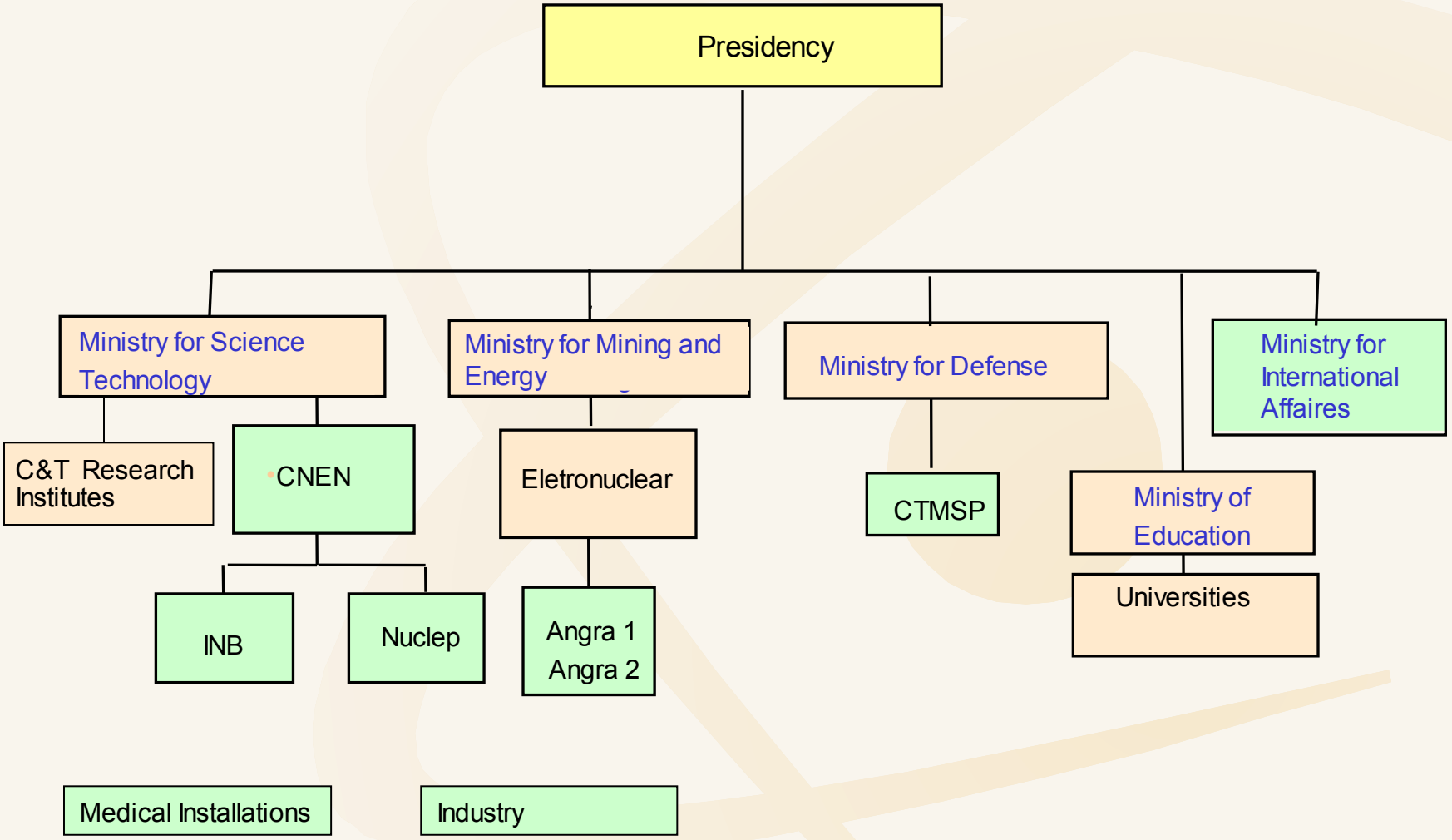
Ministério da Ciência e Tecnologia

BRASIL UM PAÍS DE TODOS GOVERNO FEDERAL

BRAZIL

- Population: 193.000.000
- Area: 8,514,215 km²
- Electricity sector
  - Installed capacity: 105 GW
  - Hydro: 92,7%
  - Oil/gas(others): 4,8%
  - Nuclear: 3%

THE BRAZILIAN NUCLEAR AREA



NUCLEAR POWER CAPACITIES

- ELECTRICITY PRODUCTION
- FUEL CICLE
  - URANIUM MINING AND MILLING
  - URANIUM ENRICHMENT
  - RECONVERSION AND PELLET FABRICATION
  - FUEL ELEMENT ASSEMBLAGE

* Nuclear represented 3% of installed electrical energy production capacity and 5% of the delivered electrical energy in 2004.

FACILITIES
(Published in the Brazilian Report for the Safety and Waste IAEA Conventions)

- 2 Nuclear Reactors
- 2 pools for temporary deposition of used nuclear fuel
- 3 temporary deposits for medium and low activity waste
- 4 High Intensity industrial irradiators
- 4 Research Reactors
- 8 (6+2) Cyclotrons for radiopharmaceutical production (+ 10 applying for license)
- 1 Synchrotron
- 5 Research Linear Accelerators
- ~ 25,000 sources in medical facilities for nuclear medicine
- ~ 30,000 sources used in industries

The Brazilian Nuclear Program

STRATEGIC PLAN
THE FUTURE

Since 2004 the Brazilian Government is studying the necessity and opportunity to launch a new program in the nuclear area, this study being conducted by MCT (trough CNEN), MME, and the Presidency.

This program was developed following a methodology that involves all main institutions and comprises:

STRATEGIC PLAN - THE FUTURE

Some basic principles:

Peaceful uses and non proliferation

Safety and Security

Waste Management

Human resources

STRATEGIC PLAN - THE FUTURE

Nuclear Energy – To reach about 5% of the Brazilian electricity production in 2030, finishing Angra 3 (2015) and building between 4 and 8 new reactors until 2030.

Fuel Cycle – Considering the uranium abundance in the country and the Brazilian technical capacity, to meet 100% of the national fuel demands in 2014, including enrichment.

Applications – To invest on S&T in nuclear applications: medical, industrial and for agro business, in order to reach self sufficiency in 10 years

Regulation - To create a new Regulatory Agency apart from CNEN

STRATEGIC PLAN - THE FUTURE

Specific goals

To Finish Angra 3

To build between other 4 and 8 new reactors of 1,000 MW to be settled in 2 or 3 sites

To plan and build a national multi purpose research rector (~30 MW)

To invest in all areas of fuel cycle but reprocessing: prospecting, oaring and mining, conversion, enrichment, reconversion and fuel assembly

To invest in all areas of nuclear applications

To Increase the regulatory capacities to face the new necessities

STRATEGIC PLAN - THE FUTURE

Specific goals

To perform a comprehensive review of the legal framework of the nuclear activities and the regulatory system

To invest in Research and Development in Nuclear Science and Technology, including fusion

To launch supporting programs in Universities and Research Institutes in order to attract new scientists, engineers, students and other human resources to the nuclear area

To build a final repository for low and intermediate level waste until 2018, and a long term interim storage site for spent fuel until 2026

STRATEGIC PLAN - THE FUTURE

Specific goals

To create a new Nuclear Regulatory body

BRAZILIAN NUCLEAR ENERGY COMISSION

The Brazilian regulatory body and nuclear promoter

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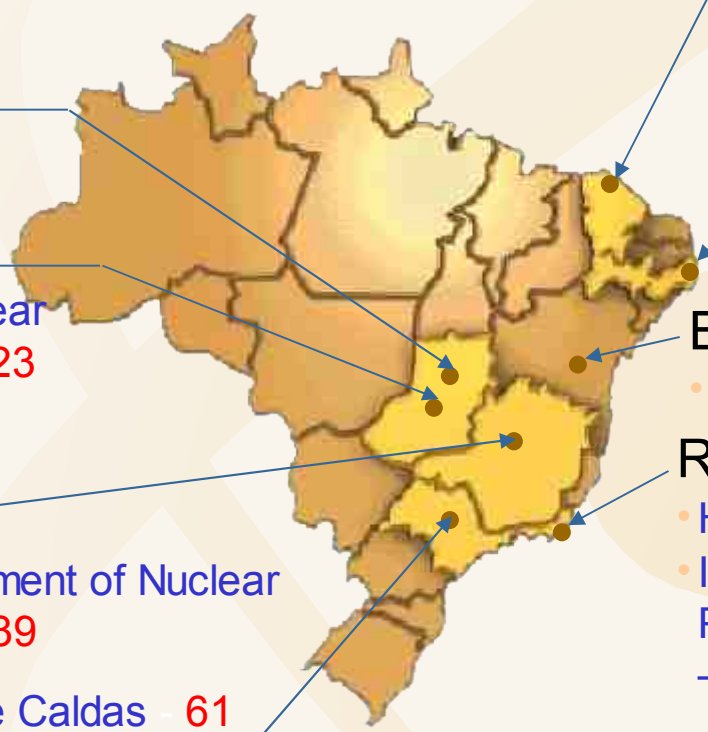
CNEN

- The National Nuclear Energy Commission was created in 1956 and became the responsible for the monopoly of nuclear energy issues.

- As in other countries, soon CNEN became the Brazilian Regulatory body

CNEN'S UNITS

(Staff)



Brasília
- Brasília office – 10

Goiás
- Regional Center of Nuclear Sciences (CRCN-CO) – 23

Minas Gerais
- Center for the Development of Nuclear Technology (CDTN) – 39
- Laboratory of Poços de Caldas – 61

São Paulo
- Institute of Energetic and Nuclear Research (IPEN) – 1.074

Ceará
- Fortaleza District – 15

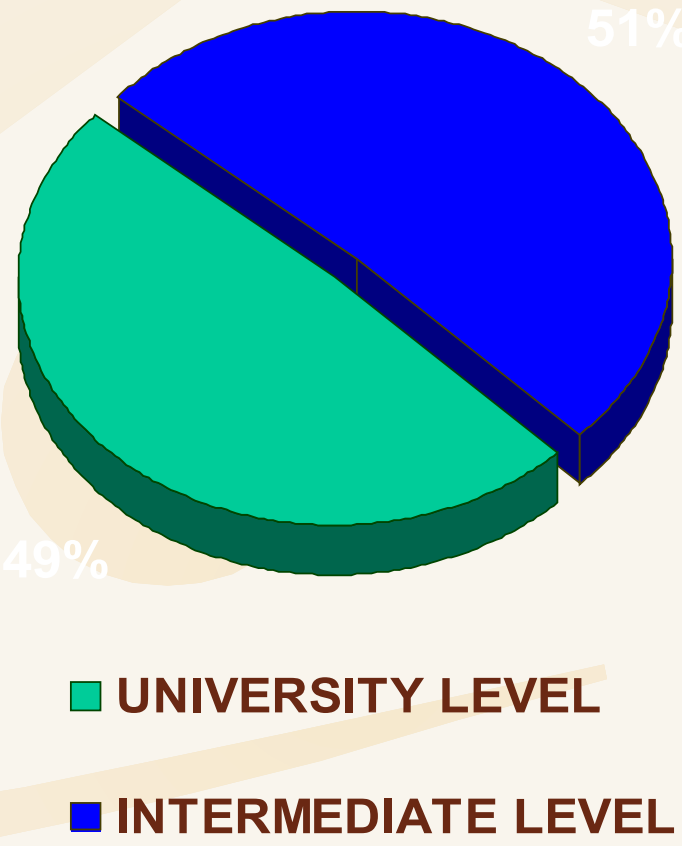
Pernambuco
- Regional Center of Nuclear Sciences (CRCN-NE) 60

Bahia
- Caetité (U mining) – 33

Rio de Janeiro
- Headquarters - 404
- Institute of Radiological Protection and Dosimetry (IRD) – 324
- Institute of Nuclear Engineering (IEN) - 287
- Angra dos Reis – 10

STAFF

- 2.665 employees
  - 49 % university level
    - 12 % PhD's
    - 17% master in sciences
    - 16% specialization
    - 4 % undergraduate
  - 51% intermediate level



CNEN Mission

NUCLEAR SAFETY AND SAFEGUARDS (BRAZILIAN REGULATORY BODY)

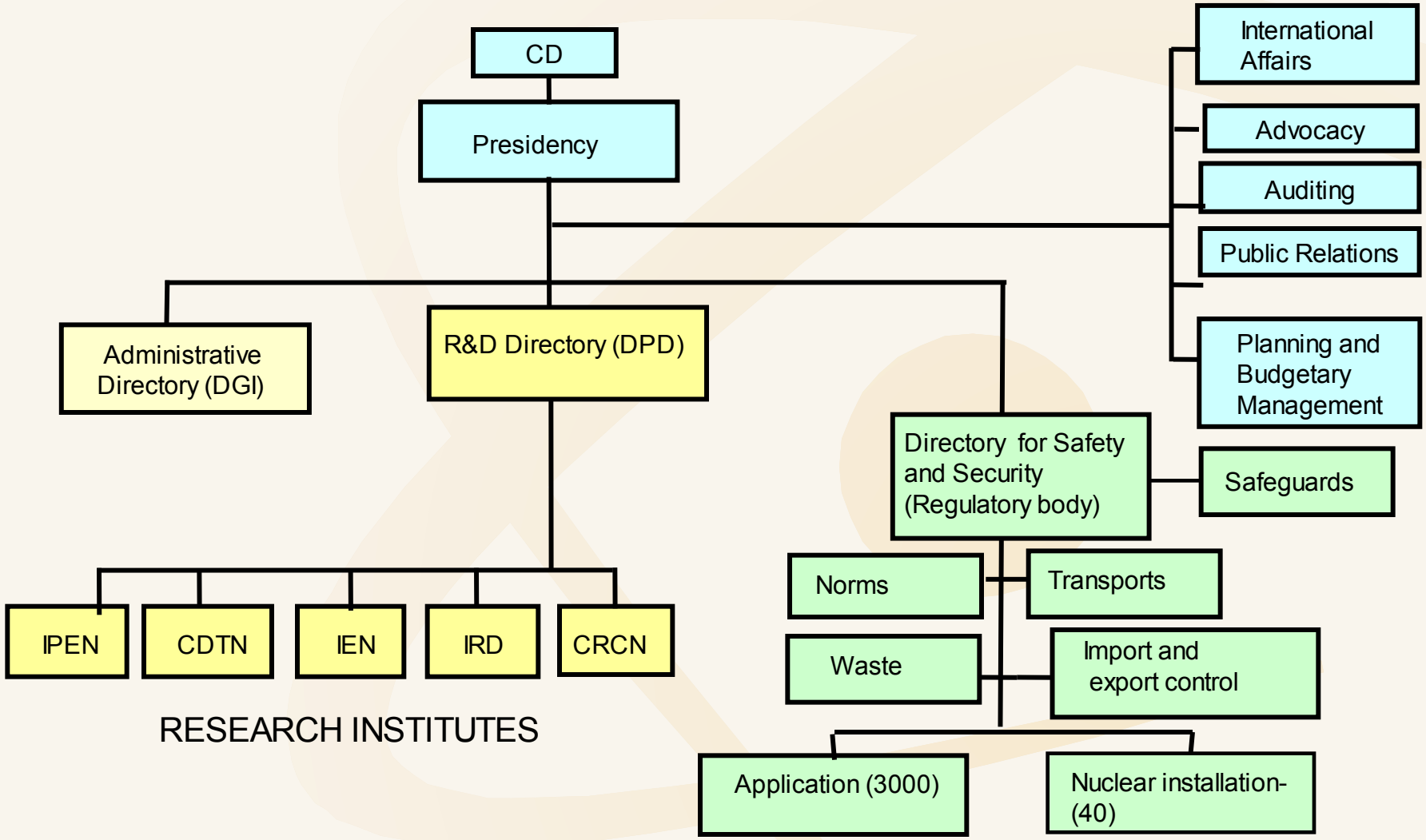
RESEARCH, APPLICATIONS AND INNOVATION

RADIO PHARMACEUTICALS PRODUCTION

EDUCATION

INTERNATIONAL ADVISORY TO THE MINISTRY OF INTERNATIONAL AFFAIRS

CNEN's ORGANIZACIONAL ESTRUTUCTURE



R&D Institutes of CNEN

- Recife, PE
- Belo Horizonte, MG
- Rio de Janeiro, RJ
- São Paulo, SP

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BRASIL UM PAÍS DE TODOS GOVERNO FEDERAL

CNEN

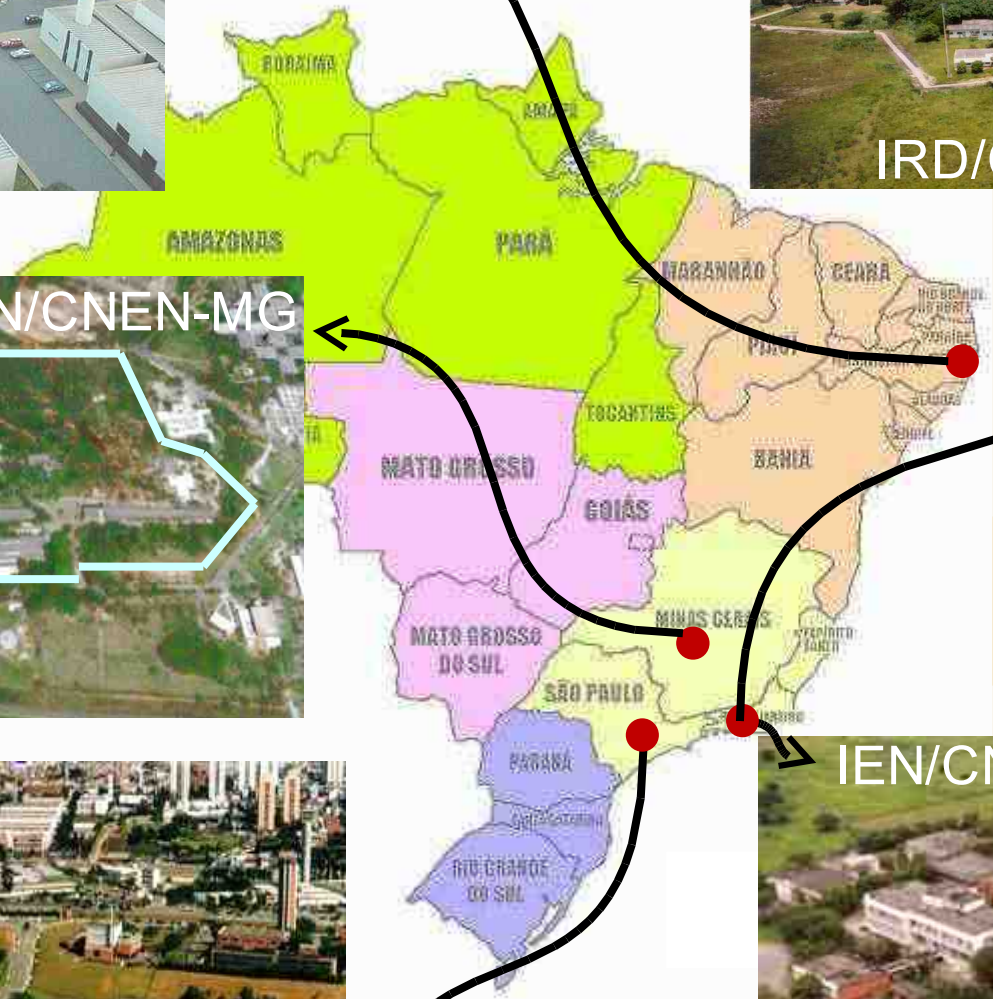

CRCN-NE/CNEN-PE


IRD/CNEN-RJ


CDTN/CNEN-MG


IPEN/CNEN-SP


IEN/CNEN-RJ


RORAIMA
AMAZONAS
PARÁ
MARANHÃO
CEARÁ
PIAUÍ
TOCANTINS
BAHIA
MATO GROSSO
GOIÁS
MINAS GERAIS
MATO GROSSO DO SUL
SÃO PAULO
PARANÁ
RIO GRANDE DO SUL

Some numbers	2005-2008
Patent registrations	171
Softwares	20
New Tecnologies	301
Research projects	2072
Published papers	1261
Presentation in congresses	3228

Work in progress...

A new multi purpose research reactor

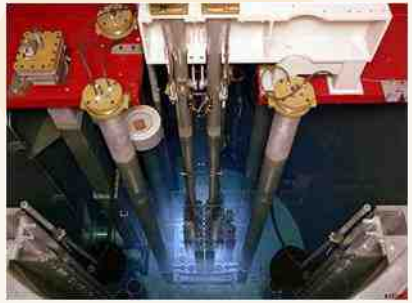
to be commissioned in 2016

- **MATERIALS IRRADIATION TESTING**
- **RADIOISOTOPE PRODUCTION**
- **R&D WITH NEUTRON BEAMS**

INVESTIMENT: ~US$ 500 MILLION

IEA-R1m
CNEN/IPEN
São Paulo

IPEN/MB-01
São Paulo



TRIGA
CNEN/CDTN
Belo Horizonte

ARGONAUTA
CNEN/IEN
Rio de Janeiro

Ministério da Ciência e Tecnologia

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GOVERNO FEDERAL

CNEN

Thank you

www.cnen.gov.br

The Brazilian regulatory body

CNEN: THE REGULATORY BODY

- Licensing and controlling of nuclear and radioactive facilities such as :
  - reactors
  - fuel cycle plants,
  - radioactive waste management facilities
  - medical, industrial and other institutions that use radioisotopes and radioactive sources
- Issuing and enforcing of Standards
- Personnel accreditation

REGULATION

1 - Nuclear Installations

2 - Security

3 - Safety

4 - Safeguards

5 - Waste

6 - Nuclear Materials, Minerals and Ores

7 - Transport

LICENSING PROCESS

- **NUCLEAR LICENSING BY CNEN**
  - SITE APPROVAL
  - CONSTRUCTION LICENCE
  - AUTHORIZATION FOR OPERATION
    - Initial
    - Permanent

- **ENVIRONMENTAL LICENSING BY OTHER AGENCIES**
  - IBAMA - BASED ON ENVIRONMENTAL IMPACT STUDY(EIA/RIMA)

EVALUATION AREAS

- Safety
- Security
- Safeguards
- Engineering and Materials
- Personnel capability
- Emergency preparedness
- Environmental protection

Regulation: lessons learned

The independence principle

- How really independent can an institution be?
- Separation of promotion (R&D) and regulation is a guarantee of independence?
- Does the institutional independency (and even the economical assurance) guarantee the effectiveness of control?
- Or is the record of the accident number and the public transparency that allow to evaluate the effectiveness and efficiency of the control
- TSOs

Think carefully about the independence principle

- For Brazil, it was important to wait for the proper time to create a Nuclear Regulatory body separated from the Nuclear Energy Commission, in order to guarantee the sustainability of both institutions.

Lessons learned

Human capacities: the first and main condition

- Necessities: engineers, physicists, geologists, chemists, and others…
- Training could take from months to one decade
- Way of thinking different from the traditional researcher or scientist: efficiency, efficacy, routine, schedule and hierarchy, are important

Lessons learned

Avoid the repressive police behaviour

- Be proactive
- If they don´t know, teach them
- Have in mind national and public interests

Lessons learned

Have a consistent legislation

- Provide different sanction grades
- Have space to deal differently with the different
- Consider the public interests

Lessons learned

Consult the operators to learn about the quality, efficiency an propriety of your service

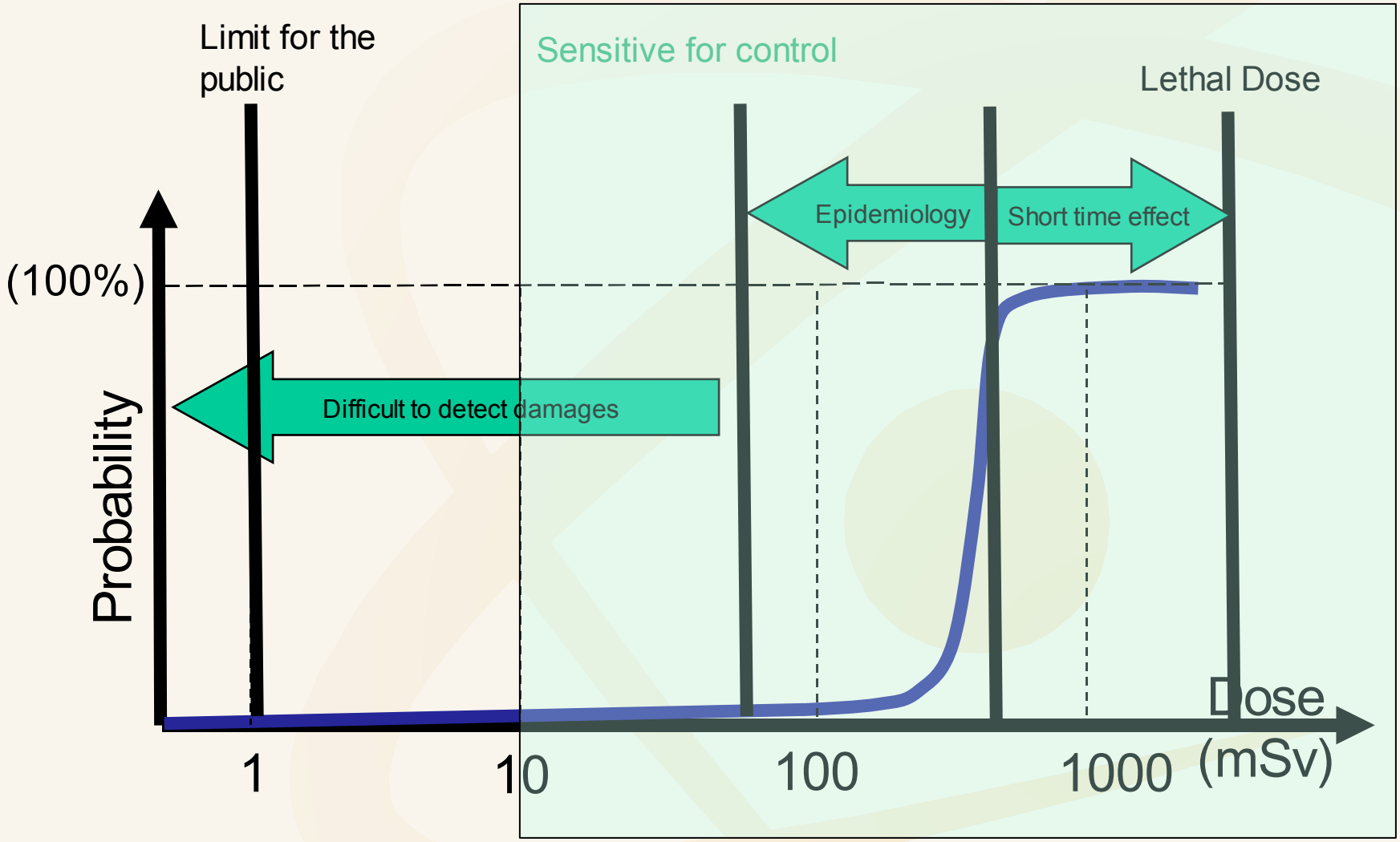
- Promote joint events with the operators
- Establish good and effective communication channels with the operators
- Reflect about suggestions

Lessons learned

Be transparent

- Inform the public about rules, risks and benefits of ionizing radiation and about the operators status
- Establish good and effective communication channels with the public
- Don´t try to hide or delay deliver of information concerning public interests.

Don´t ever forget: risk of damage



Lessons learned

Don´t try to control everything

- Take into account risks, benefits and costs .
- Consider the IAEA source classification
- Establish a prioritization for the installations aiming different scope of controls
- But… Try to keep track of ALL radioactive sources and equipment in the country

Lessons learned

The IAEA standards are the state of art. Fit them to your facilities and capacities.

- Sometimes it is better to do less but with more effectiveness, always considering risks and benefits
- Look at the different alternatives, for example American and European regulatory guides. You will be surprised.
- Somewhere another country has already dealt with similar problems and situations. Contact them.

Thank you

www.cnen.gov.br