A PROSPECTIVE RADIOLOGICAL RISK ASSESSMENT FOR A PHOSPHATE INDUSTRY PROJECT

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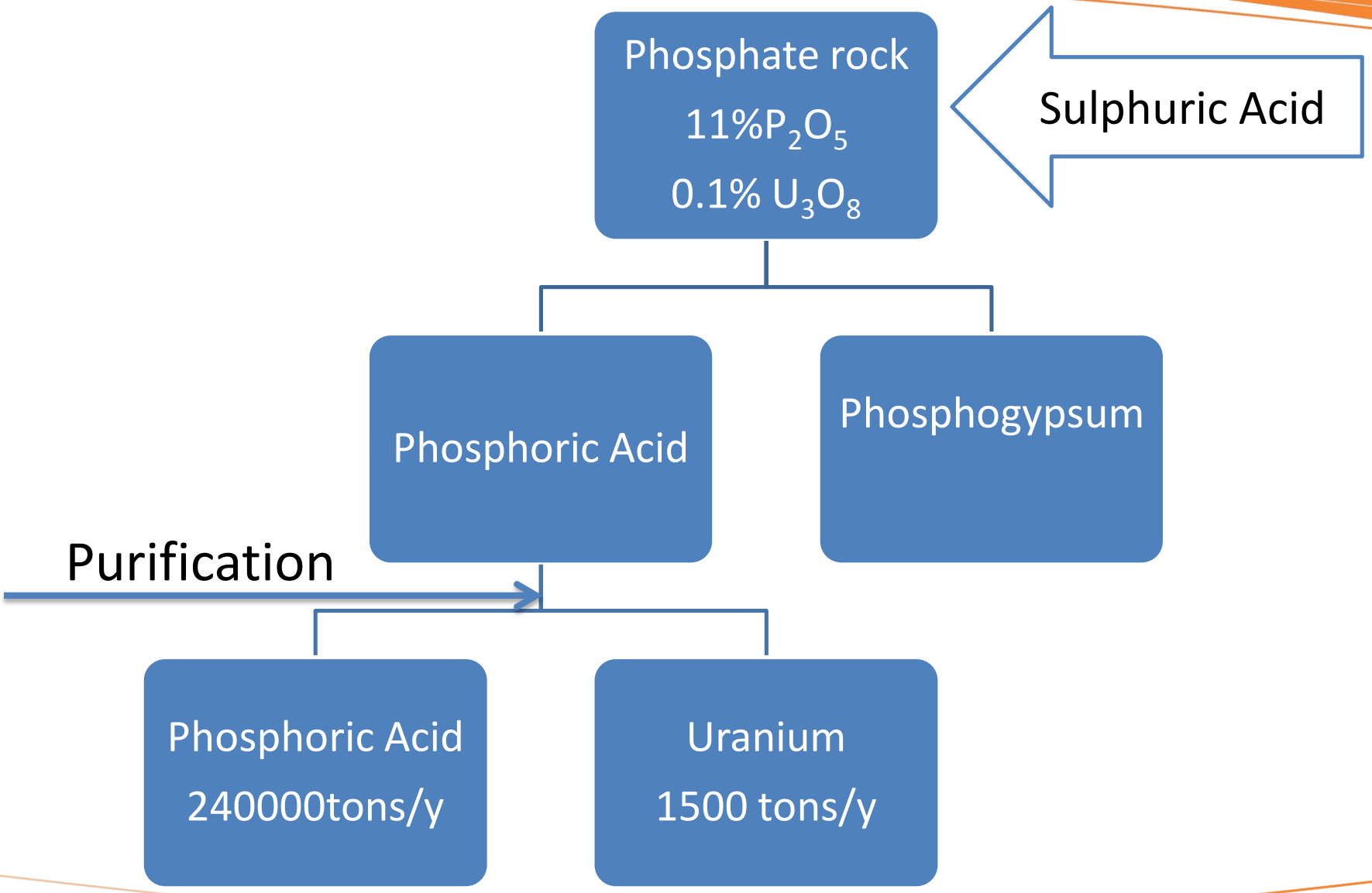
Objective

- The prospective radiological risk assessment helps the decision makers to identify the radiological risks. This can contribute for proposition of actions for minimizing risks and in consequence to ensure the viability of the project.
- This presentation concerns a prospective radiological risk assessment of a planned NORM industry: the Santa Quitéria facility,

The Santa Quitéria Facility

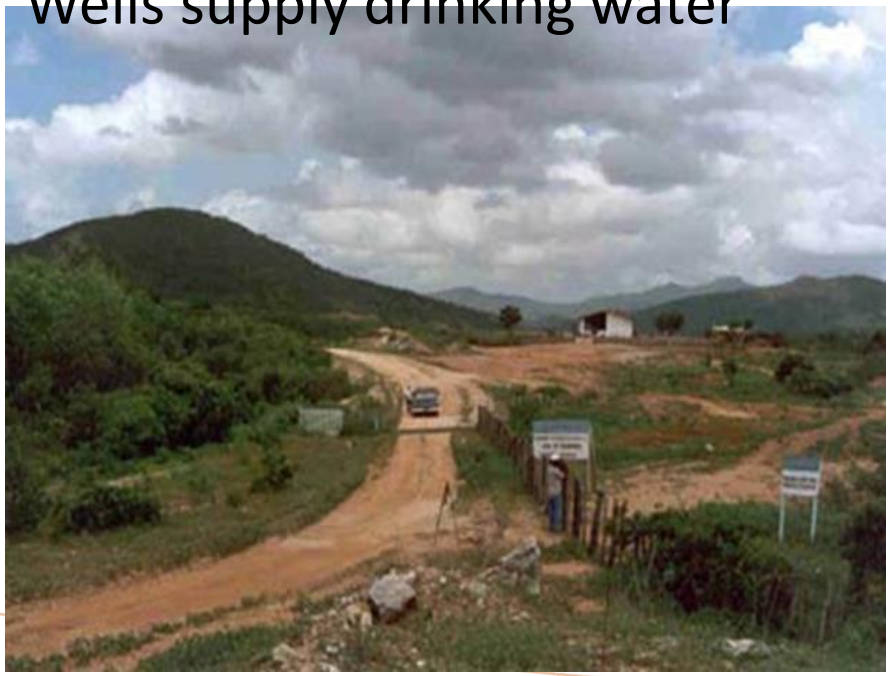
- The phosphate ore contains:
  - 11% of P_2O_5 and 0.1% of U_3O_8;
- The Santa Quitéria Facility will be the major Brazilian uranium mine;
- It will produced 240,000 tons of phosphate and 1,500 tons of yellow cake per year;
- At the end, some 37 million tons of PG will be produced.
  - The concentration of ^{226}Ra and ^{210}Pb in the PG would be 13 Bq/g.
- Stage of the project: Looking for financial support for starting the facility building.

Simplified Process of the facility



Santa Quitéria site

Semiarid climate, average temperature of 27°C, where rainfall is scarce but often of high intensity.
The soil has low permeability.
The landscape is etched by several continuous and intermittent streams. There are some perennial ponds.
Population: rural and sparse; subsistence farms;
Wells supply drinking water



Impact assessment of the PG stack

- The radiological impact was assessed with the RESRAD OFFSITE 2.6 and RESRAD (onsite) 6.5 codes;
- Parameters: available local parameters, RESRAD defaults, and similarities (e.g. the size of the PG stack)
- Three scenarios were developed :
  - A farm scenario:
    - for people living close to the borders of the site;
    - for people living on the stack, after the closure of the facility-site abandon.
  - A worker scenario.

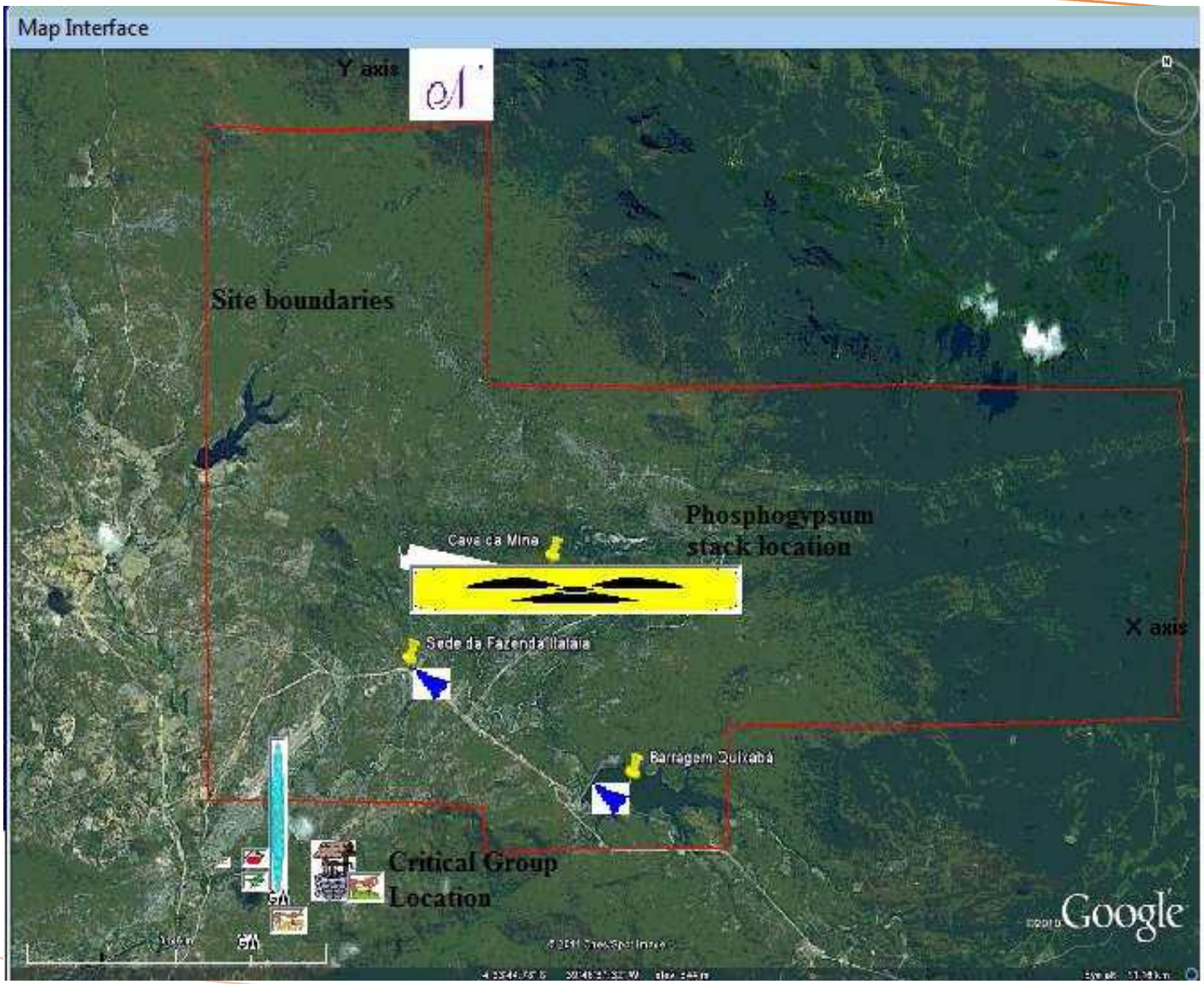
Scenario 1

- Representative person living close to the borders of the site;

  - Wells supply their drink water;
  - The products of the diet are locally produced;
  - The worst case scenario was simulated in which the direction of groundwater flux and the preferential direction of the wind are from the stack towards the farm;

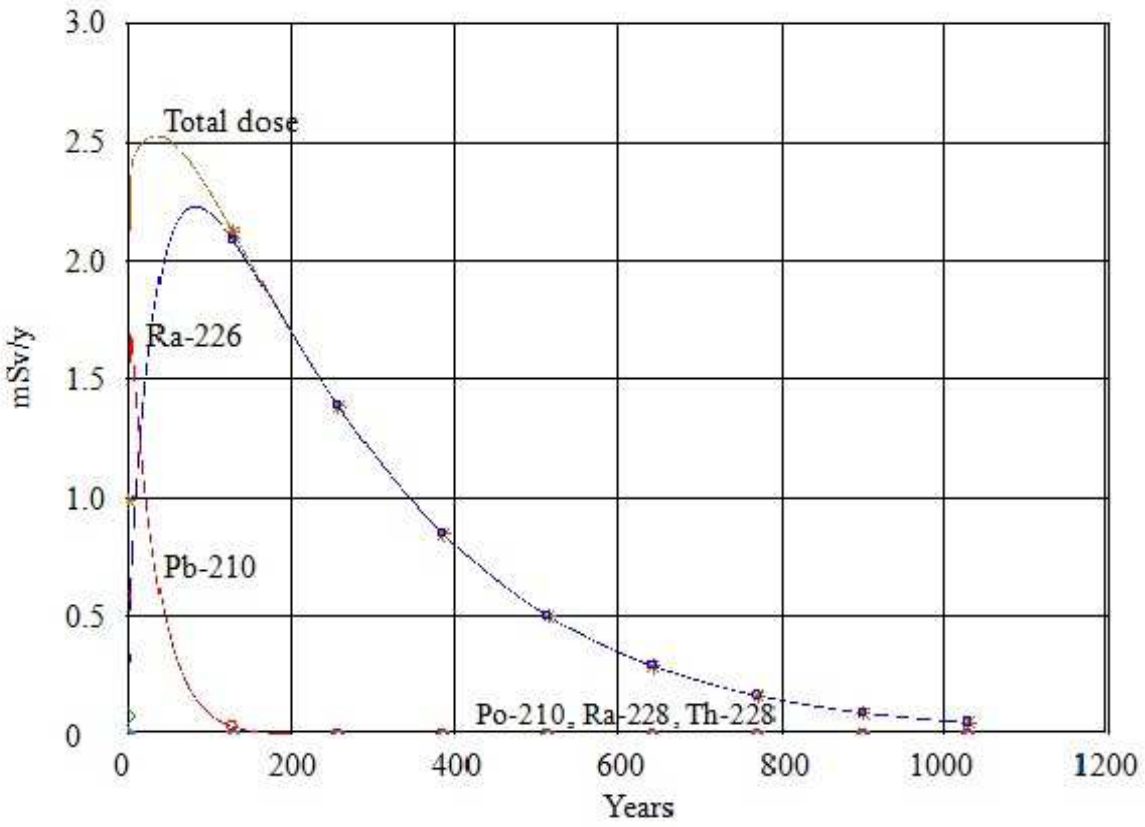
by EPA

Location of the critical group in relation to the PG stark.



Result: Scenario 1

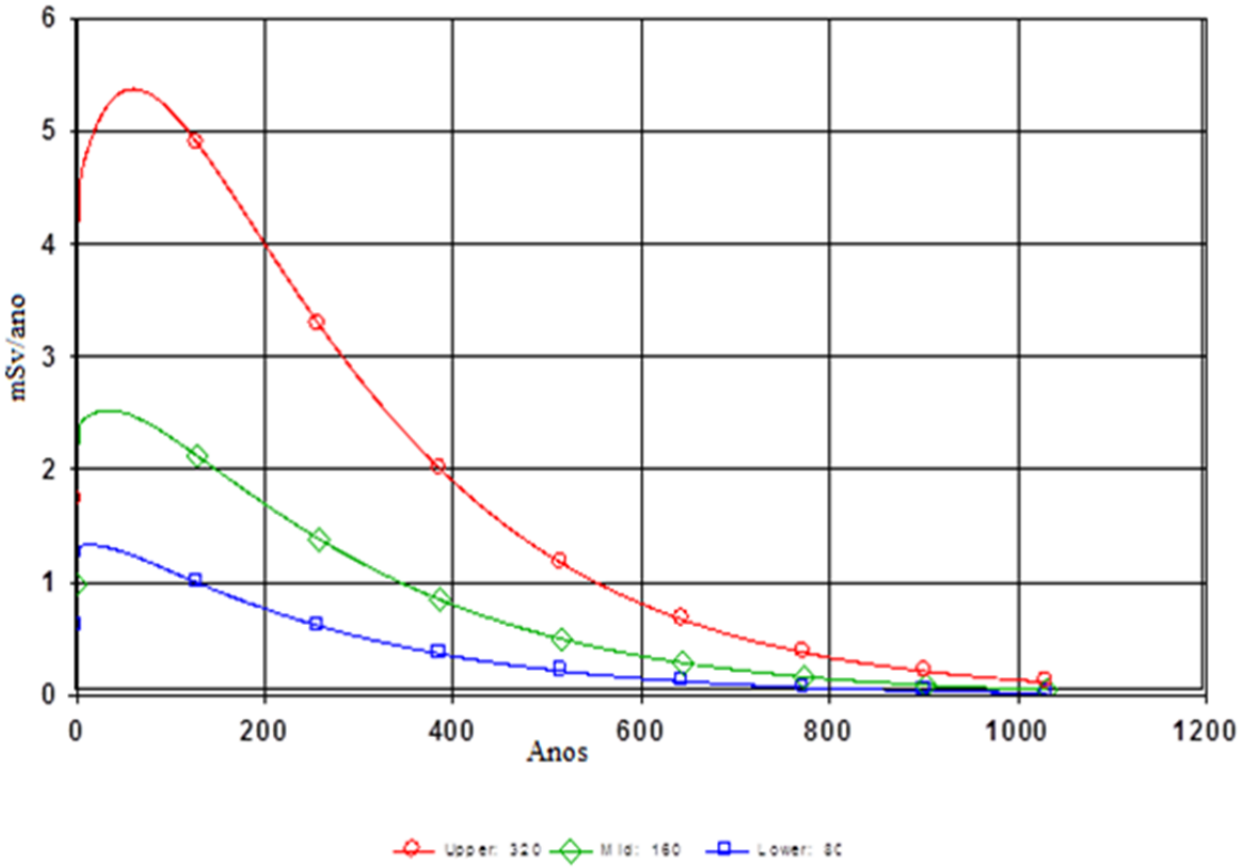
- The simulation pointed out a value of dose for the representative person of 2.5 mSv/year;



The fish consumption is the main contributor for the dose.

Sensitivity Analysis

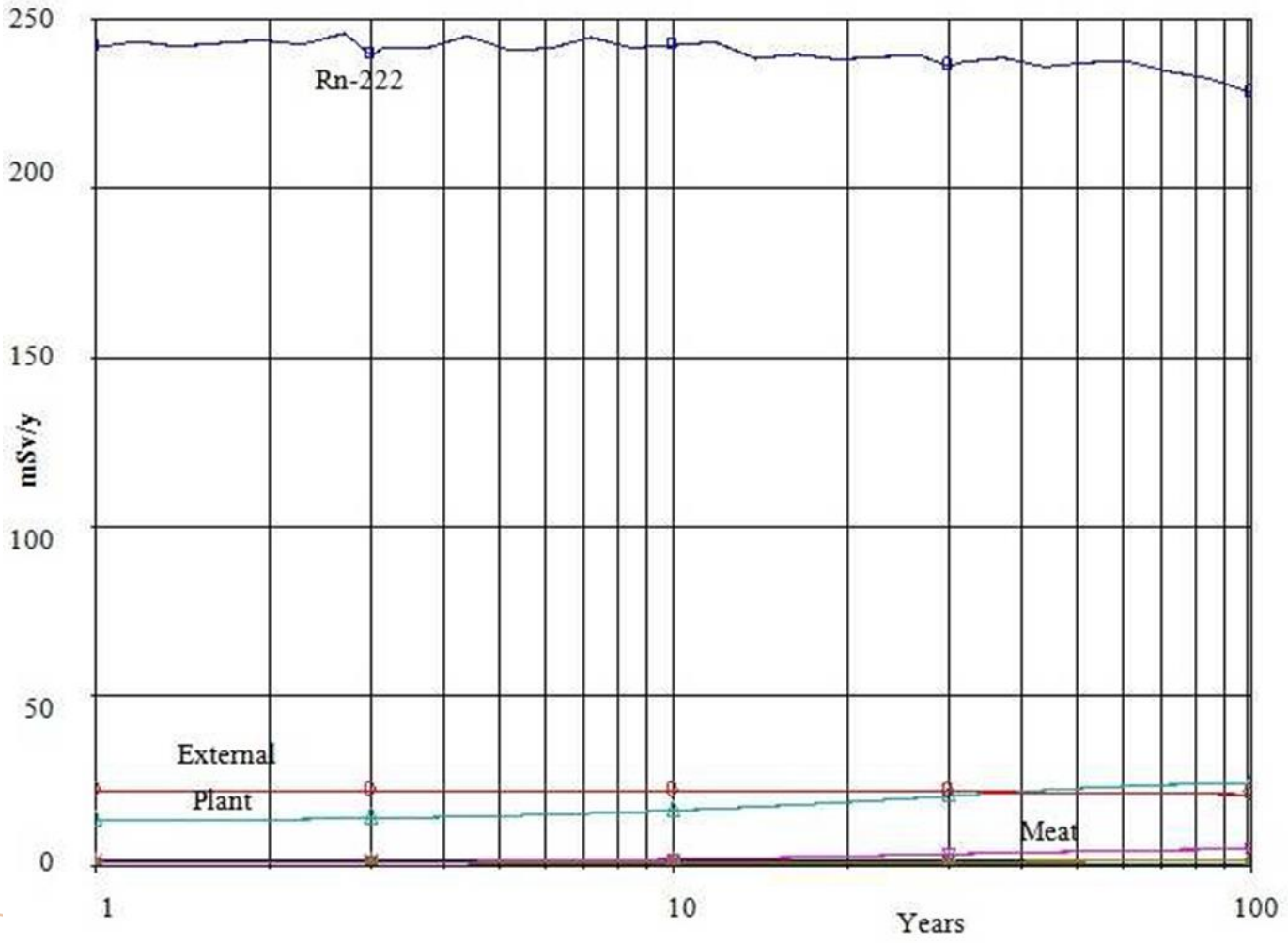
- The rainfall erosion index was identified as the most influential parameter for the total dose.



Surface runoff causes erosion of Phosphogypsum stack and then the PG is carried to the surface water.

Scenario 2-Abandon of the site

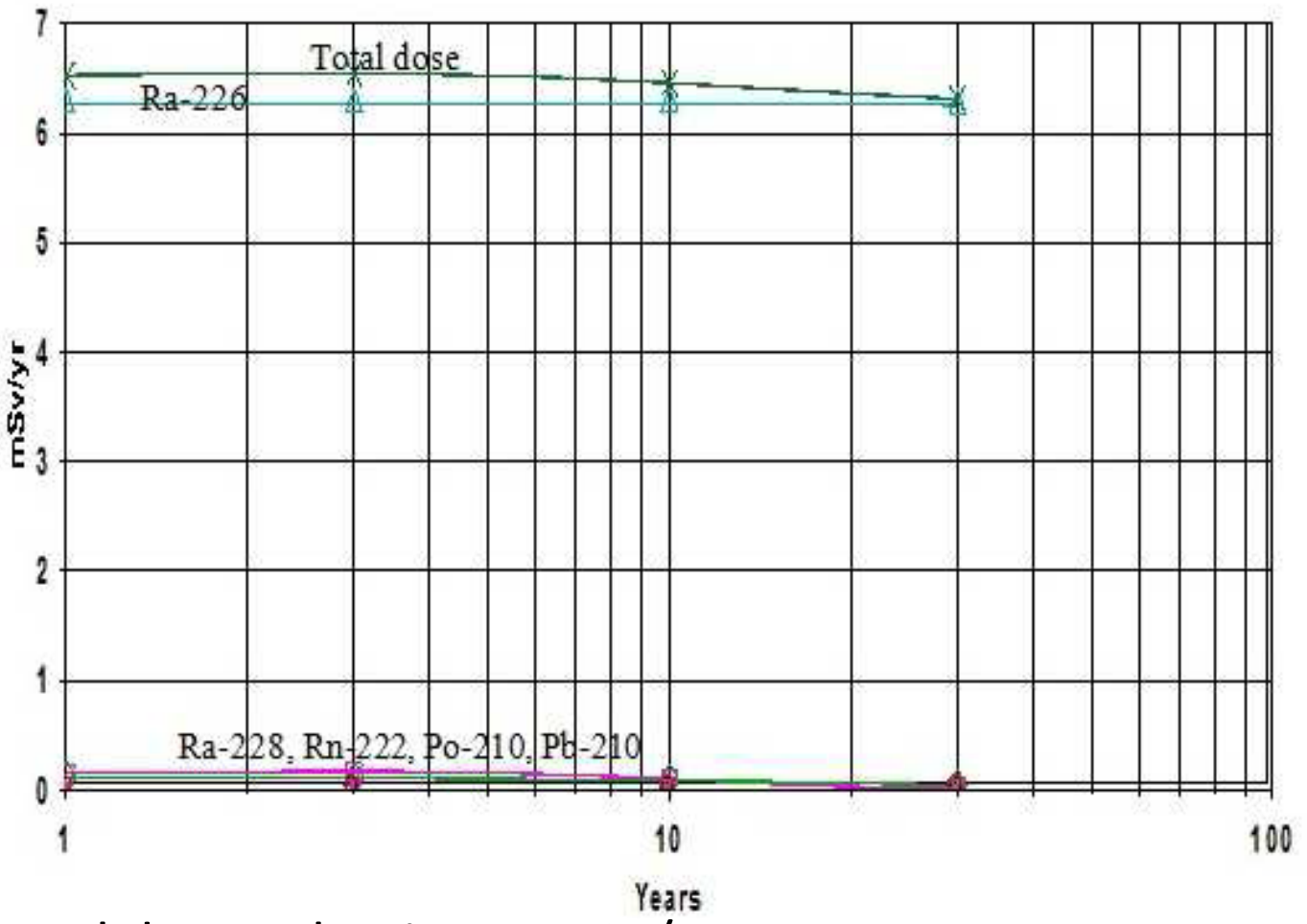
- The critical group is located on the top of the PG stack;



Worker Scenario

- The worker spends 4 hours per day on the stack;
- The exposure pathways are radon and dust inhalation, soil ingestion and external gamma;

Worker dose



The total dose value is 6.5 mSv/year;

The main contributor to the dose was ^{226}Ra;

The main exposure pathway was the external gamma exposure.

CONCLUSION

- For this assessment, the PG was the only source term of radiation in the site, and even so, the representative person dose exceeded the public dose limit of 1 mSv/year, as established by the new Basic Safety Standard (IAEA 2011) for planned exposition.
- According to the results, the disposal and shape of the stack is of major concern, since the runoff might be the main pathway for the environmental contamination.
- Based on that, studies should be carried out to determine the parameters related to runoff and the shape and disposal of the stack. Also the use of contention barriers for avoid the environmental contamination by runoff should be studied.

CONCLUSION

- The abandon scenario reveals a high dose for inhabitants who settle on the PG stack. It therefore demonstrates the need to plan the decommissioning of the site still in the phase of planning and include this subject in the studies of viability of the project. Specifically for SQS, the studies should encompass the alternatives for safe disposal and recycling of PG.
- Even though the PG stack is part of a conventional phosphoric acid facility, in view of the found value of dose, occupational radioprotection requirements will be need
- Summarizing, this study emphasizes the importance of conducting an environmental and occupational risk assessment, in the stage of planning of a NORM facility.

THANK YOU FOR YOUR ATTENTION!

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