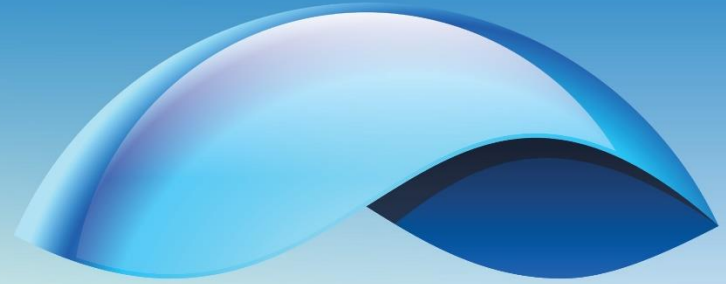


International Conference on  
**The Safety of Radioactive  
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**6-10 November 2023  
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**Ensuring Safety and  
Enabling Sustainability**



# Review of Safety Assessments for Radioactive Waste Storage facilities

Ensuring Safety and  
Enabling Sustainability

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# Background



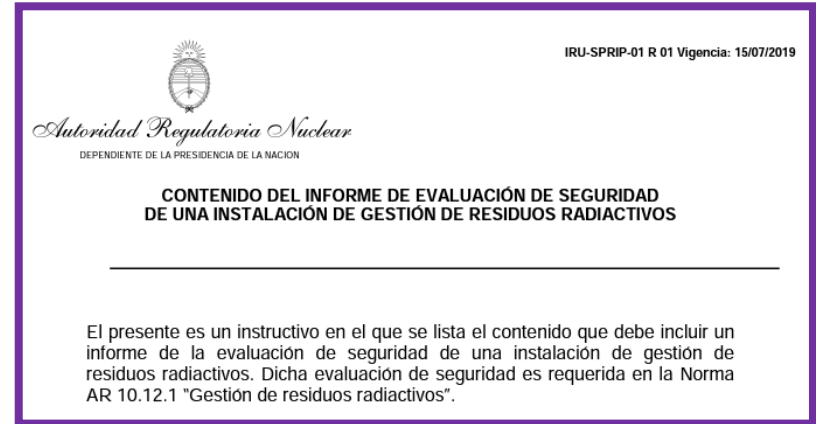
Radioactive Waste Management standard AR 10.12.1 rev. 3 of the Nuclear Regulatory Body from Argentina, requires that **radioactive waste storage facilities develop a safety assessment**, in order to **ensure safety** among their lifecycle and guarantee that **radiation protection measures** to the public and the environment are accomplished, as well as dose limits and constraints.



# Background



During 2019, an instructive of the content of the safety assessment was developed by the Radioactive Waste Management Control Section of Nuclear Regulatory Authority (NRA), in order to facilitate to operators the process of preparation of the documentation needed to perform the safety assessment and harmonize with recommendations of IAEA GSG Part 3.



*Regulatory Instructive: “Contents of the safety assessment report of a radioactive waste management facility”*

[https://www.argentina.gov.ar/sites/default/files/iru-sprrip-01\\_r\\_01.pdf](https://www.argentina.gov.ar/sites/default/files/iru-sprrip-01_r_01.pdf)

# Safety assessment documentation

## *Facilities safety assessment*

During 2020, NRA reviewed the safety assessment documentation from **RW** storage facilities located within the NPP's sites and an atomic center site.



The safety assessment was developed by the responsible entities. In total, 13 operating RW storage facilities and 2 new constructed storage facilities were evaluated.

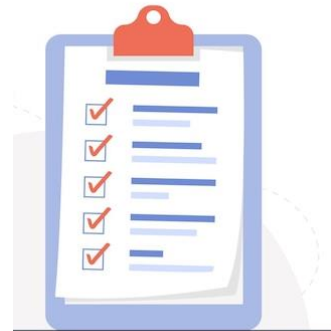
The documentation received by the NRA consisted on: **description of the facilities**, a **risk matrix identifying the potential initiating events (PIEs)** for each storage facility, the **inventories** and the calculations of the associated **scenarios and impacts**.



## *Safety assessments content information*

The different documents covered the information in line with the instructive:

- **General information:** Objective, scope, justification, description of the facilities (general, siting information, building, inventories, safety functions, associated documentation and procedures)



## *Safety assessments content information (cont.)*

- **Methodology** (assumptions, data, models, codes, criteria, identification of PIEs, scenarios, impacts, end points and dose calculations). Information about the different conducted assessments:



# Safety assessment documentation



## *Safety assessments content information (cont.)*

- \* **Normal operation:** identification of activities (e.g. waste reception and manipulation, stowage, measurements, inspections, housekeeping), duration and frequency of each one, associated procedures, reference dose rates.
- \* **Accidental situation:** diagram with natural external events, induced by human and internal events and their probability. The determination of the scenarios and impacts associated with the events.





## *Safety assessments content information (cont.)*

- **Results, conclusions** (safety level of each facility, identification of improvement opportunities on safety, procedures, barriers, etc.) and references.



# Regulatory review process



## *First step: general review*

The **Control of Radioactive Waste Management Section** conducted the main review process with an independent verification approach.

This section was in charge of coordination of the SA review, verification of all the different scenarios and impacts using IAEA SAFRAN TOOL.

# Regulatory review process



## *First step: general review*

The first step was a **general revision** in line to verify the general items:

- *Facilities and site information* and comparison with inspection reports.
- *Inventories* according to the periodic information received from the facilities and calculations of a *full storage situation*.
- Preliminary *PIEs* exclusion and *selection* of the specific ones.
- *Comparison* with *PIEs* facilities selection according with the site and building characteristics and an appropriate *graded approach*.
- Identification of the *scenarios, end points and impacts*.
- Loading data into *SAFRAN projects*.

# Regulatory review process



The screenshot displays the SAFRAN 2.2.0.17 EN/ES software interface. The main window shows a tree view of project components, including 'System description', 'Facilities', 'Waste management activities and processes', and 'Regulatory frameworks'. Three dialog boxes are overlaid on the interface, each titled 'Import PIE types' and containing a list of potential incident types with checkboxes for selection.

- Import PIE types - External natural:**
  - Lightning (effect on power supply)
  - Lightning (effect on surroundings of facility)
  - Lightning (effect on facility)
  - Extreme snowing
  - Extreme rain
  - Extreme drought
  - Strong wind
  - Extreme temperatures
  - Hydrology and hydrogeology
  - Geology of site and region
  - Seismic events
  - Other effects of ground stability
  - Geomorphology and topography of site
  - Terrestrial and aquatic flora and fauna
  - Flooding
- Import PIE types - Internal:**
  - The acceptance (inadvertent or otherwise)
  - The processing of waste that meets acceptance criteria
  - A criticality event due to the inappropriate
  - Explosion due to the evolution of explosion
  - Spontaneous combustion
  - Local hot spots generated by malfunction
  - Sparks from machinery, equipment or electrical
  - Sparks from human activities such as welding
  - Explosions
  - Gross incompatibilities between the components
  - The degradation of process materials (e.g. corrosion)
  - The failure to take account of the non-compliance
  - The generation of a toxic atmosphere
  - Dropping waste packages or other loads
  - Collisions of vehicles or suspended loads
  - Failures of structures, systems and components
- Import PIE types - External human induced:**
  - Explosion
  - Fire
  - Aircraft crash
  - Missile due to structural or mechanical failure
  - Ground subsidence or collapse due to tunneling
  - Ground vibration
  - The release of any corrosive, toxic and/or radioactive
  - Geographic and demographic data
  - Changes in population around facility (including migration)
  - External impacts from industrial and military incidents
  - Power supply and the potential loss of power
  - Civil strife



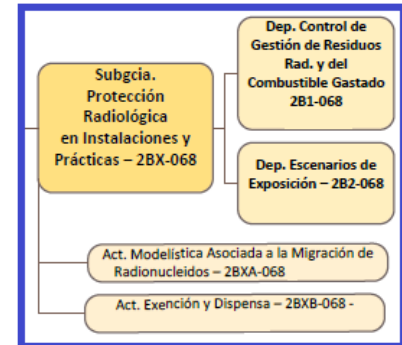
Example of SAFRAN review project and selected PIEs by category (external natural, internal and external human induced)

# Regulatory review process



## *Second step: working groups*

The **Radiation Protection Division** reviewed the specific documentation through three other multidisciplinary working groups: Modelistic, Radiation Protection and Shielding.

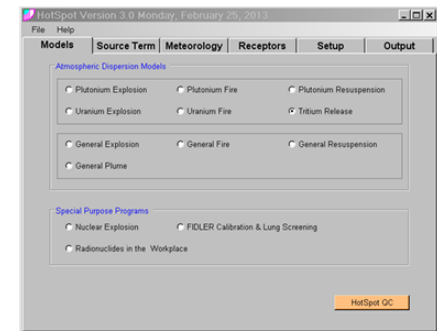


# Regulatory review process



## *Second step: working groups (cont.)*

**Modelistic Section:** considering data facility and the inventories provided, this group modeled the different identified scenarios for accident situations using codes PC-CREAM and HotSpot softwares. Their final output was an assessment of the **release of radionuclides to air and groundwater radionuclides migration.**



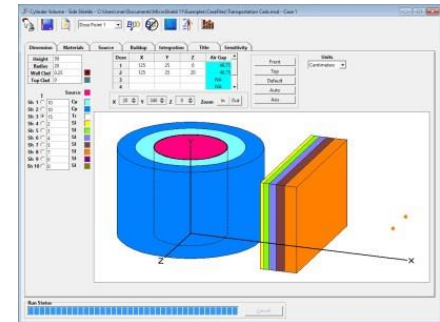
# Regulatory review process



## *Second step: working groups (cont.)*

**Shielding Section** : was in charge of verifying the dose rates on normal operation scenarios, taking into account the building characteristics and the inventory of each facility using Monte Carlo simulations. In addition, external doses in case of foreseen internal events (e.g. waste package drop) were calculated using Microshield Software.

**MicroShield<sup>®</sup>**



# Regulatory review process



## *Second step: working groups (cont.)*

**Radiation Protection Section:** verified that the activities related with normal operation, in particular, their duration and frequency were coherent with the realistic situations according to the inspection reports. The doses of the workers were also compared with dose restrictions.





# Final steps

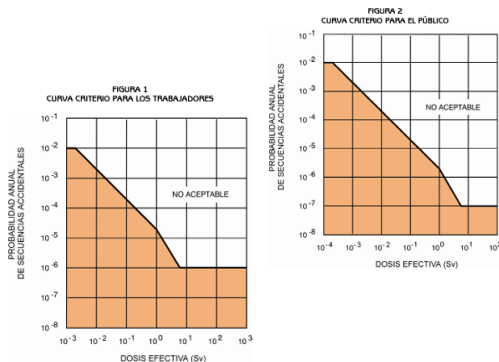


**Radioactive Waste Section** analyzed the documentation and the working groups inputs in order to verify that the safety level and safety functions of each facility were adequate, taking note of the improvements needed to fulfill the safety objectives.



# Final steps

Finally, a comparison with the safety assessment developed by the facilities owners was performed, paying particular attention in dose calculations.



Every scenario dose were compared with the correspondent dose restriction (normal operation) and the criterion curve (dose vs probability on accidents situation) according to Regulatory standards.

# Conclusions



- The results of implementing the NRA new standards and procedures for the reviewing of safety assessments of radioactive waste facilities are considered to be truly successful for the Country.
- The process allowed to detect and promote safety improvements, as well as to harmonize the safety functions of each radioactive waste storage facility.
- Nuclear Regulatory Authority has now a well-established procedure for the review and assessment of SA from predisposal RWM facilities.
- The SA review process is coordinated by the Radioactive Waste Management Section with strong contribution from other specialized groups within the regulatory body.

# References



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- [2] INTERNATIONAL ATOMIC ENERGY AGENCY, *The Safety Case and Safety Assessment for the Predisposal Management of Radioactive Waste*, IAEA Safety Standards Series No. GSG-3, IAEA, Vienna (2013)
- [3] NUCLEAR REGULATORY AUTHORITY, *Basic Safety Standard, AR 10.1.1 Rev. 4*, Buenos Aires (2019)
- [4] NUCLEAR REGULATORY AUTHORITY, *Radioactive Waste Management Standard, AR 10.12.1 Rev. 3*, Buenos Aires (2016)
- [5] NUCLEAR REGULATORY AUTHORITY, *Regulatory Instructive, Contents of the safety assessment report of a radioactive waste management facility (IRU-SPRIP-01)*, Buenos Aires (2019)
- [6] INTERNATIONAL ATOMIC ENERGY AGENCY, *Generic Models for Use in Assessing the Impact of Discharges of Radioactive Substances to the Environment*, Safety Reports Series No. 19, IAEA, Vienna (2001)
- [7] INTERNATIONAL ATOMIC ENERGY AGENCY, *Methodology for Safety Assessment Applied to Predisposal Waste Management*, IAEA-TECDOC-1777, IAEA, Vienna (2015)



**iThank you for your  
attention!**

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