

# Disposal solutions implemented for VLLW

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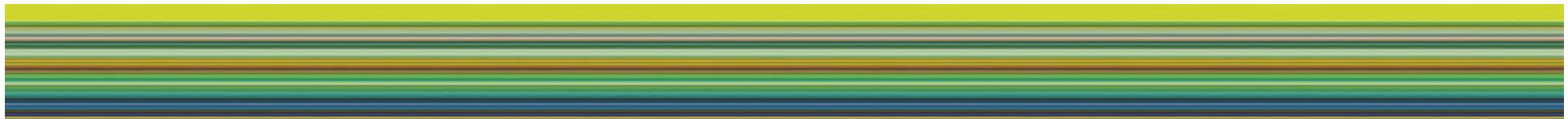
ENRESA



International Atomic Energy Agency Scientific Forum  
**RADIOACTIVE WASTE:  
MEETING THE CHALLENGE**  
Science and Technology for  
Safe and Sustainable Solutions  
23–24 September 2014, Vienna, Austria

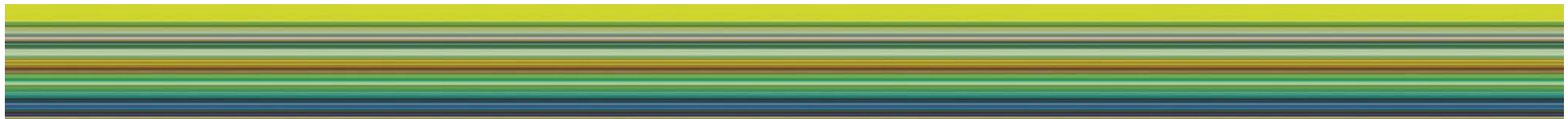
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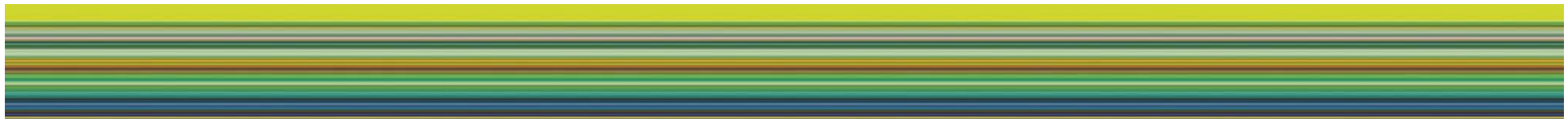
# CLASSIFICATION OF RADIOACTIVE WASTE

- The classification of radioactive waste can be defined according to:
  - Origin
  - Half-life
  - Radiation level
  - Disposal route
- The disposal route is the practical way to classify the waste, taking into account its characteristics and protection means
- Knowledge of the characteristics of the waste needed



# CLASSIFICATION OF RADIOACTIVE WASTE

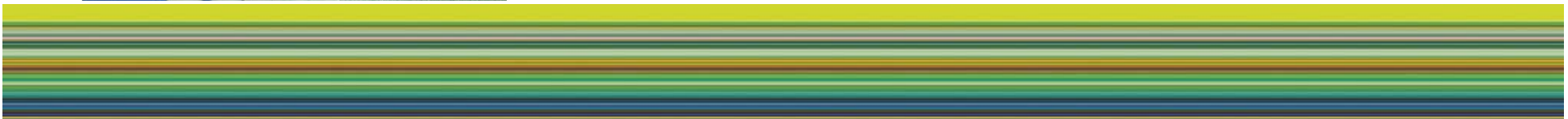
- IAEA General Safety Guide GSG-1
  - Exempt Waste (Exemption and clearance)
  - Very short lived waste (VSLW)
  - Very Low Level Waste (VLLW)
  - Low Level Waste (LLW)
  - Intermediate Level Waste (ILW)
  - High Level Waste (HLW)



## Origin of Very Low Level Waste (VLLW)



- *Nuclear installations*
  - *Operation*
  - *Decommissioning*
  - *Site restoration*
- *Mining or Processing of Ores and Minerals*
  - *U mining and milling*
- *Conventional industry*
  - *Phosphate*
  - *Oil / gas exploration*
  - *Metal scrap furnace incidents*



# DISPOSAL SOLUTIONS FOR VLLW

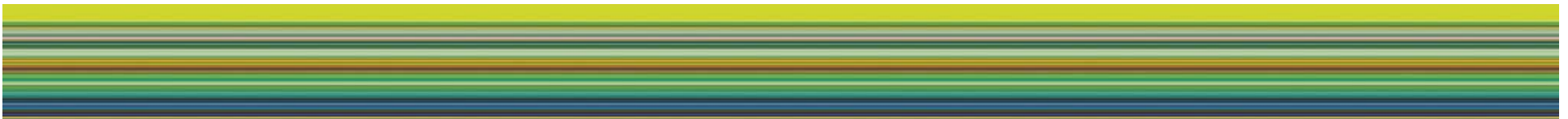


VLLW disposed of together with LLW



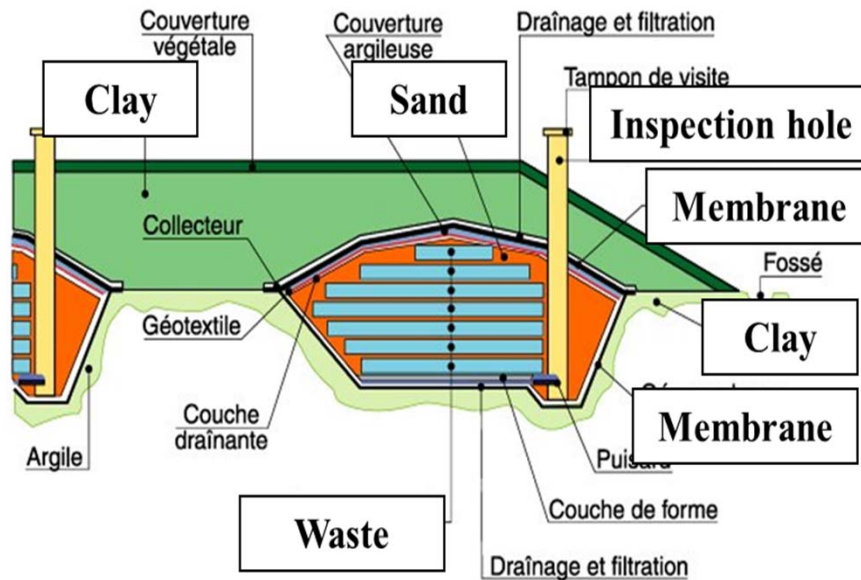
Dedicated facility for VLLW

In situ stabilization of tailings



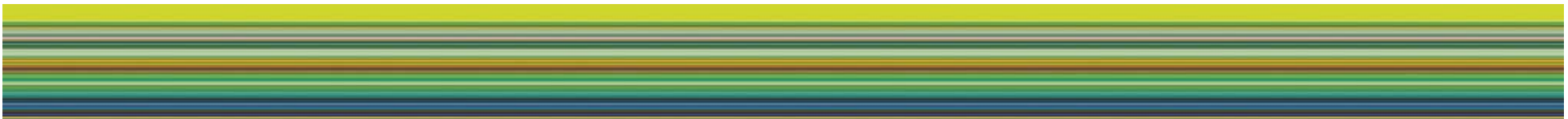
## DEDICATED FACILITIES FOR DISPOSAL OF VLLW

Cross section of a disposal cell



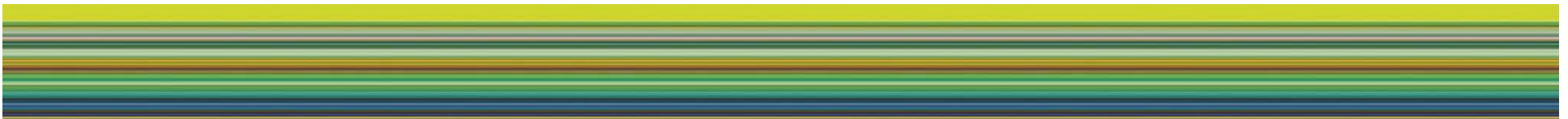
Courtesy of ANDRA

- Engineered surface landfill type facilities
- Requirements proportional to the hazard
- Limited nuclear regulatory control



## GENERAL OBJECTIVES

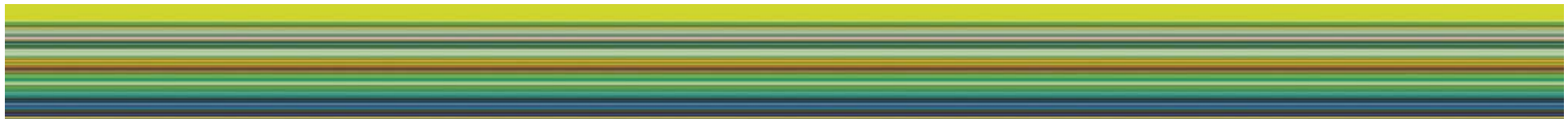
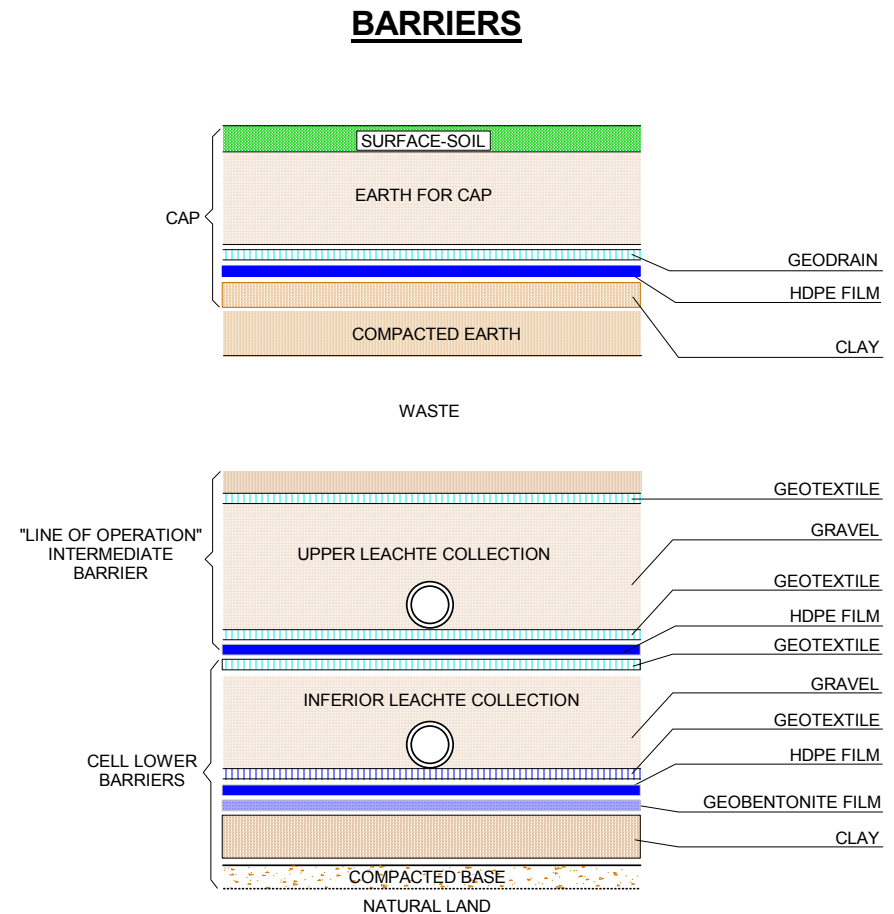
- Ensure the immediate and deferred protection of the public, the workers and the environment, during operation and after closure
- Ensure the control and surveillance of the site





# DESIGN CRITERIA

- The use of isolation barriers to prevent radionuclide migration
  - Geomembrane
  - Clay
- Limitation of activity per waste disposal unit (package, cell)
- Requirement for a surveillance period

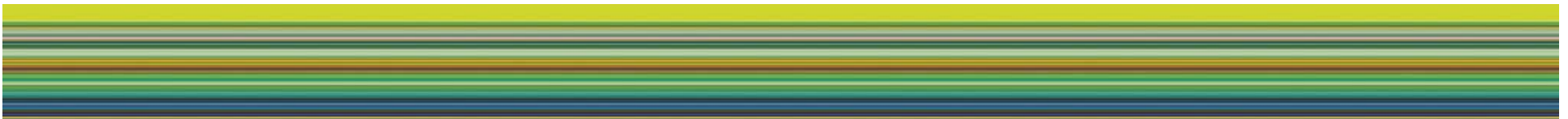


# WASTE FORM CHARACTERISTICS

- Site specific Waste Acceptance Criteria
- Waste forms



- Batch configurations



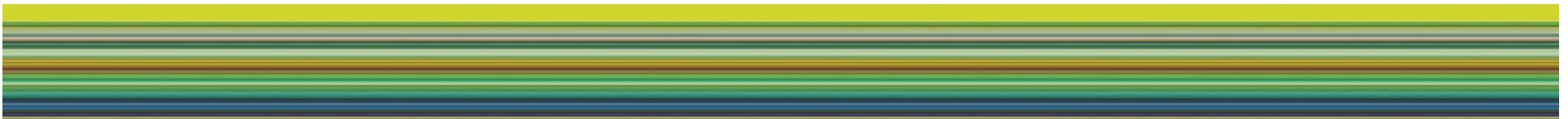
# WORLDWIDE EXPERIENCE

## Shallow land burials for VLLW in Sweden



Oskarshamn NPP, Sweden

- Forsmark NPP
- Oskarshamn NPP
- Ringhals NPP
- Studsvik



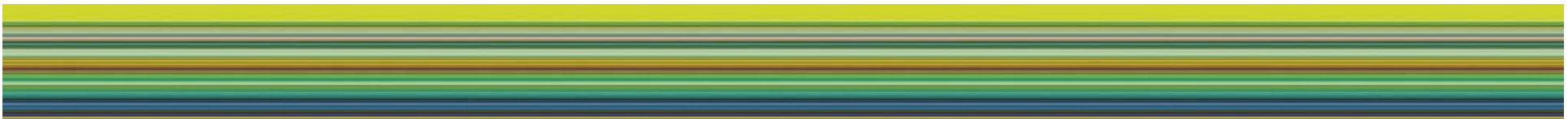
# WORLDWIDE EXPERIENCE

## United States of America



Barnwell, USA

- Existing facilities for LLW disposal
- *Class A* can be assimilated to VLLW
- Disposal facilities with specific areas for Class A
  - Richland (Washington)
  - Barnwell (South Carolina)
  - Clive (Utah)
  - Oak Ridge (Tennessee)
  - Andrews (Texas)



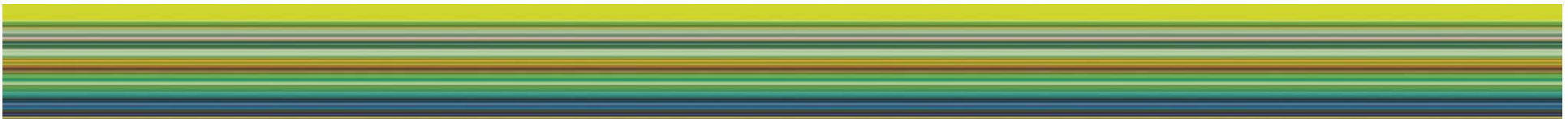
# WORLDWIDE EXPERIENCE

## France

- Morvilliers disposal facility in operation since 2003
  - Disposal capacity for up to 650,000 m<sup>3</sup>
  - Cells excavated as needed
  - Isolation barriers
  - Operation shelter
  - Processing and repackaging systems (compaction, inertization)
  - Monitoring the environment
  - Surveillance after closure (30 years)



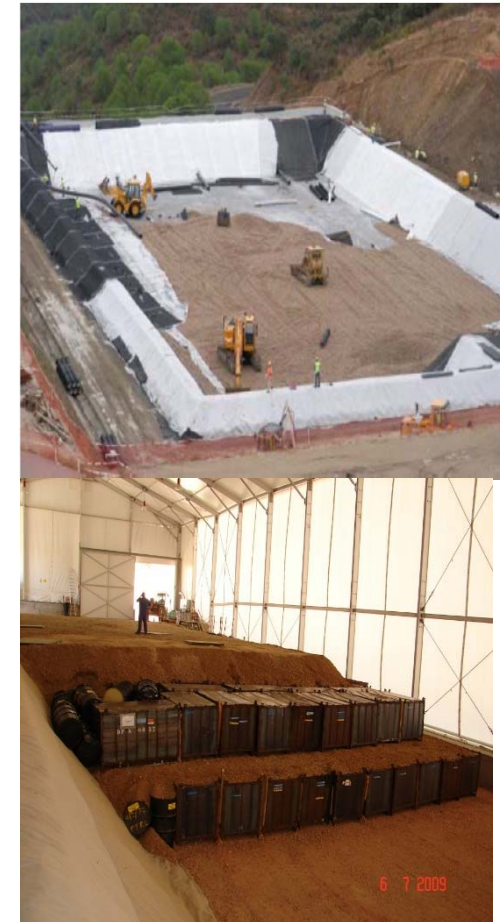
Morvilliers, France



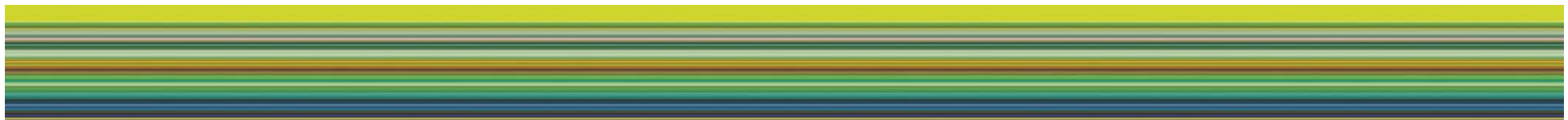
# WORLDWIDE EXPERIENCE

## Spain

- Part of the El Cabril disposal centre in operation since 2008
  - Disposal capacity for up to 130,000 m<sup>3</sup>
  - Cells excavated as needed
  - Isolation barriers
  - Operation shelter
  - Processing and repackaging systems (compaction, inertization)
  - Monitoring the environment
  - Surveillance after closure (60 years)



El Cabril, Spain



# WORLDWIDE EXPERIENCE

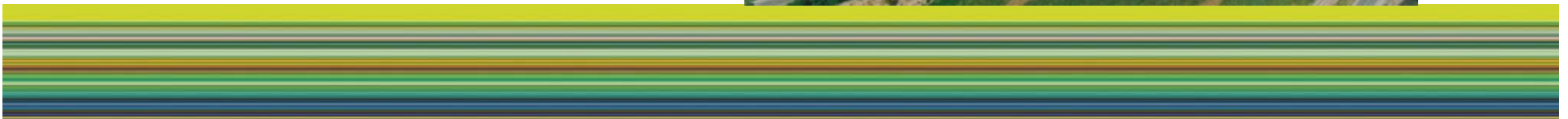


Pre rehabilitation 1980s

In situ stabilization for uranium mining and milling tailings



Post rehabilitation 1995 ➔



## CONCLUSIONS

- A safe disposal solution well fitted to the radiological hazards
- Allow flexibility for RWM programmes
- A cost effective disposal option
- Today, demonstrated as environmentally sound solution
- Increasing number of projects worldwide

