# Progress and Difficulties in Low-level Radioactive Waste Disposal in Taiwan


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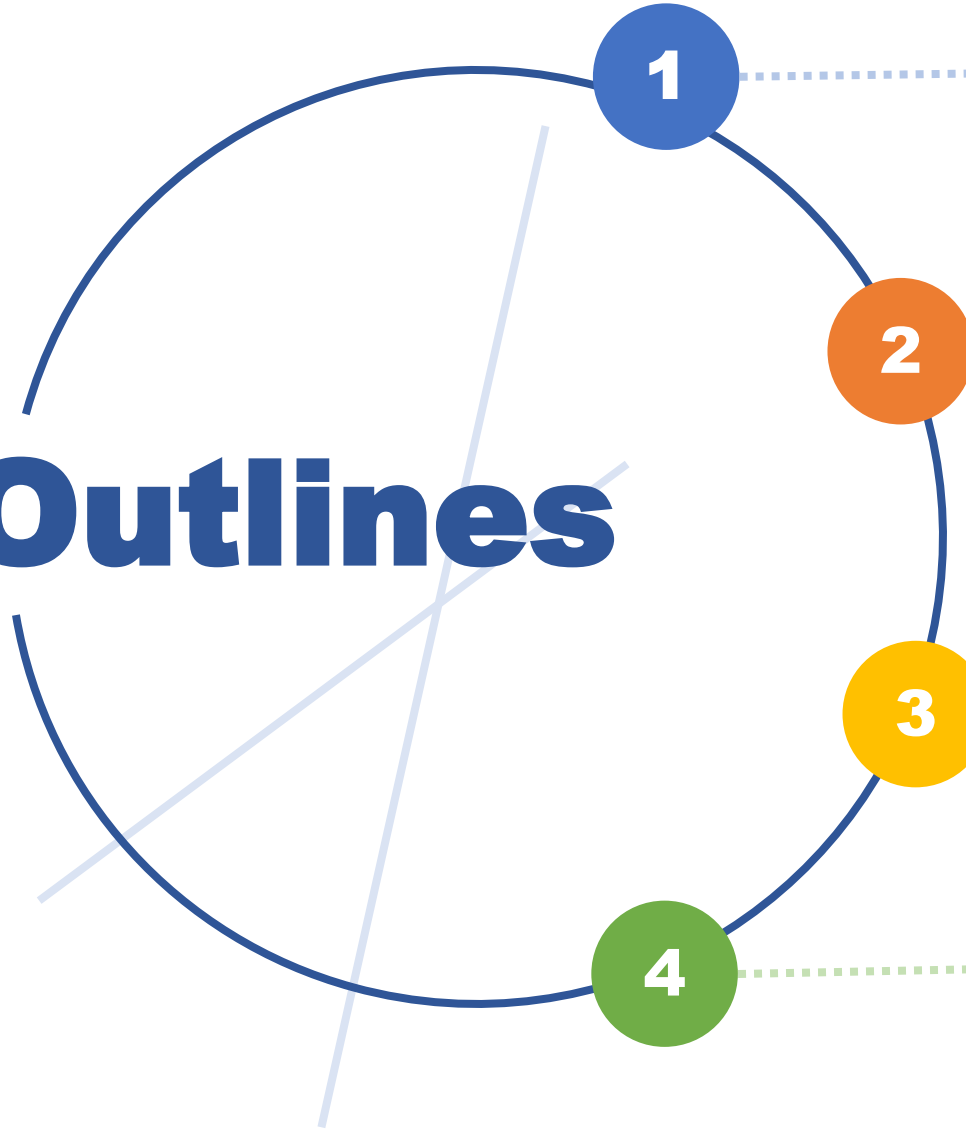
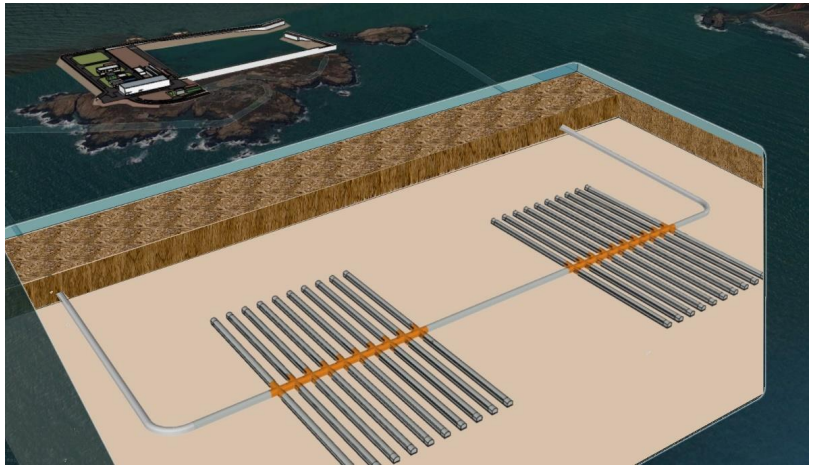
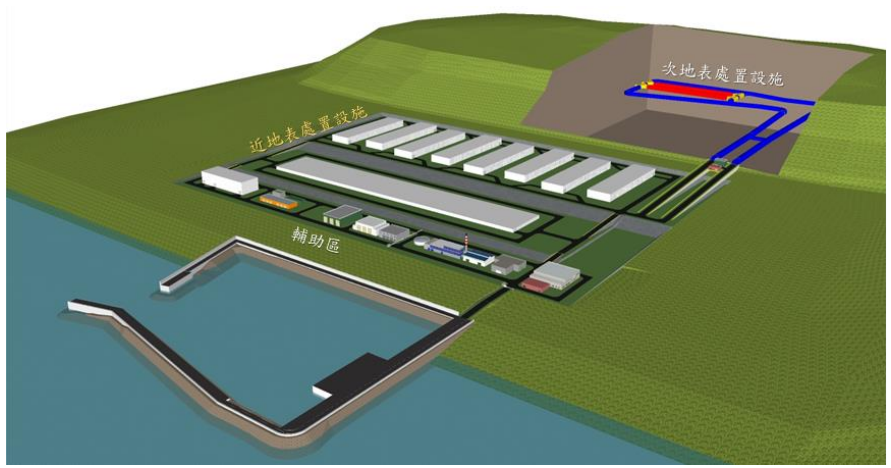
# Outlines




1. **Overview low level radioactive waste (LLW) of Taiwan**
2. **The current status of LLW final disposal (LLWD) in Taiwan**
3. **Difficulties of LLWD in Taiwan**
4. **Next steps in Taiwan LLWD**

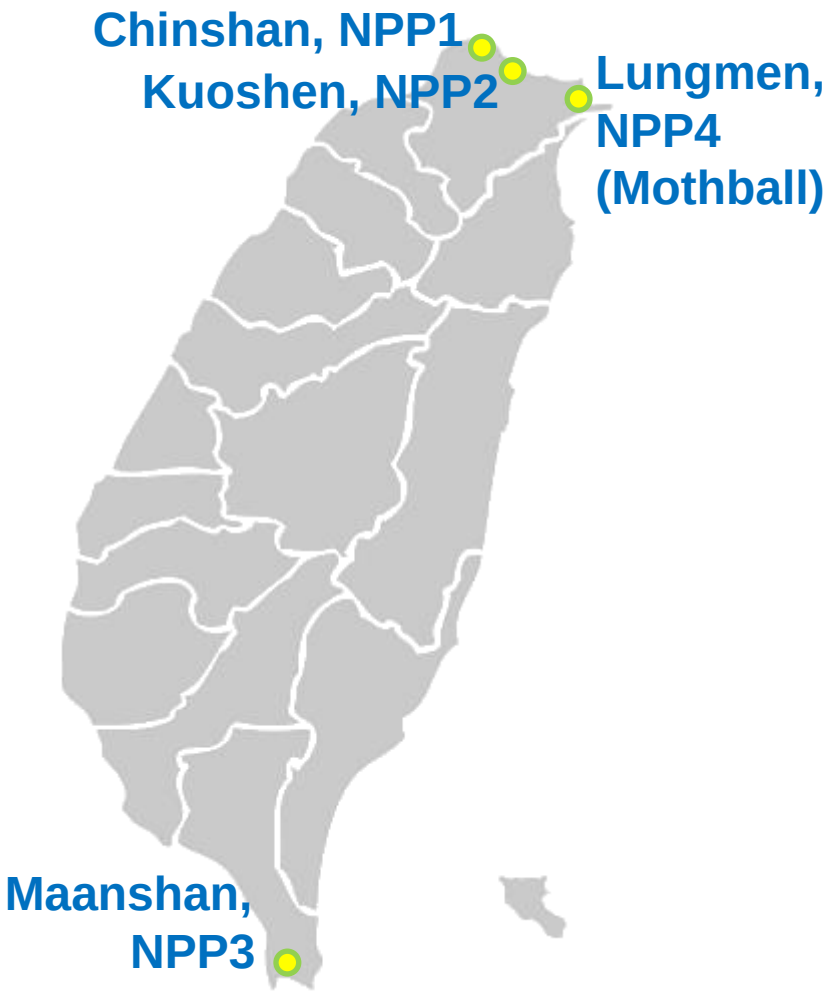
# 1. Overview LLW of Taiwan






# Overview of Nuclear Power Plants in Taiwan

- According to nuclear-free homeland policy, all nuclear power plants will stop operating by 2025.




| Plant | Chinshan | Kuosheng | Maanshan | Lungmen |
|---|---|---|---|---|
| Reactor Type | BWR-4 | BWR-6 | PWR | ABWR |
| Containment Type | Mark-I | Mark-III | Large, Dry Post-Tensioned | Reinforced Concrete Containment Vessel |
| Thermal | 1,804 MWt | 2,943 MWt | 2,822 MWt | 3,926 MWt |
| Electric | 636 MWe | 985 MWe | 951 MWe | 1,350 Mwe |
| Commercial | | | | Mothball |
| Unit 1 | 12/6/1978 | 12/28/1981 | 7/27/1984 | Mothball |
| Unit 2 | 7/16/1979 | 3/15/1983 | 5/18/1985 | Mothball |
| Scheduled Permanent Cessation Date | | | | |
| Unit 1 | 12/5/2018 | 12/27/2021 | 7/27/2024 | -- |
| Unit 2 | 7/15/2019 | 3/14/2023 | 5/17/2025 | -- |

# Initial estimation of radioactive waste in Taiwan

| classification | source | amount |
|---|---|---|
| High-level waste | ● Spent fuel  | NPP1 : *1 6,966 bundles<br>NPP2 : *1 10,924 bundles<br>NPP3 : *1 4,320 bundles<br>Total : *1 22,210 bundles<br>(~ 4,913 mt-U) |
| Low-level waste | ● Operation & decommission of NPPs<br>● Medical(1)<br>● Agriculture(2)<br>● Industries(3)<br>● Academic institution(4)  | Operation : *2 123,500<br>Lanyu : *2 111,277<br>decommission : *3 275,640<br>(1)+(2)+(3)+(4) : *4 51,900<br>Total : *5 562,317<br>(unit：55-gallon drum) |

*1 from“Spent Nuclear Fuel Final Disposal Program Preliminary Development of Pre-Siting Safety Case” (SNFD 2021)
*2 from “Low-level radioactive waste final disposal technology assessment report” (in Chinese, 2017)
*3 from Decommission projects of NPPs：NPP1: 61,791 drums, NPP2: 131,375 drums, NPP3: 81,374drums. Numbers do not include releasable waste.
*4 from “Low-level radioactive waste final disposal technology assessment report” (in Chinese, 2017)；number is estimated until 2025 preliminarily
*5 preliminary design capacity of LLW: 750,000 drums.

# Management of LLW in three NPPs and Lanyu storage facility


## Low Level RadWaste Database System (LRWDS)

# Low Level RadWaste Database System (LRWDS)


1995
Start studying nuclides concentration classification of LLW

2000
developing LLW classification code 「LMSN 2000」 (standalone)

2007
LLW management system 「LRFM」 (standalone) enable

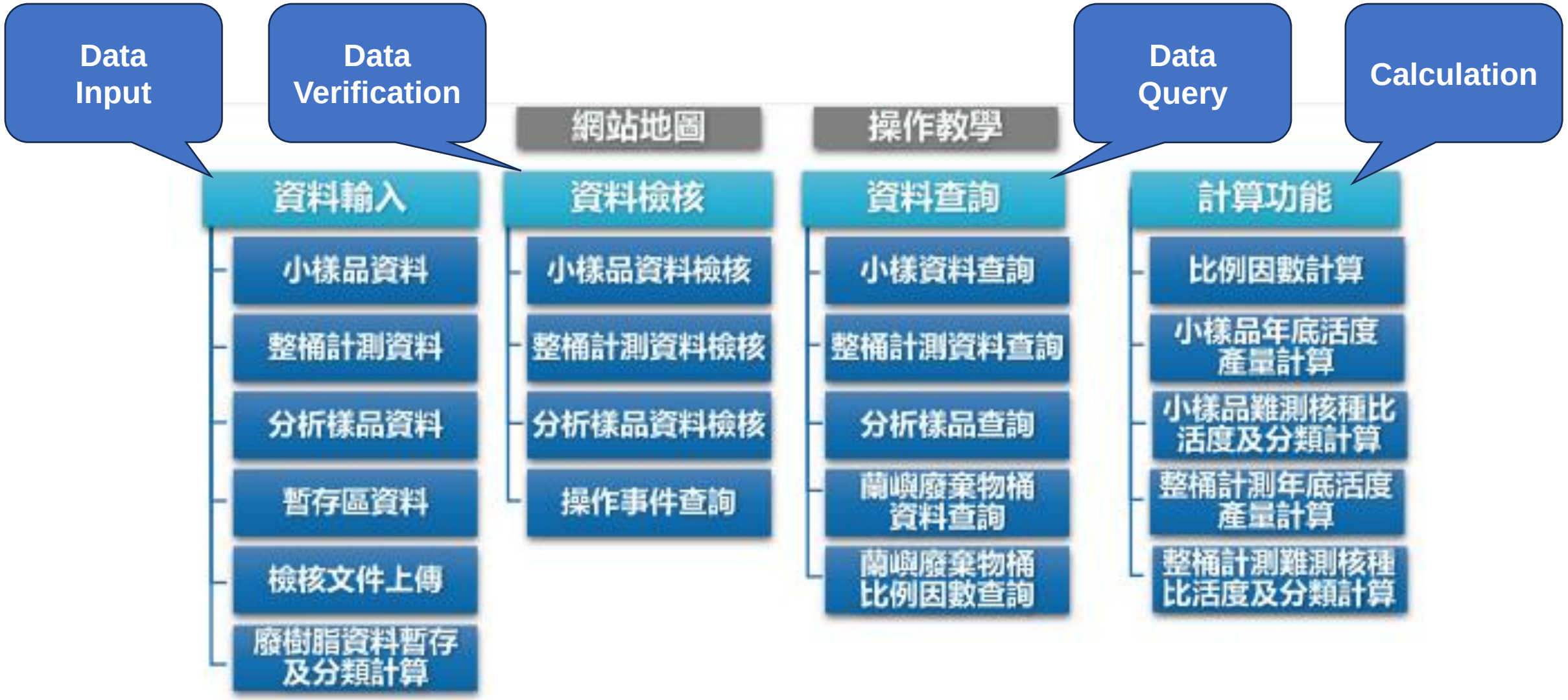
2017
LRWDS (cloud version) enable

2023
Upgrade LRWDS

✓ Add functions…

1. Enable two-way search for containers where the waste packed by outer cabinet is located
2. Enable to create data chart and the relative report
3. advance the algorithm of scaling factor estimation

# Functions of LRWDS (I)



# Functions of LRWDS (II)

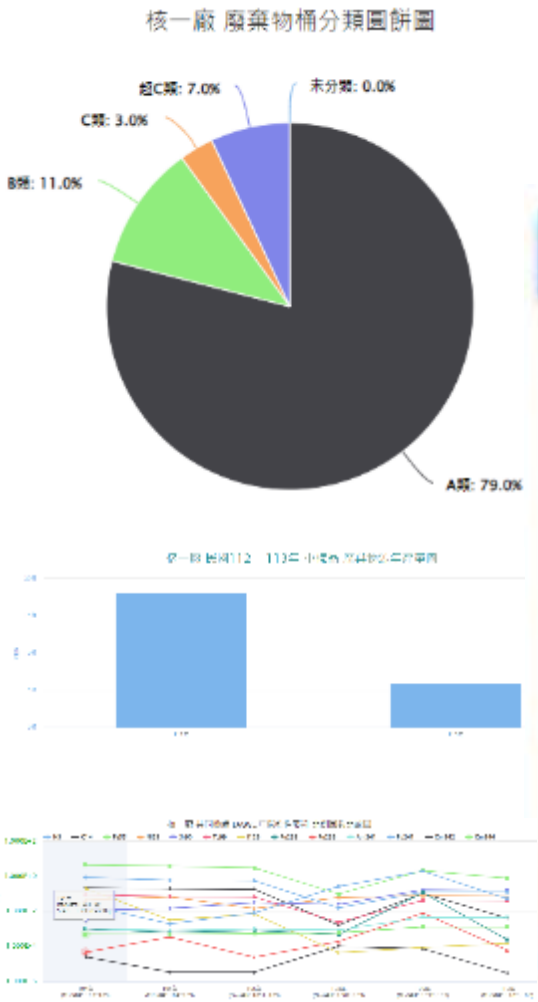



**Chart Report**

- 統計圖報表
  - 年產量衰減圖報表
  - 廢棄物桶分類圖表
  - 廢棄物源產量圖表
  - 活度批次分析月報表
  - 同廢棄物源比例因數比較圖
  - 倉庫核種活度計算

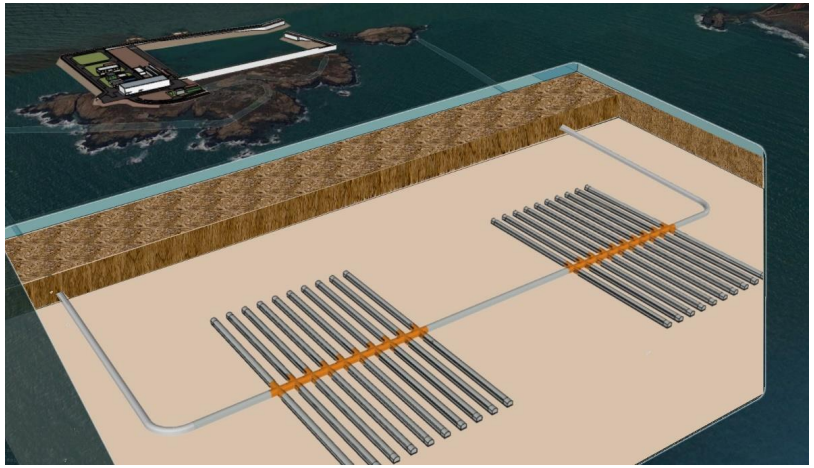
**System Parameter Setting**

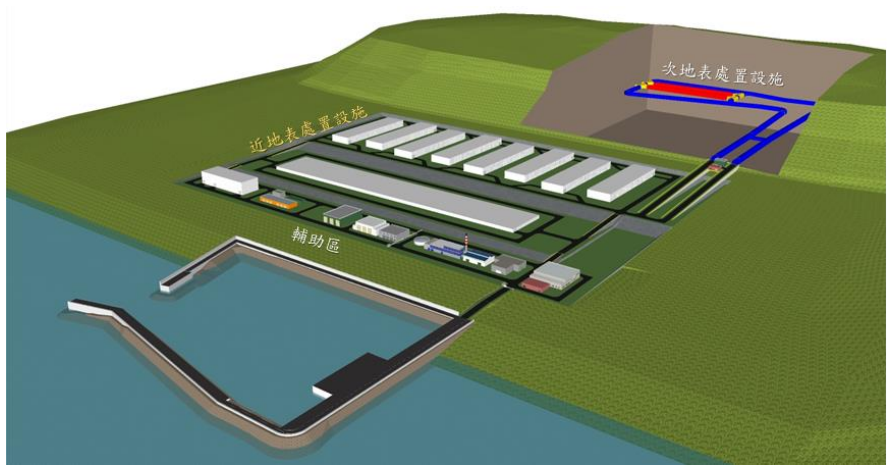
- 系統參數設定
  - 廢棄物產生/貯存單位設定
  - 機組設定
  - 廢棄物源設定
  - 廢棄物處理方式設定
  - 核種衰變常數設定
  - 盛裝容器類別設定
  - 外容器類別設定

**System Management**

- 系統管理
  - 廢棄物桶生產履歷查詢
  - 比例因數生產履歷查詢
  - 帳號管理
  - 系統功能管理
  - 公告訊息管理
  - 密碼變更

# 2. The current status of LLWD in Taiwan






# Taiwan radioactive waste management plan (original)

| Present | Interim Storage | Final Disposal |
|---|---|---|
| Store at facilities temporarily | Storage 40~100 yrs | Final disposal |


Nuclear Power Plants

HLW


Spent fuel pool

LLW


repository of NPPs

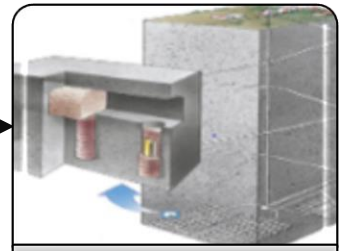

medical、agriculture、industry、academic


Lanyu Storage Facility

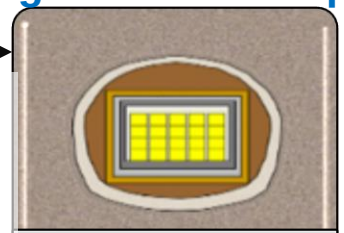

dry storage

The local government has approved the modification of “Soil and Water Conservation Plan”.

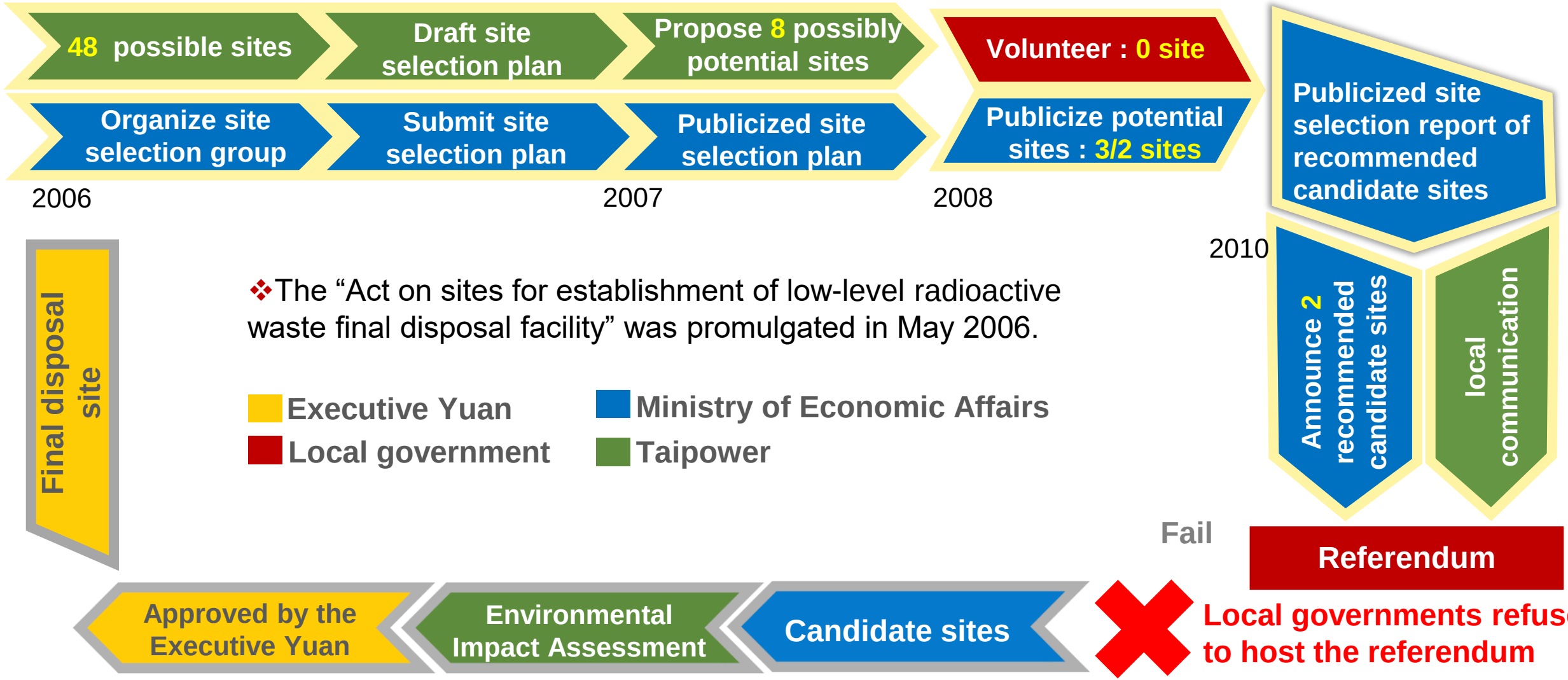
The local governments of recommended candidate sites refuse to host the referendum.


HLW final disposal

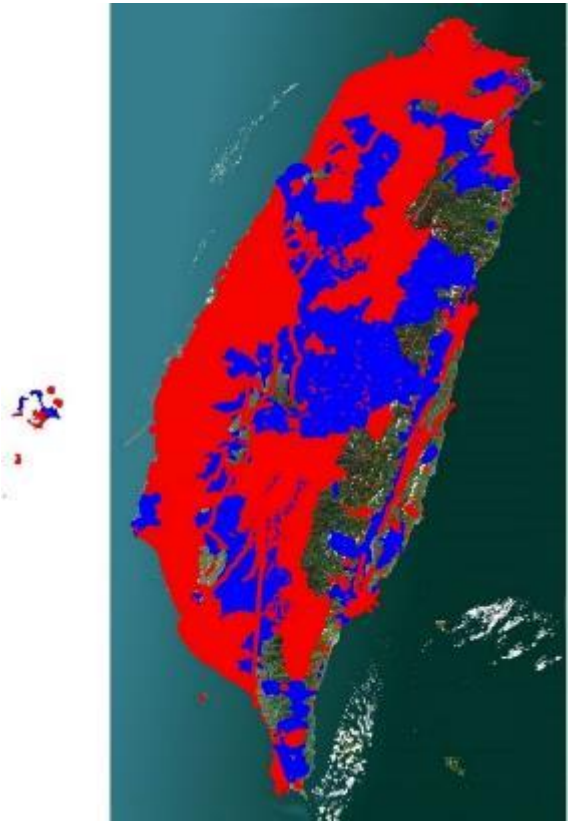
A project management office is setting to charge legislative issues of site selection regarding HLW/LLW disposal.


LLW final disposal

# Site selection process in Taiwan



# Site selection process and results



Prohibited setting area

- ✓ The must not be located criteria
- ✓ The prohibited setting area by other regulations

Environmentally sensitive area

- ✓ The upstream basin of
  - Water supply facility
  - Water resource intake location
  - Groundwater aquifer


**Potential sites (48)**

- Preferred: 8
- Secondary: 11
- Qualified: 29

**Potential recommended candidate site (8)**

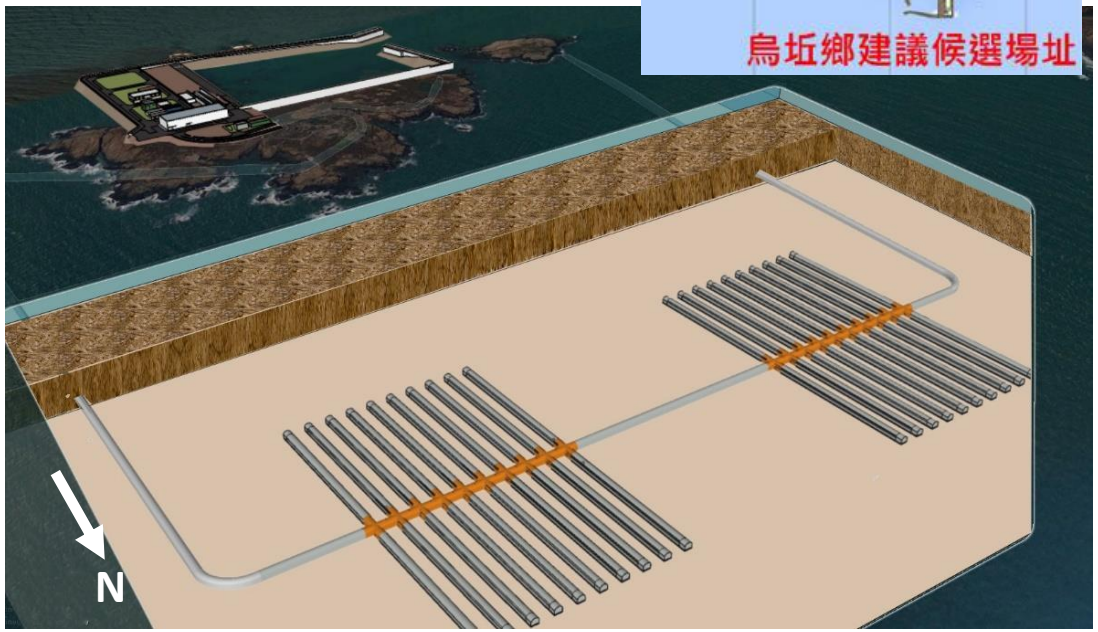
- Adds prefer criteria

**Recommended candidate site (2)**

- Voting

# The conceptual LLWD facilities of two recommended candidate sites

**Kinmen-Wuqiu**
Tunnel facility under the seabed

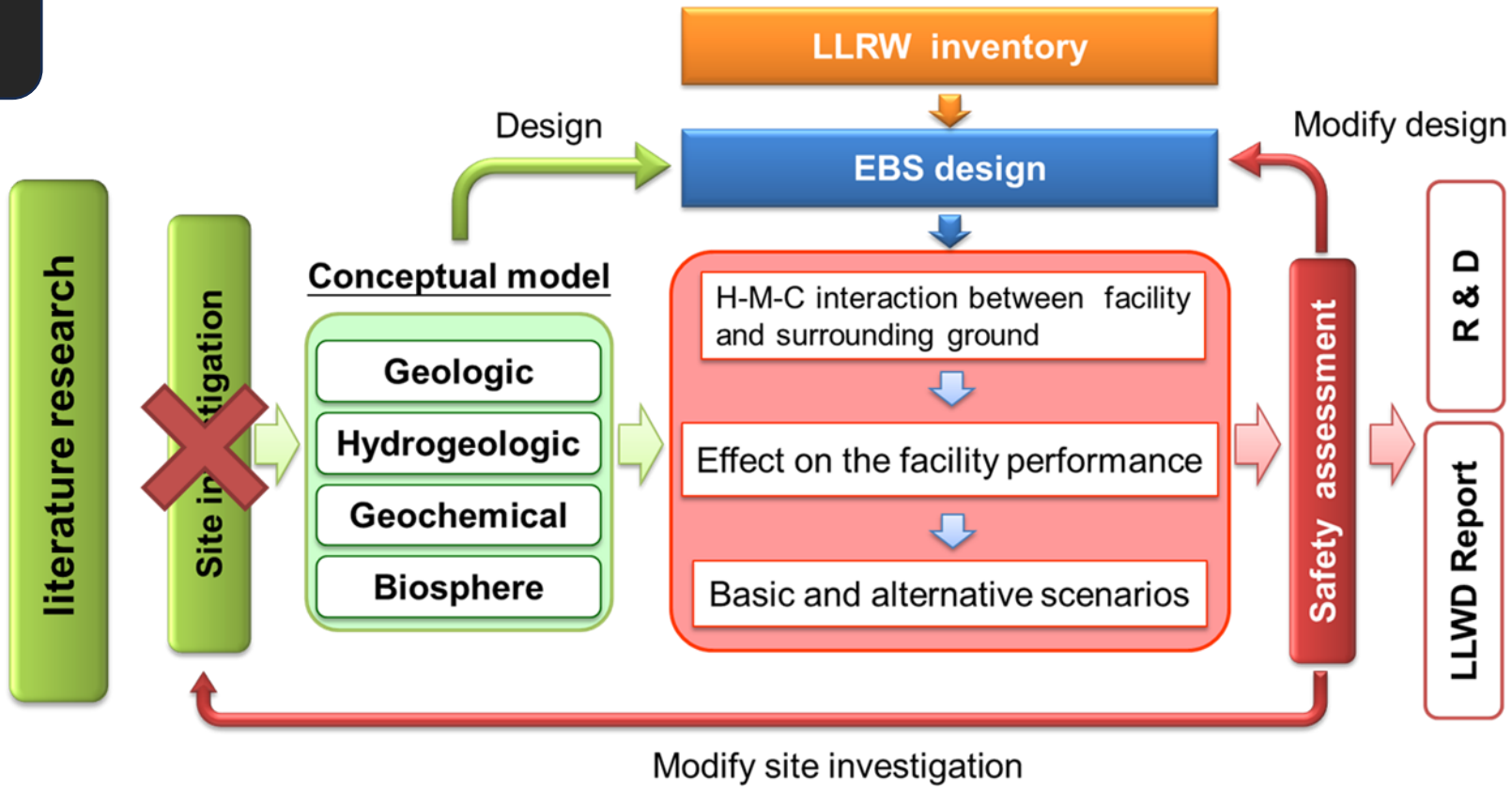

**Taitung-Daren**
Tunnel facility under the mountain


# LLW disposal R&D project

## The LLW disposal R&D project

- Started since 2013
  - LLWD2016 report
  - LLWD2020 report
- Improve technical feasibility
- Must be published every four years
- Must pass domestic/international peer reviews

Affected by COVID-19, the LLWD 2020 report was completed in 2021.



# Public communication

Forum

Visit local governments & related agencies

Brochure

Promotional activities

Door-to-door visits

Website

Facebook

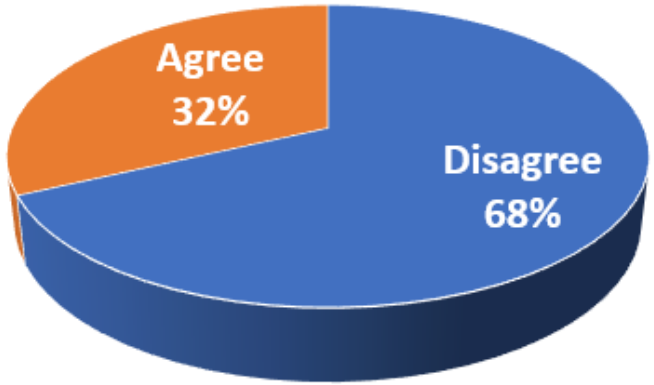
Short video


Instagram

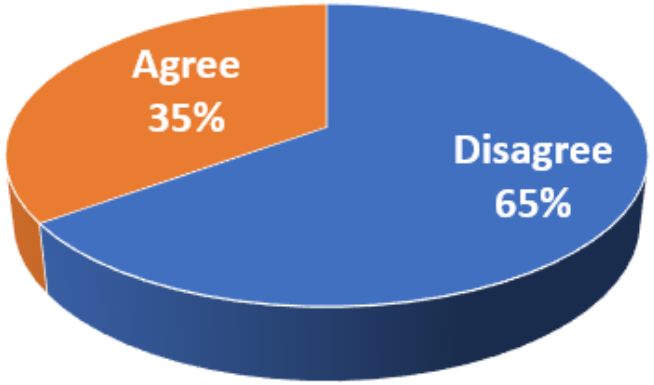
# Opinion Poll

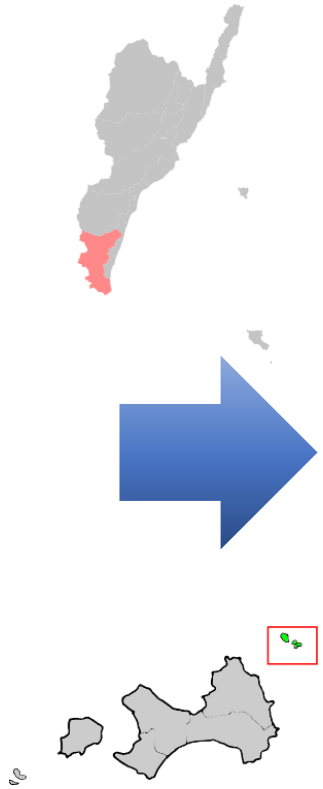
**Without any precondition**

Taitung



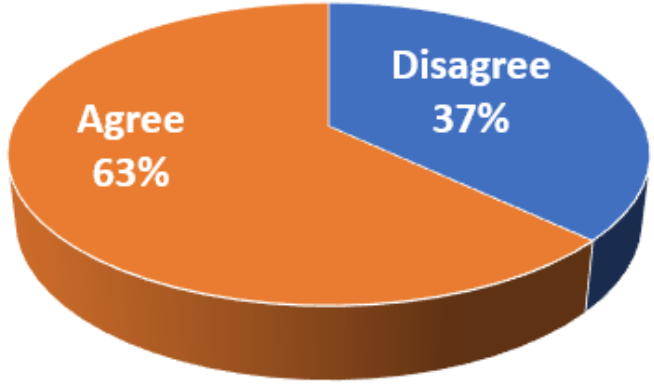

Kinmen



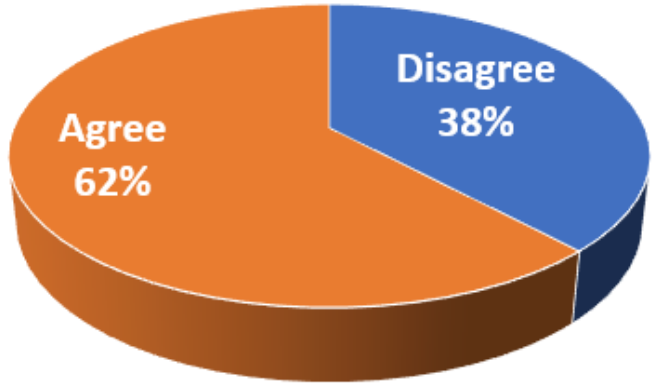



**With more than half of agreement of the people in the township where the site is located**

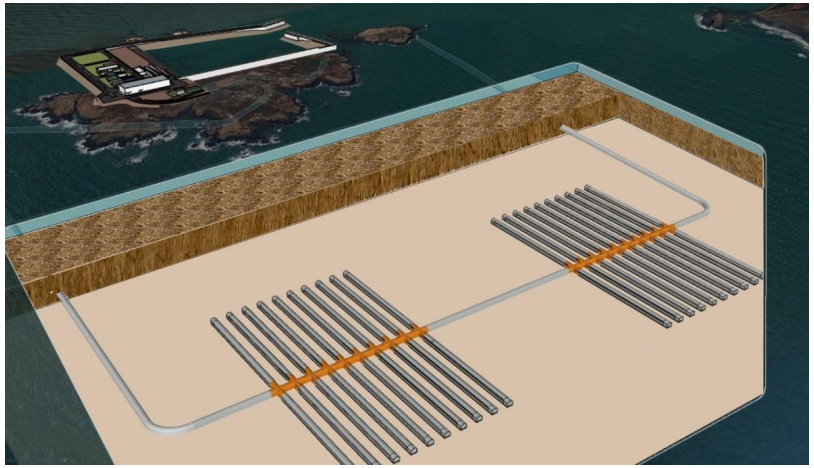
Taitung

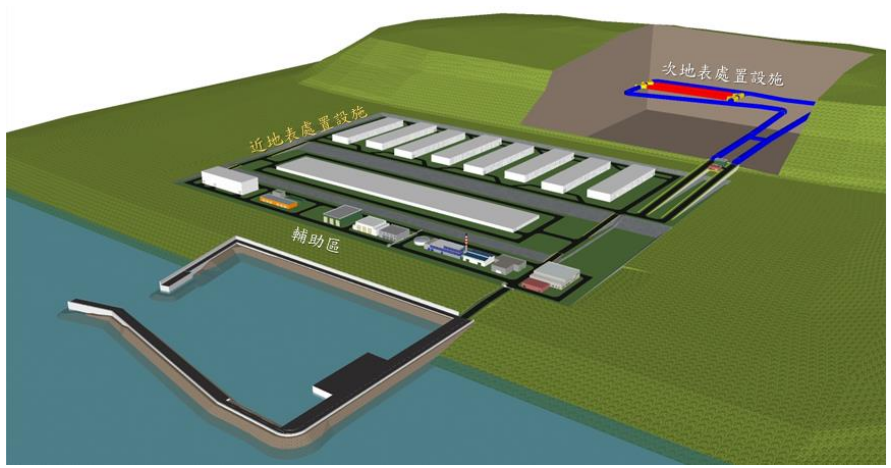



Kinmen



# 3. Difficulties of LLWD in Taiwan



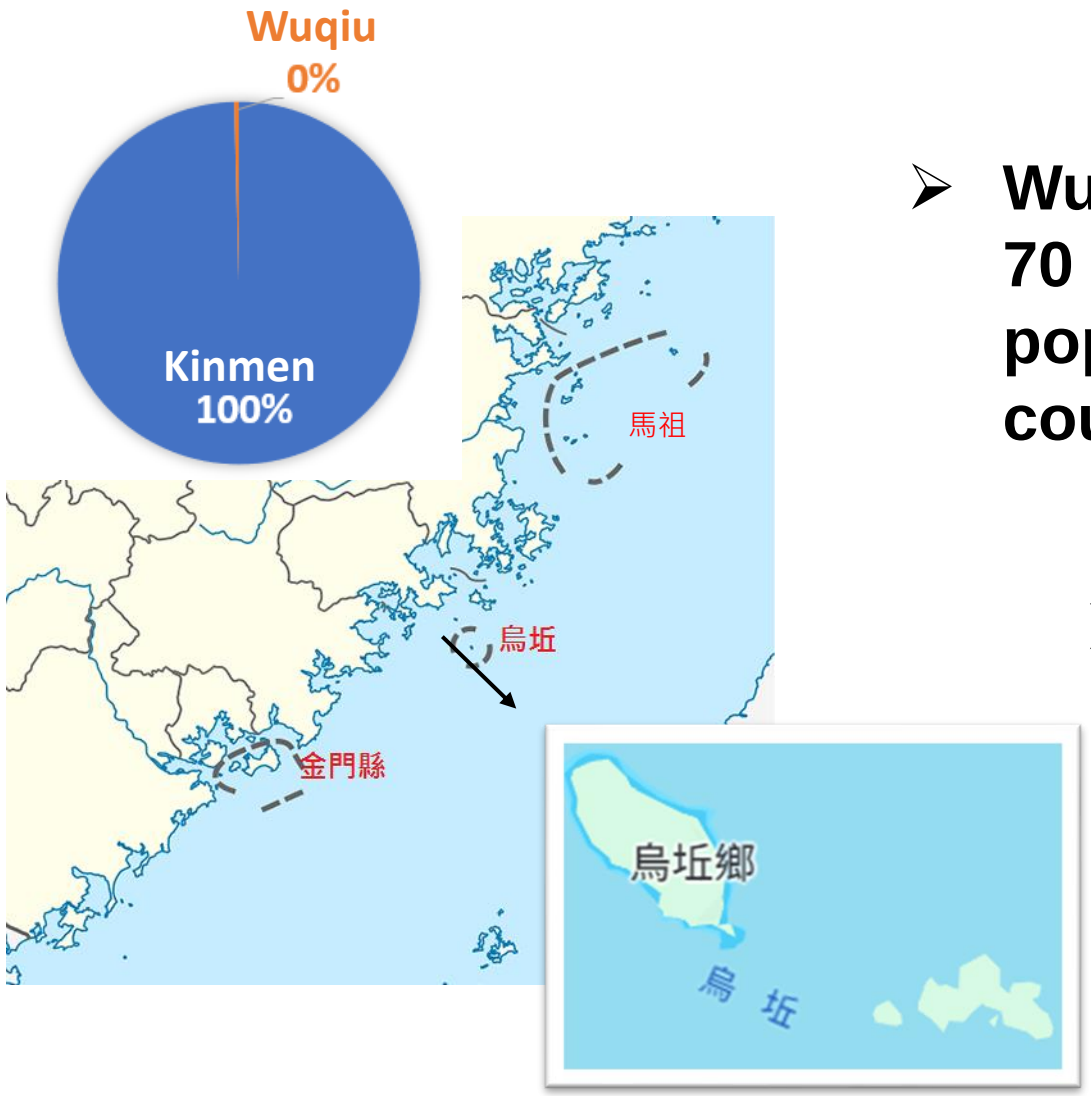



# Reason why Taitung refused the referendum

- The Taitung County Council believes that the LLWD site determination must be reviewed by the council.

- At present, the "Referendum Autonomy Ordinance" has not been legally prepared and has not been reviewed by the council. So we cannot assist in handling the referendum matters.

# Reason why Kinmen refused the referendum

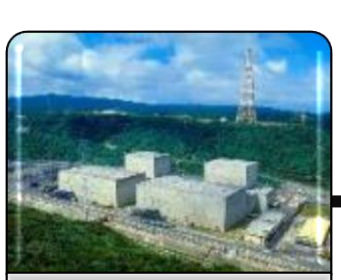



- Wuqiu Township is an island isolated 70 nautical miles away. The township's population is less than 1% of the county's population.

- Using a "county" referendum to determine the LLWD site seems to be contrary to the "spirit of residents' self-determination."

# Fallback plan of Taiwan radioactive waste management

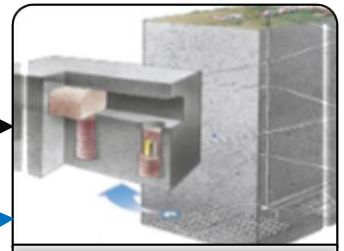
| Present | Interim Storage | Final Disposal |
|---|---|---|
| Store at facilities temporarily | Storage 40~100 yrs. | Final disposal |


Nuclear Power Plants

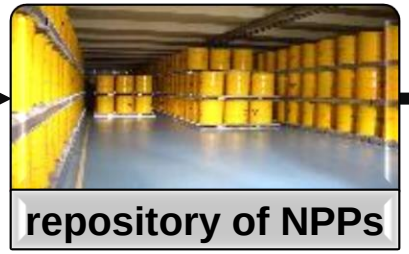
HLW


Spent fuel pool


dry storage


HLW final disposal

LLW


repository of NPPs

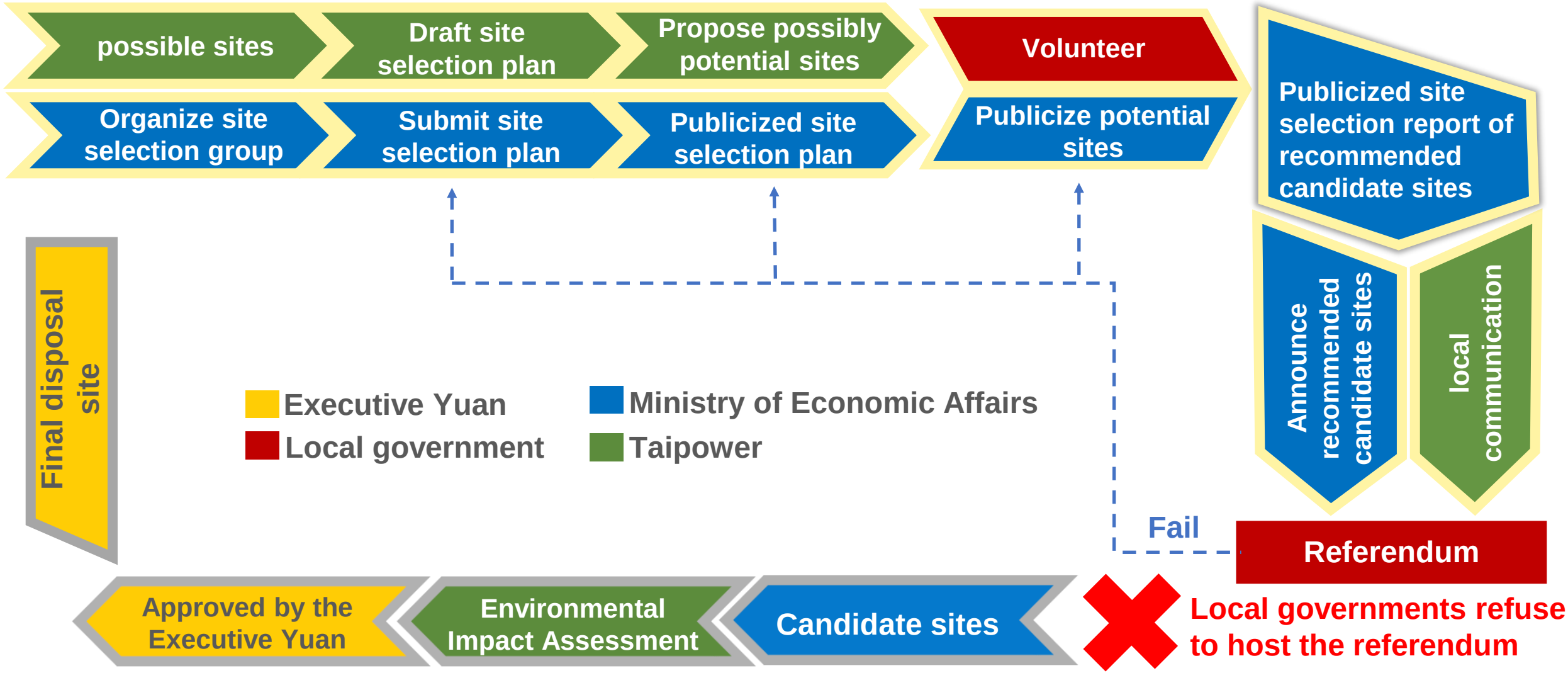

Interim Storage facility


medical、agriculture、industry、academic

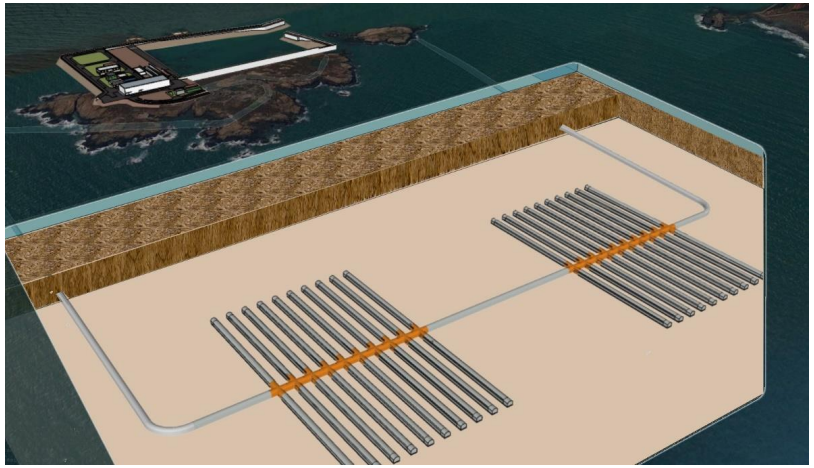

Lanyu Storage Facility

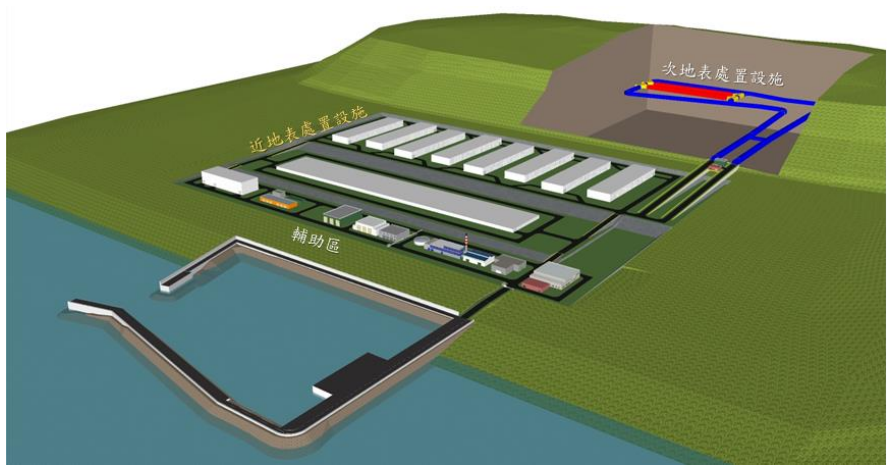

LLW final disposal

# Stalled in single path of site selection



# 4. Next steps in Taiwan LLWD

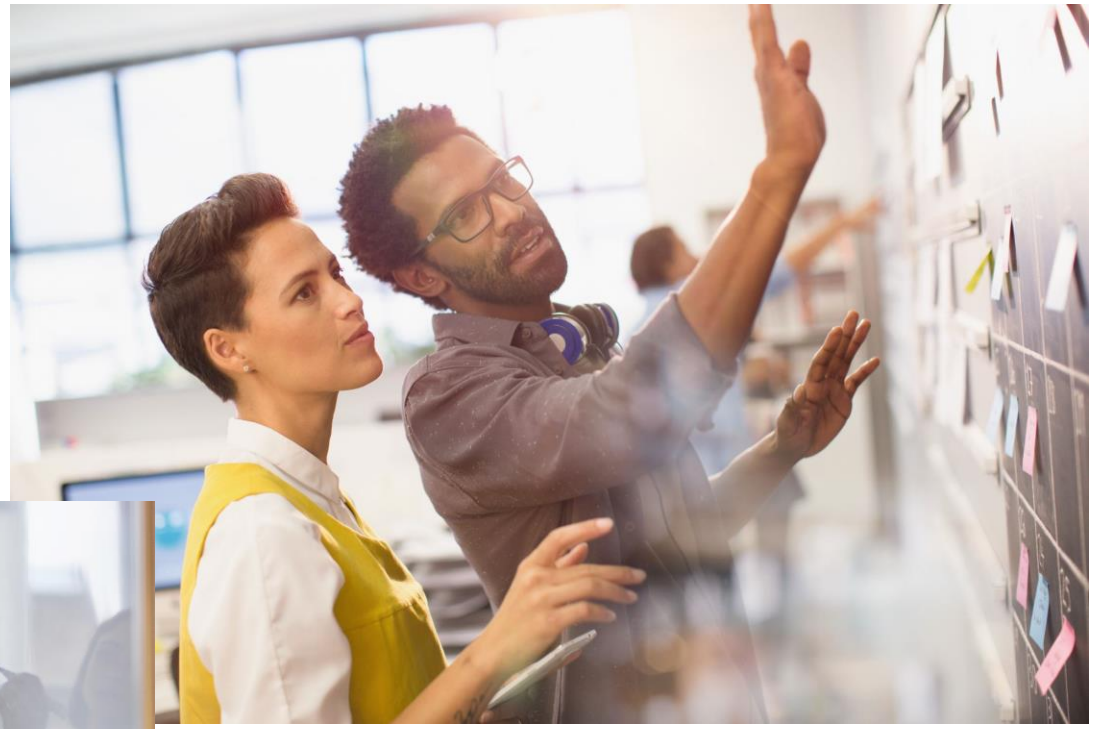





# The schedule of LLWD R&D project

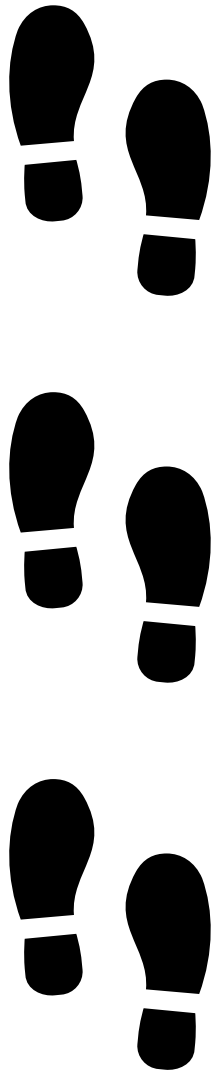
# Current status of interim storage in Taiwan

- **Site selection criteria is going to establish:**
  - ✓Requirements of geological conditions for sites
  - ✓Site selection process



# The next steps…

- **LLWD:**
  - Continuously improving the design results and ensuring the disposal system's robust safety
  - Considering the study for the near-surface disposal facility to reduce the LLWD cost
  - Considering to amend Low-level radioactive site selection regulations
- **Interim storage:**
  - Referring to the international experiences to formulate site environmental criteria and site selection procedures applicable to Taiwan



# Thanks for your attention.