



Institute of Nuclear Energy Research

Development of decommissioning information management system for nuclear power plants combined with demolition method simulation

Sheng-Chang Cheng

Present Date and Time : 15:00 December 3rd, 2018

International Workshop on Application of Advanced Plant Information Systems for Nuclear Decommissioning and Life-cycle Management

Outline

- Introduction
- Development of Decommissioning information management system of NPP
- 3D Engineering Simulation of nuclear facility
- Conclusion

Status of Nuclear Reactor Facilities in Taiwan

	NPPs of TPC*	Operation license expiry date		Status
Nuclear power plants (3)	Chinshan	Unit 1: Dec. 05, 2018	Unit 2: Jul. 15, 2019	DP Approved in Jun 2017
	Kuosheng	Unit 1: Dec. 27, 2021	Unit 2: Mar. 14, 2023	DP in preparation
	Maanshan	Unit 1: Jul. 26, 2024	Unit 2: May 17, 2025	Operation

	Reactor	Location	Status
Research reactors (6)	Tsing Hua Mobile Educational Reactor (THMER)-0.1 W	NTHU*	Decommission completed in 1993
	Water Boiler Reactor (WBR)-100 kW	INER**	Decommission completed in 1997
	Tsing Hua Argonaut Reactor (THAR)-10 kW	NTHU	Decommission completed in 2003
	Taiwan Research Reactor (TRR)-40 MW	INER	Decommission permit granted by the competent authorities in 2004
	Zero Power Reactor at Lungtan (ZPRL)-10~30 kW	INER	Decommission permit granted by the competent authorities in 2013
	Tsing Hua Open-pool Reactor (THOR)-2 MW	NTHU	Operation

*Taiwan Power Company

**National Tsing Hua University

***Institute of Nuclear Energy Research



Status of Chinshan NPP Decommissioning

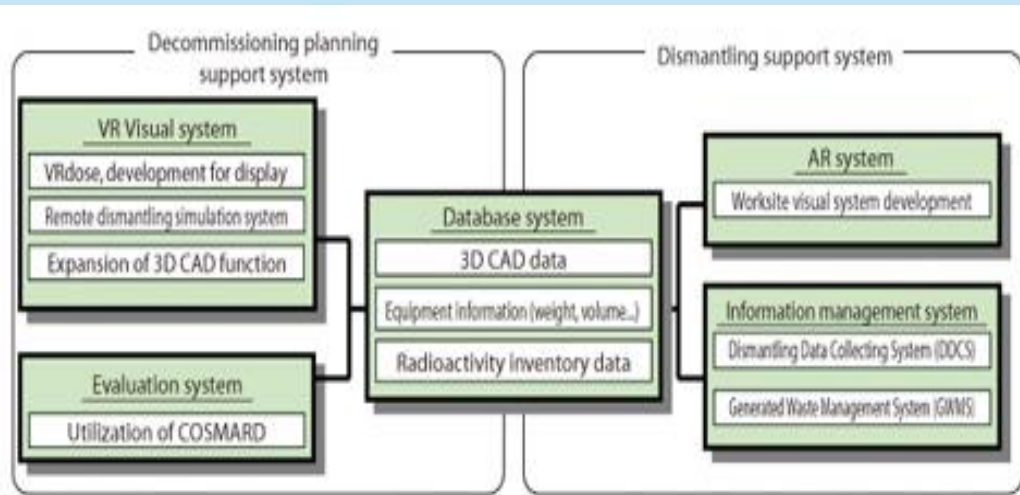
- The detail information about Chinshan NPP



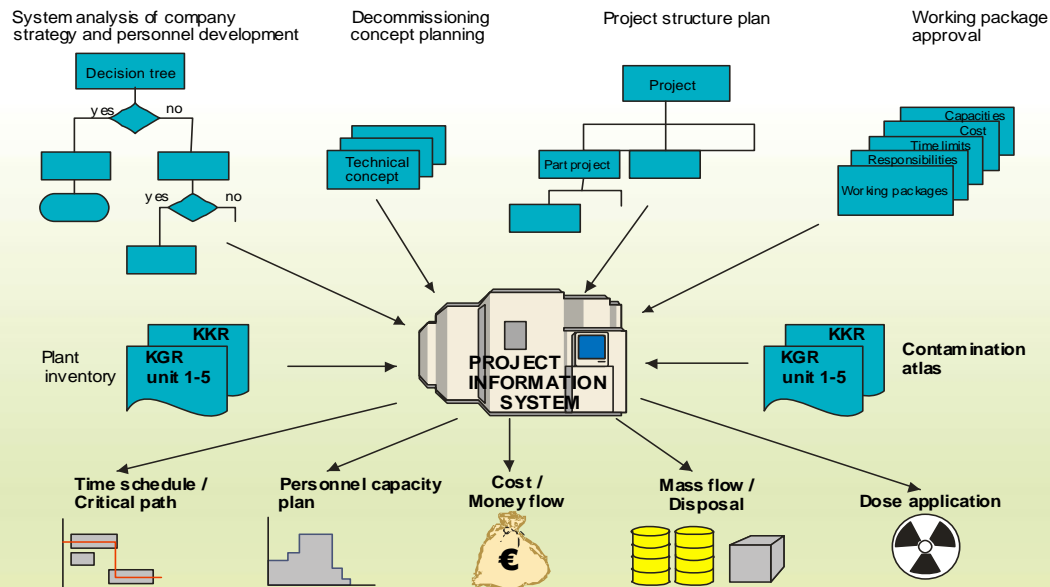
Reactor Type	BWR-4 (GE)	
Turbine Manufacturer	Westinghouse	
Containment Type	Mark-I	
Thermal	1804 MWt	
Electric	636 MWe	
	Unit 1	Unit 2
Commercial Operation	since 1978.12.06	since 1979.07.16
License Expiration Date	2018.12.05	2019.07.15

Development of Decommissioning Information Management System of NPP

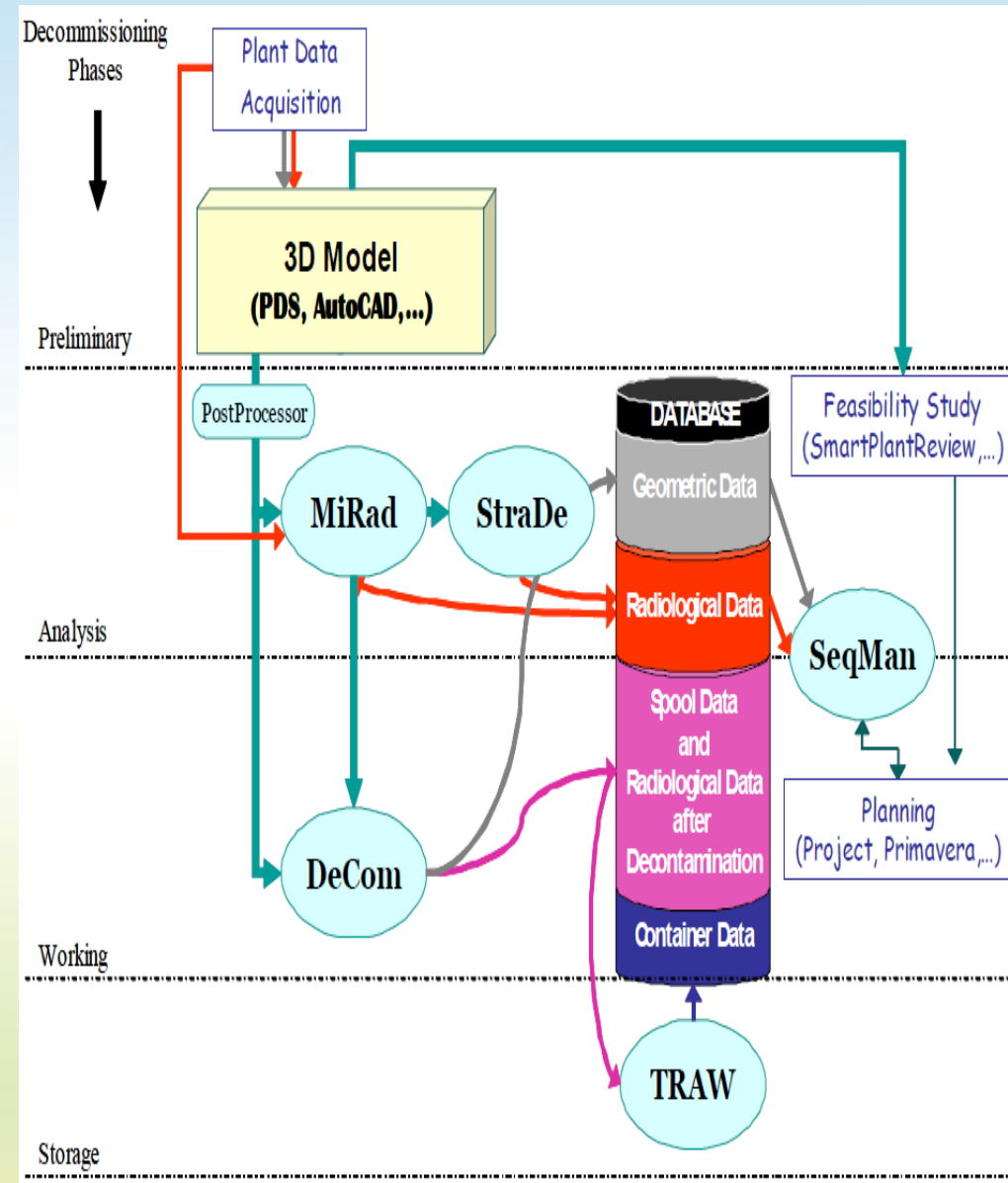
Japan : Decommissioning Engineering Support System (DEXUS)



Germany : Decommissioning Master Planning Tool(MPT)



Italy : Integrated Decommissioning Management Tools(IDMT)



每日速報表	WBS	計畫文件管理	環境特性調查
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 最新消息速報表	<input type="checkbox"/> 停機過度階段	<input type="checkbox"/> 計畫文件	<input type="checkbox"/> 輻射調查
<input type="checkbox"/> 知識管理	<input type="checkbox"/> 除役拆廠階段	<input type="checkbox"/> 品保文件	<input type="checkbox"/> 調查報告
<input type="checkbox"/> 調查報告	<input type="checkbox"/> 最終狀態階段	<input type="checkbox"/> 文件出處選項管理	<input type="checkbox"/> 匯入調查資料
<input type="checkbox"/> 財產管理	<input type="checkbox"/> 廠址復原階段	<input type="checkbox"/> 文件類別選項管理	
<input type="checkbox"/> 拆除管理	<input type="checkbox"/> WBS階段編輯	<input type="checkbox"/> 關鍵議題選項管理	
<input type="checkbox"/> 廢棄物管理	<input type="checkbox"/> WBS甘特圖	<input type="checkbox"/> 閱讀心得選項管理	
	<input type="checkbox"/> CPM/PERT圖	<input type="checkbox"/> 工作小組選項管理	
	<input type="checkbox"/> WBS資料匯入		

成本估算

<input type="checkbox"/>
<input type="checkbox"/> 成本估算系統資料維護
<input type="checkbox"/> - 電廠工程準備金維護
<input type="checkbox"/> - 電廠名稱維護
<input type="checkbox"/> - WBS資料維護
<input type="checkbox"/> - WBS年度成本分攤比例維護
<input type="checkbox"/> - 單價資料維護
<input type="checkbox"/> - 建物名稱維護
<input type="checkbox"/> - 工作困難度調整因數(WDF)維護
<input type="checkbox"/> - 數量資料維護
<input type="checkbox"/> - 台電人力費用資料維護
<input type="checkbox"/> - 台電人力薪資批次調整
<input type="checkbox"/> - 國內、國外顧問費用資料維護
<input type="checkbox"/> - WBS Schedule and Manpower Plan
<input type="checkbox"/> 報表列印
<input type="checkbox"/> - 總表
<input type="checkbox"/> - 詳細價目表
<input type="checkbox"/> - 單價分析表
<input type="checkbox"/> - 資源統計表
<input type="checkbox"/> - 人員分配統計表
<input type="checkbox"/> - WBS成本分配表
<input type="checkbox"/> - 分年成本分配表

綜合管理

<input type="checkbox"/>
<input type="checkbox"/> 帳號管理
<input type="checkbox"/> 群組管理
<input type="checkbox"/> 知識管理
<input type="checkbox"/> 最新消息
<input type="checkbox"/> FAQ討論區
<input type="checkbox"/> 人力資源管理
<input type="checkbox"/> 採購管理
<input type="checkbox"/> 風險管理系統
<input type="checkbox"/> 綜合類別管理系統

廠址歷史評估

<input type="checkbox"/>
<input type="checkbox"/> 資料查詢
<input type="checkbox"/> 匯入HSA檔案資料
<input type="checkbox"/> 參考資料
<input type="checkbox"/> 偵檢包管理
<input type="checkbox"/> 污染分類管理
<input type="checkbox"/> 污染等級管理
<input type="checkbox"/> 污染介質管理

廠區盤點

<input type="checkbox"/>
<input type="checkbox"/> 財產管理

拆除管理

<input type="checkbox"/>
<input type="checkbox"/> 組件管理
<input type="checkbox"/> 虛擬3D
<input type="checkbox"/> 圖面資料
<input type="checkbox"/> 管線資料查詢系統
<input type="checkbox"/> 拆除管理3D模型

廢棄物管理/輻射防護

<input type="checkbox"/>
<input type="checkbox"/> 廢棄物管理
<input type="checkbox"/> 輻射防護



Technique Adopted by The System

- ASP.NET Platform ◦
- JavaScript : Ajax、JQuery、 CSS、 etc.
- DB server : SQL Server 2016

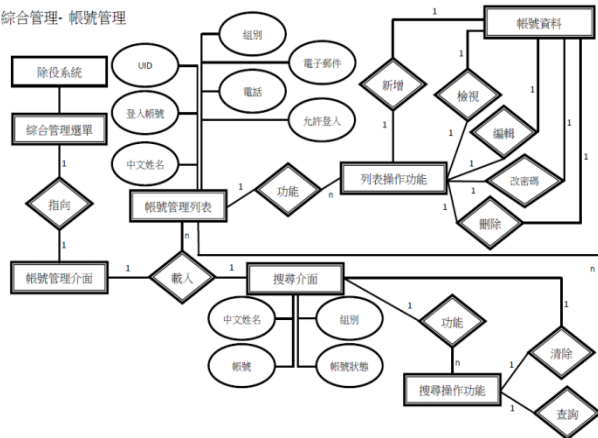


Technique Adopted by The System

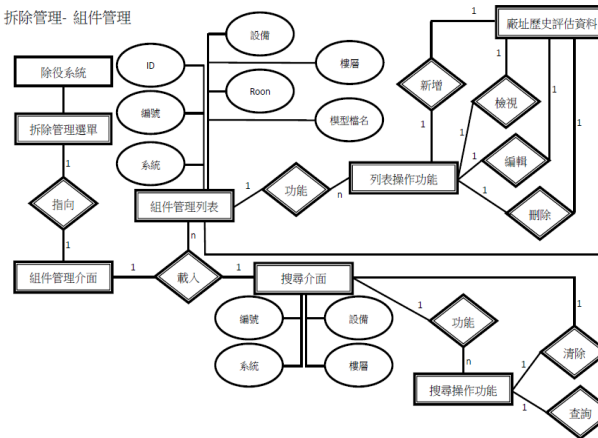
- ❑ Integrate **ASP** 、 **ASP.Net** and **PHP platform** to single **ASP.Net platform**
- ❑ Adopt Microsoft **SQL Server** to keep stable development and management for different stages of NPP decommissioning.
- ❑ Software and Hardware considered:
 - Communication network
 - Adopt ethernet interface to communicates among workstations and Servers
 - Adopt standard TCP/IP protocol to connect with internet and intranet.
 - Supporting Software
 - Adopt Microsoft Windows operating system for workstation.
 - Adopt Microsoft SQL Server 2008R2 higher and installed on Server.
 - Browser : Support Internet Explorer 8.0 higher, Microsoft Edge, Google Chrome
 - Development Environment : **Visual Studio 2012 or higher**
- ❑ Development and Application of 3D Model : **Solidworks** 、 **AutoCAD Plant 3D** 、 **AutoDesk 3ds Max**, etc.

System Design - ER-MODEL

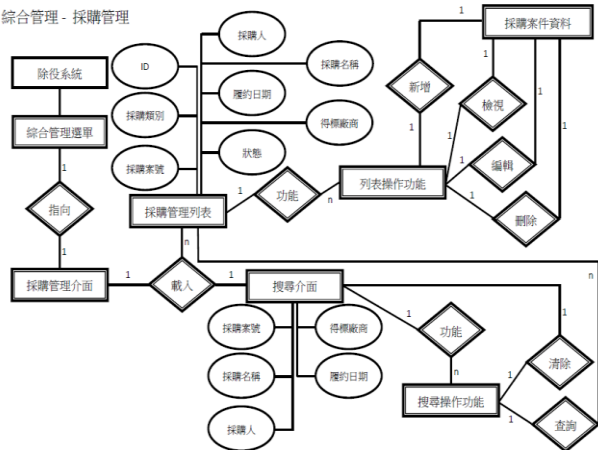
綜合管理-帳號管理



拆除管理-組件管理



綜合管理-採購管理



```
# region USERS
String UID = db.getStringField(row, "UID");
String SYSTEM_ADMIN = db.getStringField(row, "SYSTEM_ADMIN");
String USER_ID = db.getStringField(row, "USER_ID");
String USER_NAME = db.getStringField(row, "USER_NAME");
String EMAIL1 = db.getStringField(row, "EMAIL1");
String EMAIL2 = db.getStringField(row, "EMAIL2");
String EXT = db.getStringField(row, "EXT");
String TEL = db.getStringField(row, "TEL");
String MOBILE = db.getStringField(row, "MOBILE");
int dept = db.getIntField(row, "dept");
ui.UID = UID;
ui.SYSTEM_ADMIN = SYSTEM_ADMIN;
ui.USER_ID = USER_ID;
ui.USER_NAME = USER_NAME;
ui.EMAIL1 = EMAIL1;
ui.EMAIL2 = EMAIL2;
ui.EXT = EXT;
ui.TEL = TEL;
ui.MOBILE = MOBILE;
ui.dept = dept;
ui.userid = USER_ID;
ui.cname = USER_NAME;
# endregion
```

```
# region FUNCTIONS
sql = new StringBuilder();
sql.Append(" SELECT f.FUNCTION_SEQ, f.FUNCTION_TYPE, f.FUNCTION_NAME, f.FUNCTION_URL, gf.FUNC");
sql.Append(" WHERE gf.GROUP_ID IN (select GROUP_ID from USER_GROUP WHERE UID=" + UID + ")");
sql.Append(" AND gf.FUNCTION_SEQ = f.FUNCTION_SEQ");
sql.Append(" ORDER BY FUNCTION_SEQ");
dt = db.getDataTable(db.TaiwanPower1, sql.ToString());
foreach (DataRow row2 in dt.Rows)
{
    FUNCTIONS ft = new FUNCTIONS();
    ft.FUNCTION_SEQ = db.getStringField(row2, "FUNCTION_SEQ");
    ft.FUNCTION_TYPE = db.getStringField(row2, "FUNCTION_TYPE");
    ft.FUNCTION_NAME = db.getStringField(row2, "FUNCTION_NAME");
    ft.FUNCTION_URL = db.getStringField(row2, "FUNCTION_URL");
    ft.FUNCTION_MODE = db.getStringField(row2, "FUNCTION_MODE");
    ui.allFUNCTIONS.Add(ft);
}
# endregion
```

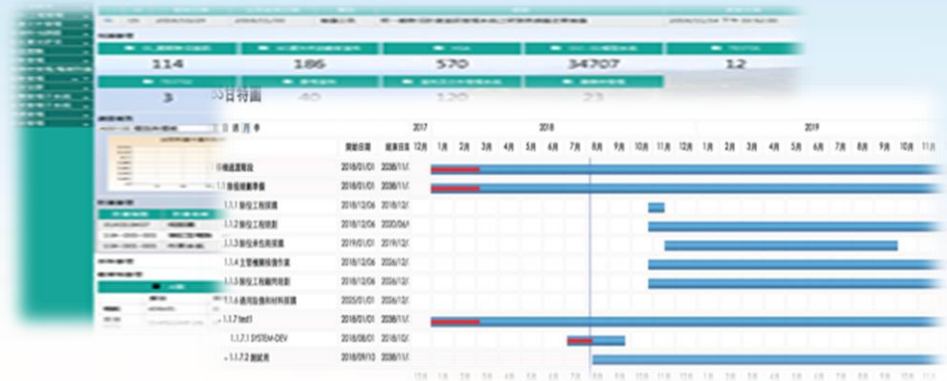
Project Management

- Import of Work Breakdown Structure
- Work breakdown, schedule and management for each stage of decommissioning
- Work items add/update/delete
- Gantt Chart generation
- Document management

Solves



Various type of tasks, schedule and documents related to project have to be managed.



Solves



Historical Site Assessment (HSA)

- Data import
- Event query
- Classification/Pollution level management
- Nuclide analysis management

History of major operation events and incidents have to be recorded and analysis.

事件ID	事件名稱	發生日期	污染分級	污染等級
A001.00	01 xxxxxxxxxx	07/04/19	事件故障 人為失誤 氣體洩漏	無污染
A001.01	01 主爐腔射線屏蔽體檢測異常，新裝裝置(CHAMBER)，造成A、B腔漏N2OP	07/10/11	氣體洩漏	無污染
A00600	02 主冷器輸出之廢氣經廢氣綜合處理系統，將廢氣濃度降低	07/08/29	氣體洩漏	無污染
A101.00	01 汽機廢氣排放水質監測異常，導致廢氣濃度超過20%	08/04/01	氣體洩漏	無污染
A101.01	01 核部LCV-103-22A1廢氣異常，導致廢氣濃度超過20%以上且持續達4小時	08/11/17	氣體洩漏	無污染
A101.00	01 核部LCV-103-22A1廢氣異常，導致廢氣濃度超過20%以上且持續達4小時	09/06/17	氣體洩漏	無污染
A102.00	01 主爐腔腔室溫度異常，導致廢氣濃度超過20%以上且持續達4小時	09/04/22	事件故障	無污染
A102.00	01 主爐腔腔室溫度異常，導致廢氣濃度超過20%以上且持續達4小時	09/04/24	事件故障	無污染
A102.00	01 預計對性維護期間停機檢修主爐腔腔室	09/05/23	事件故障	無污染
A102.00	01 ST-A斷路器跳脫造成4.1kV Bus1/3斷電，緊急柴油發電機A台自動啟動並發電至4.16kV Bus3	09/11/05	人為失誤	無污染
A10300	01 汽機電力系統測試期間20/7B異常停機檢修	07/10/20	事件故障	無污染

Waste Management

- Waste classification
- Quantity tracking
- Waste estimate

Solves



A lot of Non-radioactive, hazardous waste, low-radioactive object ,and mixed waste data to be calculated and managed.

Waste ID	Waste Name	Waste Type	Waste Code	Waste Quantity	Waste Unit	Waste Status	Waste Location	Waste Date	Waste Operator
W001	Low-level radioactive waste	Low-level	W001	1000	kg	Active	Waste Management Center	2023-01-01	Operator A
W002	Hazardous waste	Hazardous	W002	500	kg	Active	Waste Management Center	2023-01-01	Operator B
W003	Mixed waste	Mixed	W003	200	kg	Active	Waste Management Center	2023-01-01	Operator C

Cost Estimation System

- Define Work Difficulty Factors
- Calculation for different types of costs
- Labor costs estimate
- Cash flow management
- Maintenance of Engineering reserve fund

Solves



Proper model should be developed to estimate cost for decommissioning of NPP.



Inventory Management

- Classification of General, Power, and Other equipments
- Inventory add/update/delete/query

Solves



Asset in the plant should be collected and categorized to form inventory database for further use.

Radiation Dose Management

- Decontamination factor
- Shielding factor
- Decay factor

Solves



Radiation dose of personnel should be collected, estimated and managed to ensure the safety.

工作編號	工作名稱	劑量率(mSv/h)	工作時間(h)	劑量(mSv)	備註	單位
12.1	核能廠廠址測量	4.141 x 10 ⁻²	153.32	-	-	6.349
12.2.1	核能廠廠址測量	4.141 x 10 ⁻²	122.68	-	-	5.08
12.2.2	核能廠廠址測量	4.141 x 10 ⁻²	30.68	-	-	1.27
12.2.3	核能廠廠址測量	4.141 x 10 ⁻²	153.32	-	-	6.349
12.2.4	核能廠廠址測量	4.141 x 10 ⁻²	153.32	-	-	6.349
12.3	核能廠廠址測量	3.300 x 10 ⁻²	3.440.00	-	-	1.137 x 10 ⁻²
12.4	核能廠廠址測量	2.203 x 10 ⁻²	613.27	-	-	1.351 x 10 ⁻²
12.4.1	核能廠廠址測量	2.203 x 10 ⁻²	613.27	-	-	1.351 x 10 ⁻²
12.4.2	核能廠廠址測量	9.136 x 10 ⁻²	613.27	-	-	5.640 x 10 ⁻²
12.4.3	核能廠廠址測量	9.136 x 10 ⁻²	613.27	-	-	5.640 x 10 ⁻²
12.5	核能廠廠址測量	1.404 x 10 ⁻²	2.868.93	-	-	4.022 x 10 ⁻²
12.5.1	核能廠廠址測量	1.404 x 10 ⁻²	1.870.91	-	-	2.611 x 10 ⁻²
12.5.2	核能廠廠址測量	1.404 x 10 ⁻²	623.39	-	-	9.900 x 10 ⁻³
12.5.3	核能廠廠址測量	1.404 x 10 ⁻²	499.01	-	-	6.964 x 10 ⁻³
12.5.4	核能廠廠址測量	4.141 x 10 ⁻²	499.01	-	-	2.066 x 10 ⁻²
12.5.5	核能廠廠址測量	4.141 x 10 ⁻²	990.02	-	-	4.132 x 10 ⁻²
12.6	核能廠廠址測量	3.300 x 10 ⁻²	1.840.00	5	-	1.396 x 10 ⁻²
合計			1.404 x 10 ⁻²			1.396 x 10 ⁻²

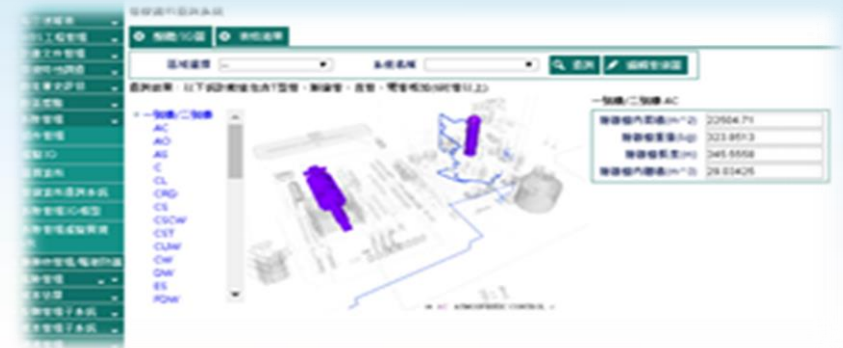
Demolition & 3D Model System

- Create and manage 3D models of pipelines, plants and equipments
- 3D demolition simulation

Solves



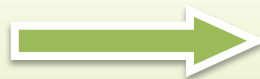
Lots of engineering data such like plants and equipments with 2D drawings which are difficult to be parsed and utilized efficiently



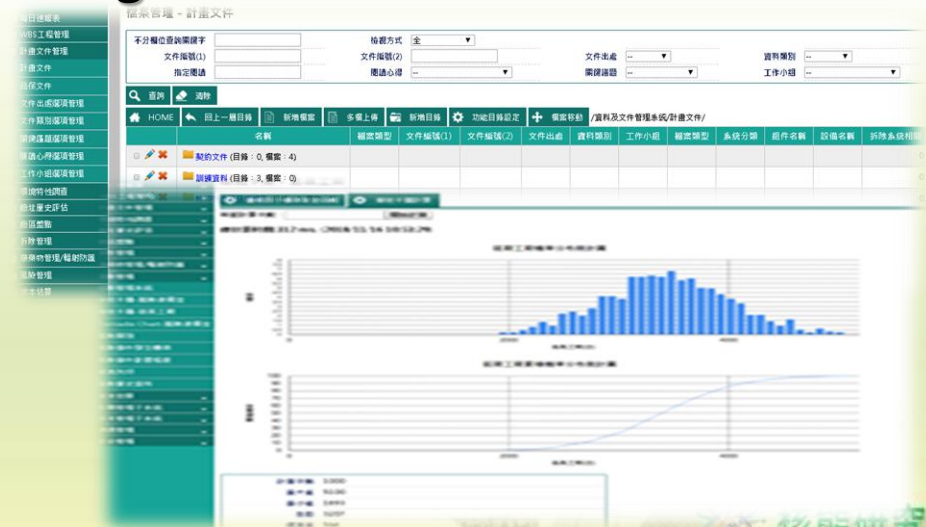
Integrated Management

- Account management
- Monte Carlo simulation
- Risk assessment management

Solves



Auxiliary management works such as account, communication, risk management and others.



Characteristics Survey Management

- Create/Update/Delete/Read detective data
- Import/Export report

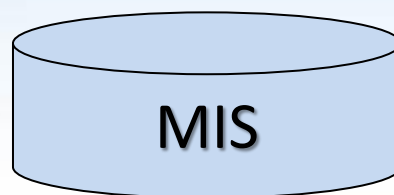
Solves



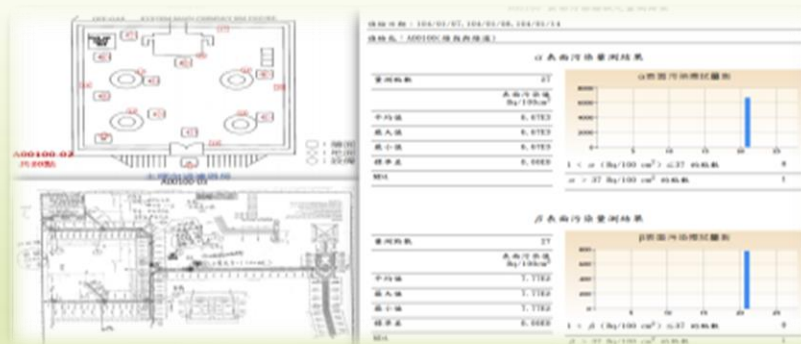
Need to track the current status of radiation characteristics at each site

序	姓名	時間	地點	儀器	單位	時間	MDA	測量結果	備註
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

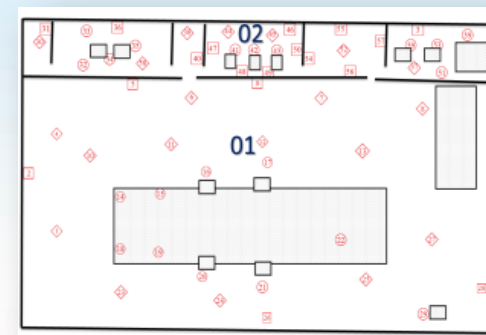
Characteristic survey data



Statistical Analysis



Radiation characteristics survey report



Location information of detective package

Historical data

Instrument calibration data

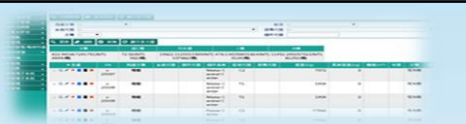
Quality assurance data

Decommissioning Information Management System – 3D Engineering Simulation

Project Management



Waste Management



WBS Management



Cost estimation



Demolition & 3D Model System



Integrated Management



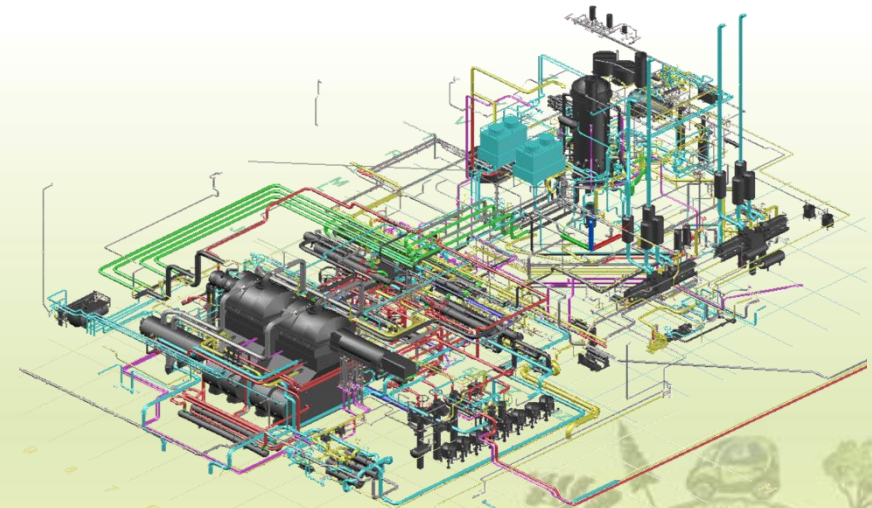
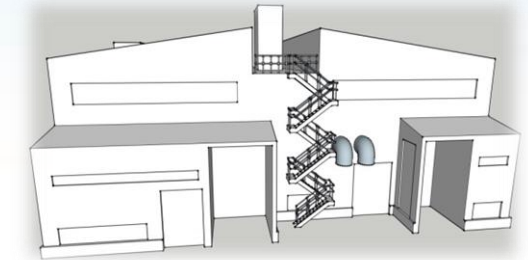
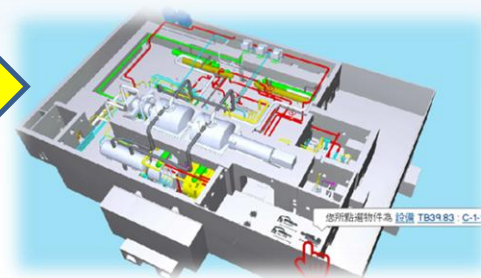
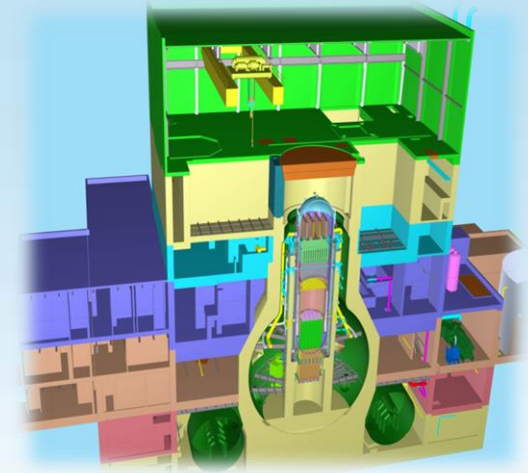
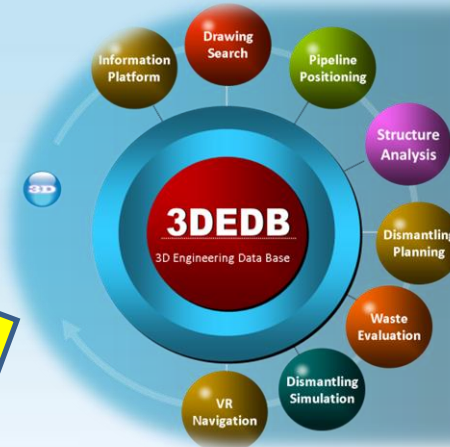
Characteristics Survey Management



Radiation Dose Management



Inventory Management



Decommissioning Information System-Engineering information Query

核一廠除役拆解模擬系統

http://www.taipower.com/Decommission.aspx

首頁 搜尋 HELP

廠房選擇 汽機廠房 樓層選擇 EL 39.83 ☒ 一般選擇模式 ☐ 進階選擇模式 確定

工程資訊 輻射評估 切割工法評估 廢棄物計算

Isometric Top Bottom Right Left Back Front User 3D/2D



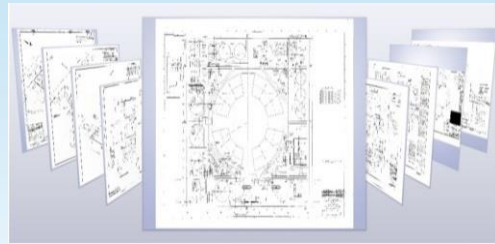
您所點選物件為 設備 TB39.83 : C-1-1C

設備項目 (235)
 管線項目 (4217)
 結構體項目 (23)
 其他組件 (6598)

☐ TB 39.83 C-1-1A
☐ TB 39.83 C-1-1B
☒ TB 39.83 C-1-1C
☐ TB 39.83 D-1-1A
☐ TB 39.83 D-1-1B
☐ TB 39.83 E-117-1A
☐ TB 39.83 E-117-1B

Name	System	Area No	Room
TB 39.83 C-1-1A	107	T1	143
TB 39.83 C-1-1B	107	T1	143
TB 39.83 C-1-1C	107	T1	143
TB 39.83 D-1-1A	107	T1	143
TB 39.83 D-1-1B	107	T1	143
TB 39.83 E-117-1A	107	T1	143
TB 39.83 E-117-1B	107	T1	143

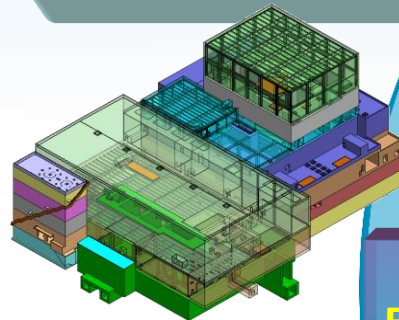
3D Engineering Data Base Establishment for Chinshan NPP



➤ Collect Drawing Data

系统	设备名称	设备规格	重量(kg)	长(m)	宽(m)	高(m)	工程备注
CDCW	PUMP	B31-C001A	16454	1.8	2.35	5.5	
CDCW	PUMP	B31-C001B	16454	1.8	2.35	5.5	
BD	PIPE	1.000.0001	1000	1.0	1.0	1.0	
FC	SPACE RECIRCULAT	P-1000	1000	1.0	1.0	1.0	
RHR	RHR HEAT EXCH	R001A	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001B	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001C	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001D	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001E	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001F	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001G	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001H	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001I	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001J	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001K	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001L	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001M	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001N	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001O	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001P	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001Q	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001R	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001S	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001T	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001U	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001V	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001W	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001X	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001Y	15195	7.2	1.82	1.82	1.82
RHR	RHR HEAT EXCH	R001Z	15195	7.2	1.82	1.82	1.82

➤ Classification & Integration



➤ 3D Model of Building

Establishment

3DEDDB
3D Engineering Data Base

Information Platform

Drawing Search

Pipeline Positioning

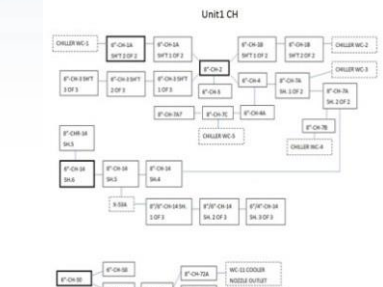
Structure Analysis

Dismantling Planning

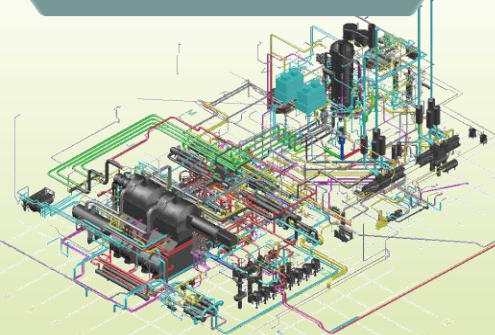
Waste Evaluation

Dismantling Simulation

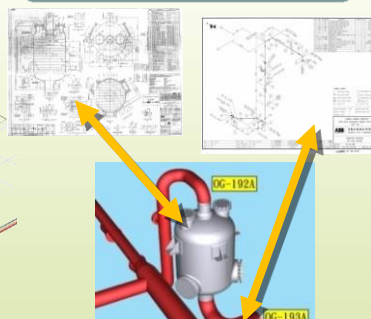
VR Navigation



➤ Drawing Check



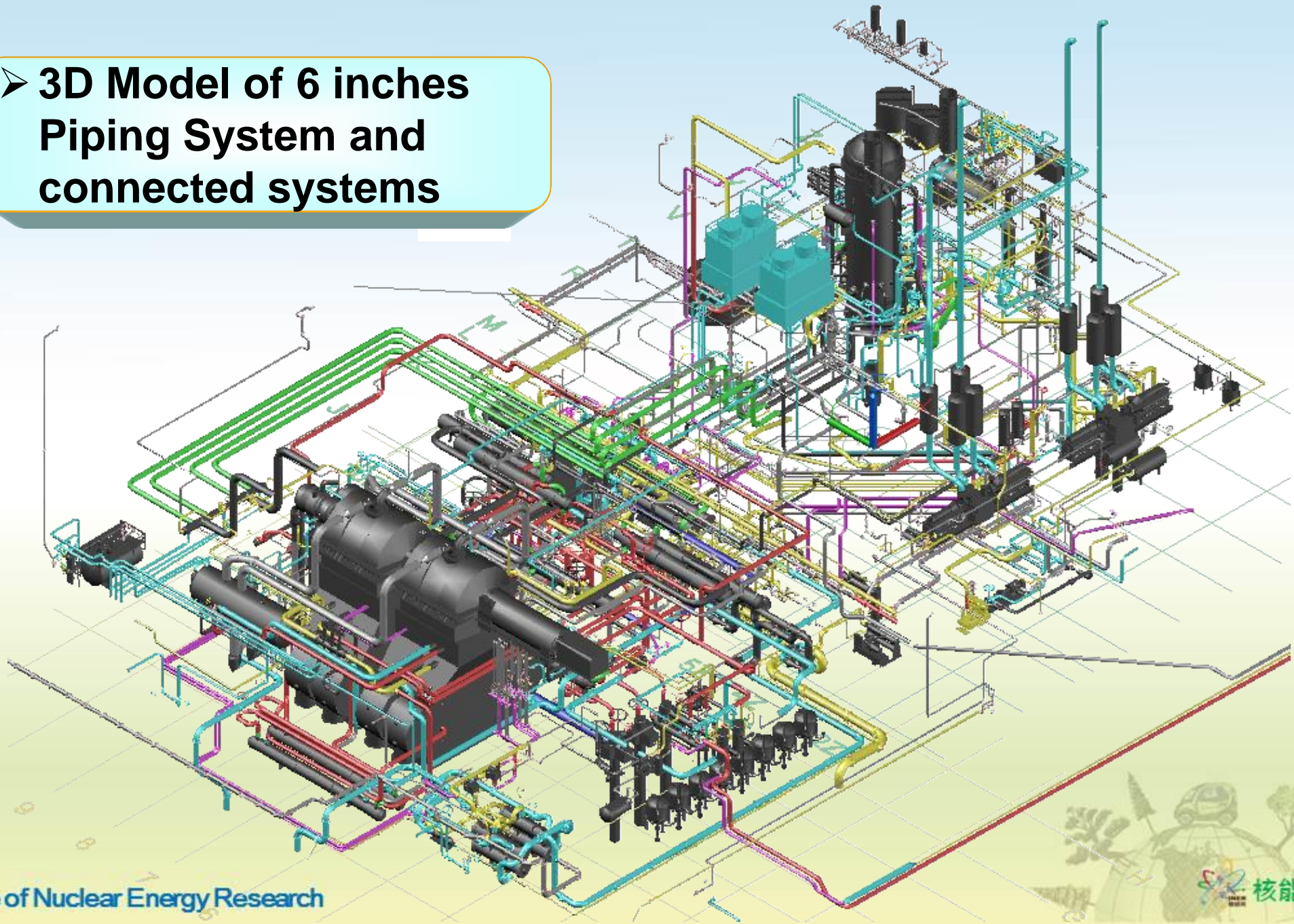
➤ 3D Model of Equipment and Pipes



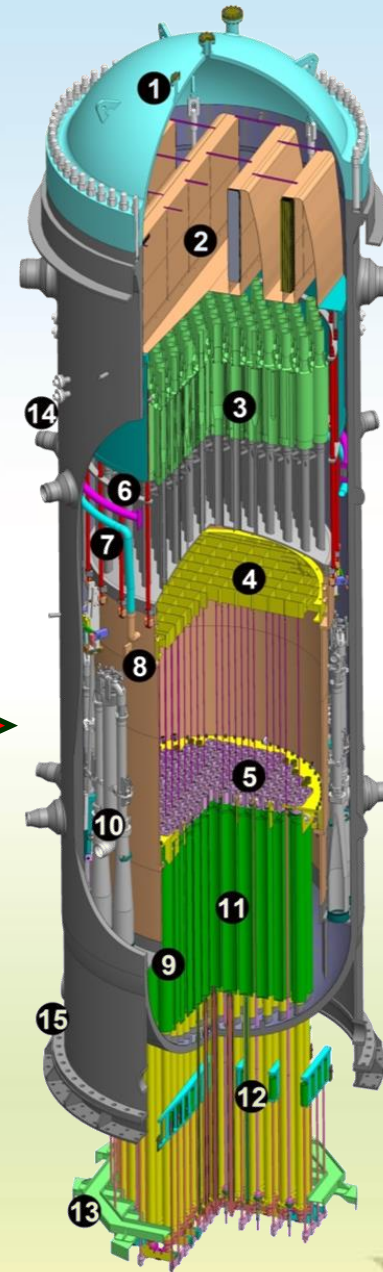
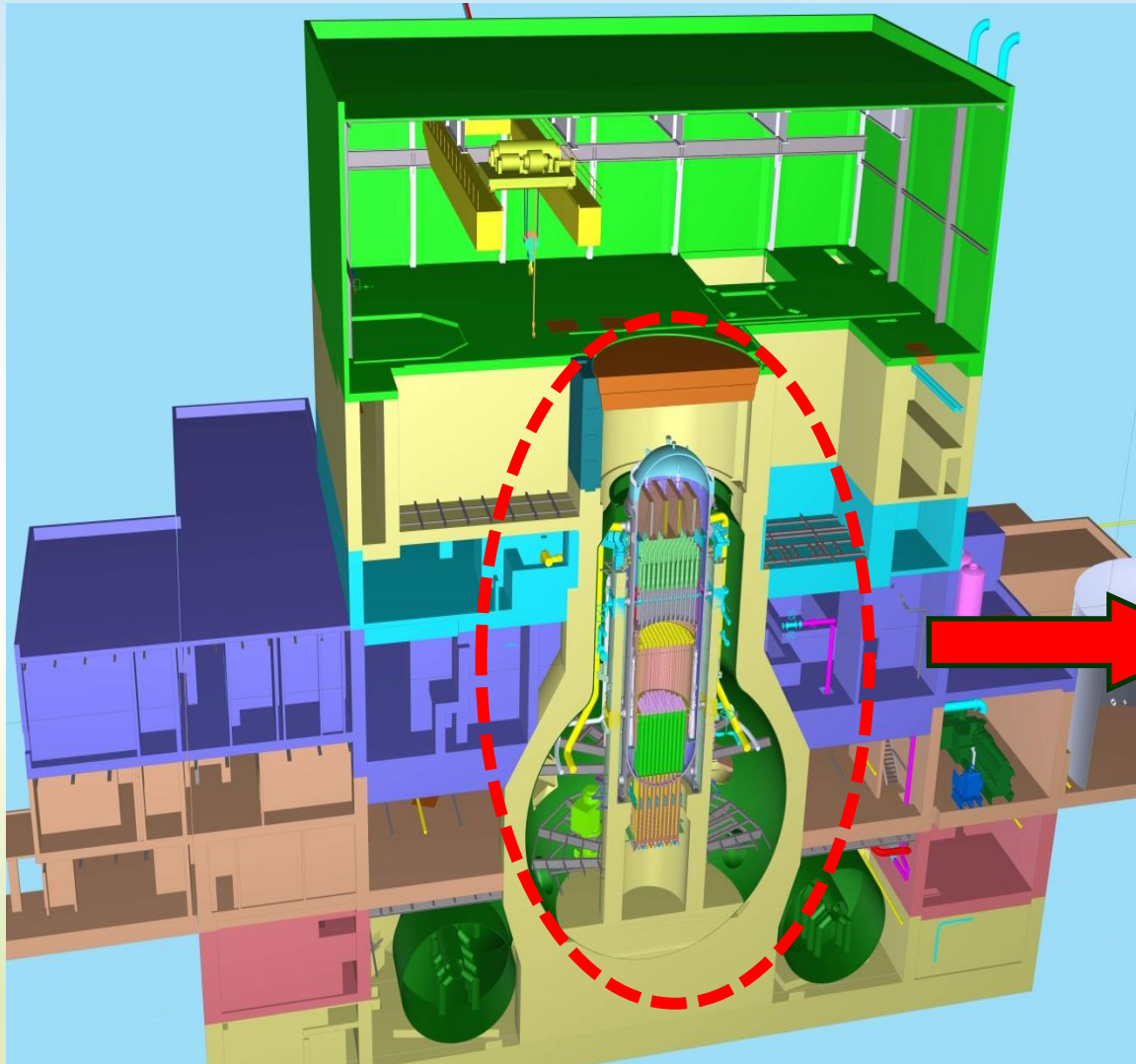
➤ Engineering Information Check

3D Model of Equipment and Piping System of NPP

- 3D Model of 6 inches Piping System and connected systems

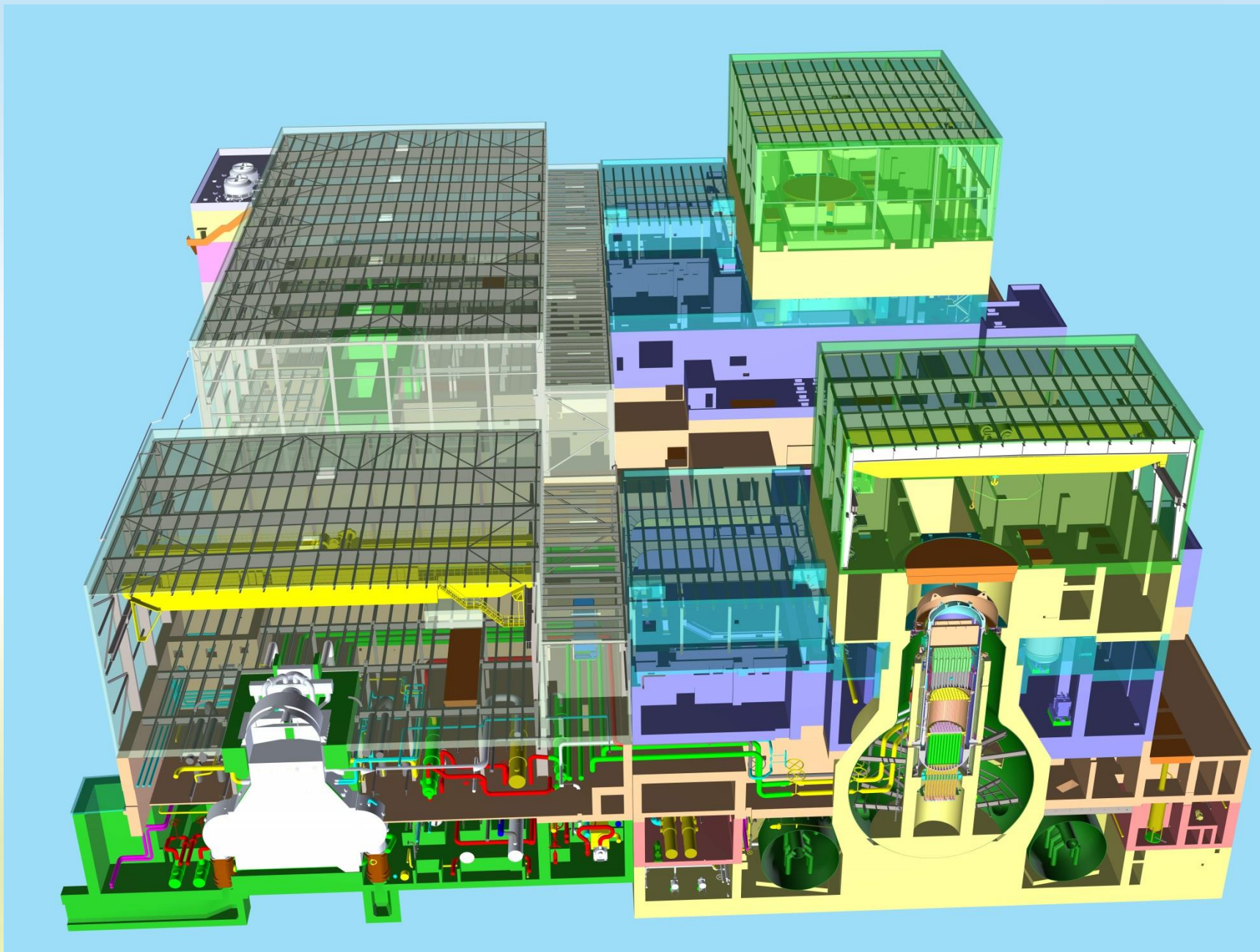


3D Model of Reactor & Internals



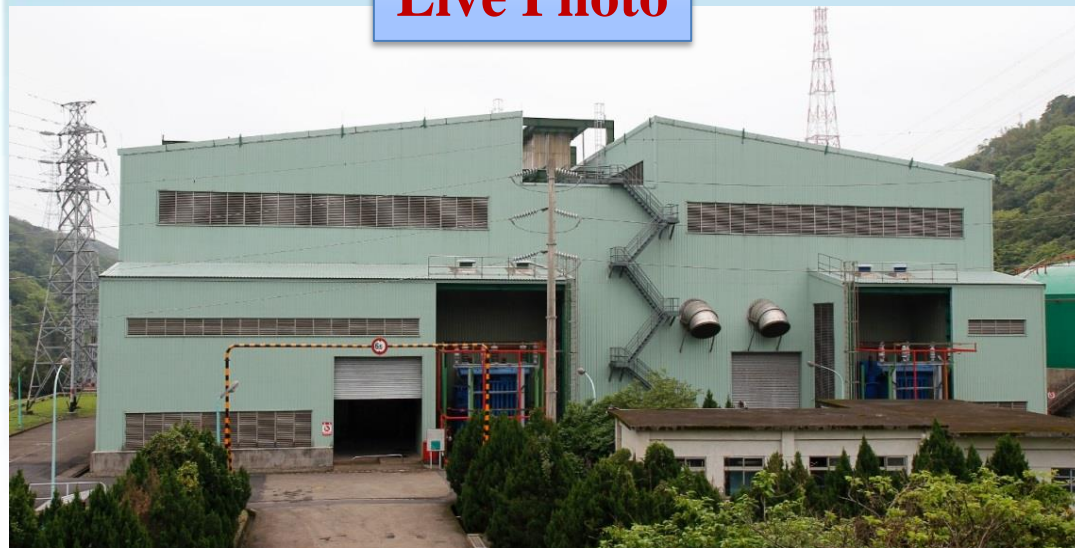
號 球	組 件 名 稱
1	壓力槽頂蓋
2	蒸汽乾燥器
3	汽水分離器與側板頂蓋
4	頂部導板
5	爐心底板
6	飼水噴嘴
7	爐心噴灑噴嘴
8	爐心側板
9	爐心側板支持板
10	噴射泵組件
11	控制棒導管
12	控制棒驅動殼
13	控制棒驅動殼支架
14	反應爐壓力槽
15	壓力槽支撐裙板

The whole plant 3D Model of NPP

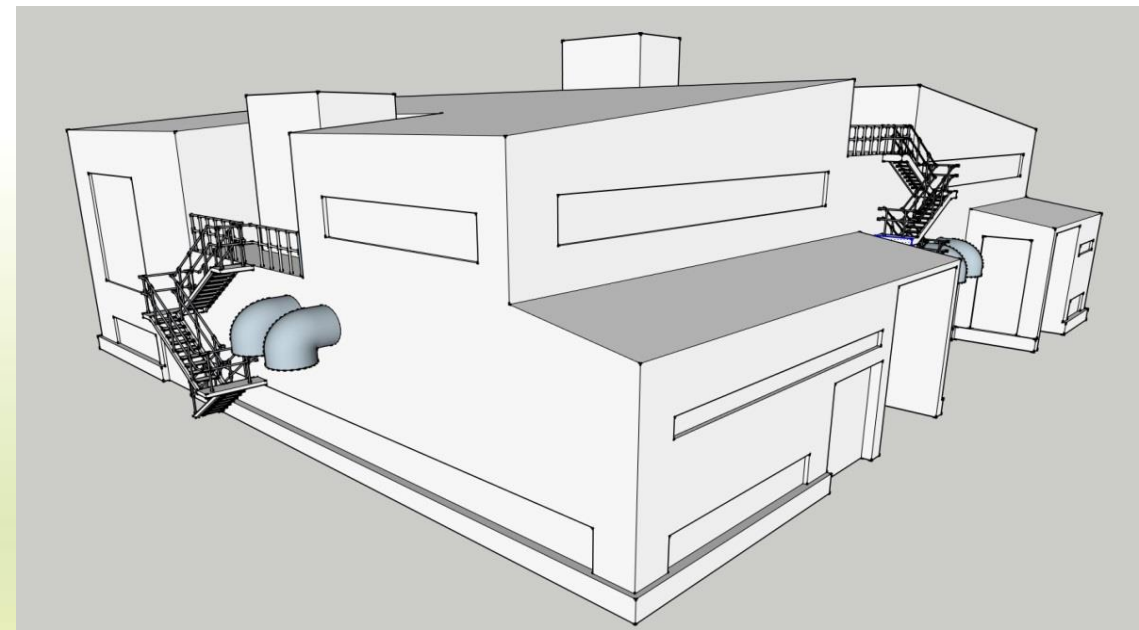
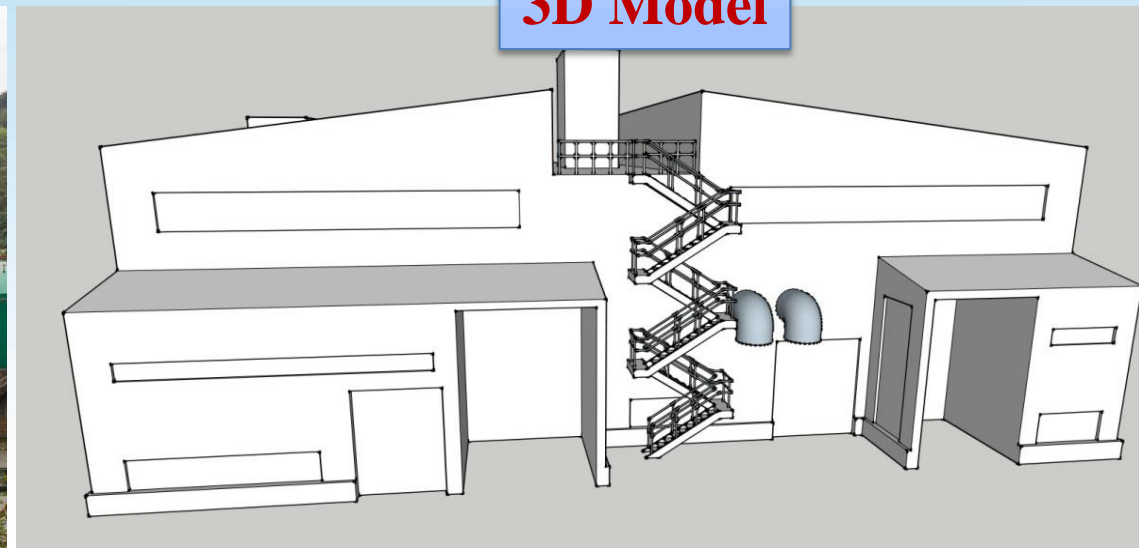


3D Model of the Building of NPP

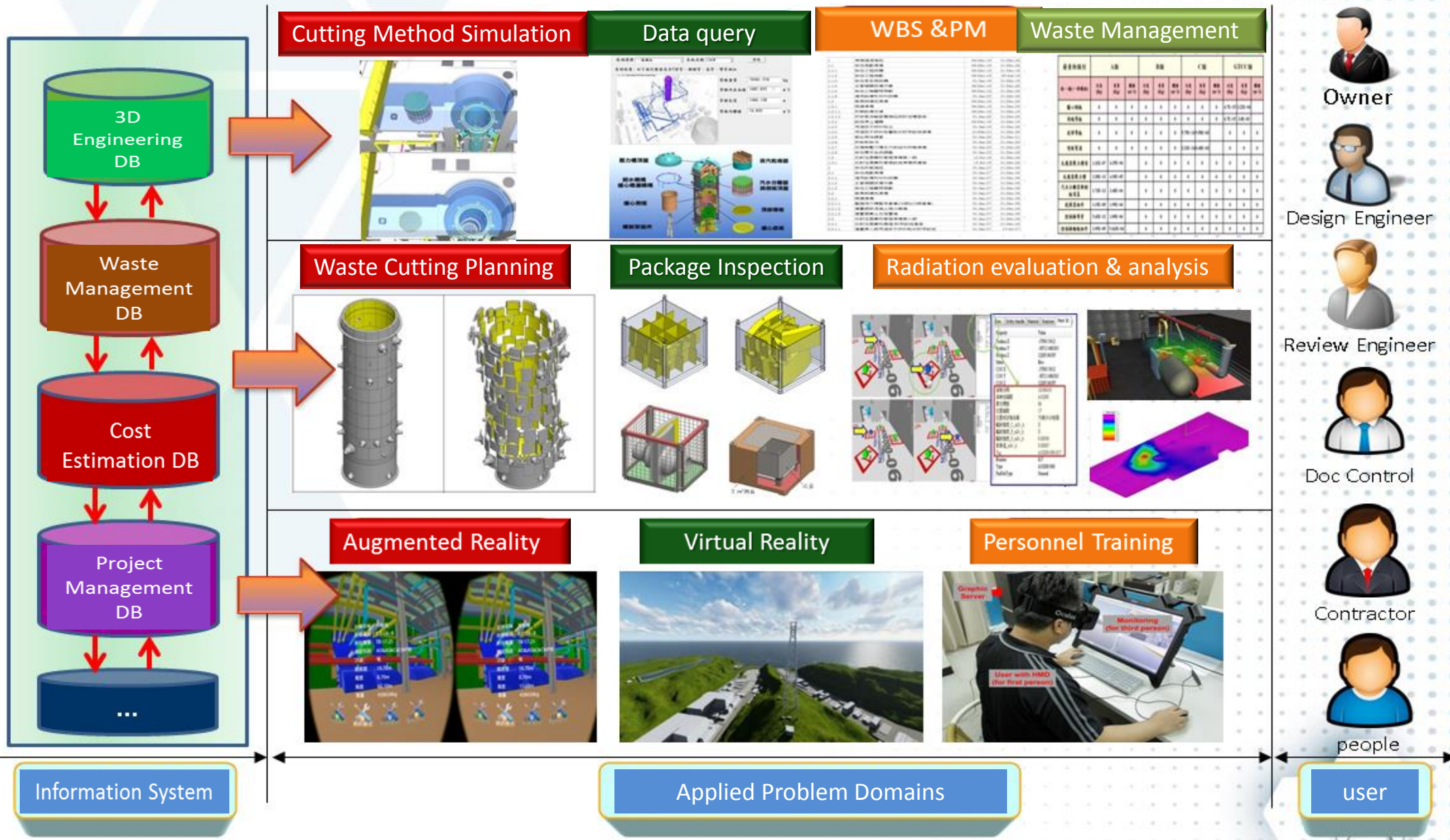
Live Photo



3D Model



Application of Database of NPP Decommissioning Information Management System



3D engineering simulation of NPP Decommissioning Information Management System

Application of NPP 3D Engineering simulation : Disassembly and Moving Paths Planning, Waste Inventory, Characteristic Survey Planning, Radiation Dose Analysis, Personnel Training. ♦ Dismantle Method Simulation ♦ Transport Route Planning /Personnel Training



拆除工法模擬



動線規劃/人員訓練

♦ Characteristic Survey Planning and Radiation Dose analysis

♦ Waste Inventory

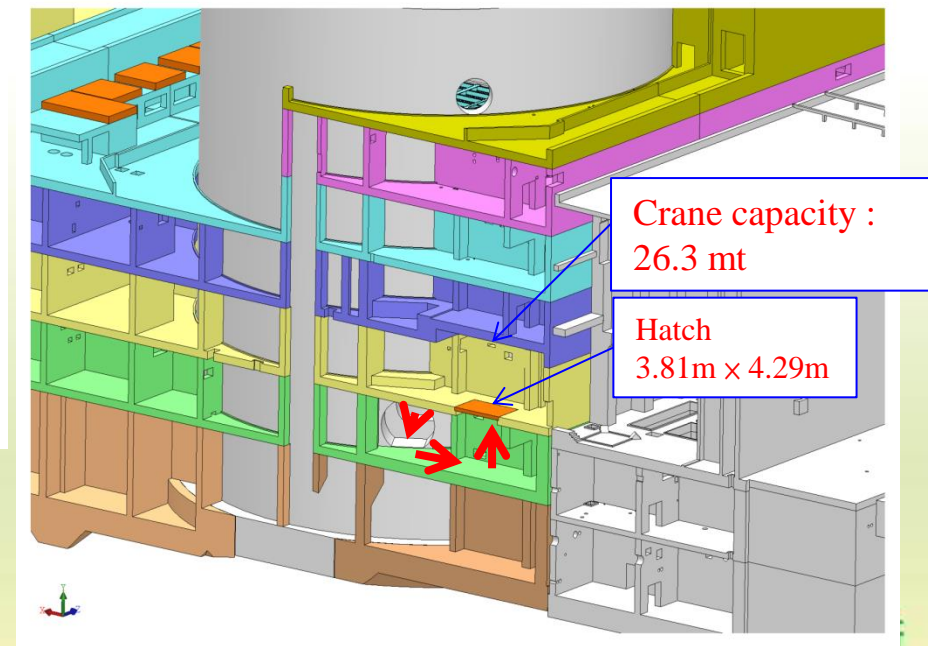
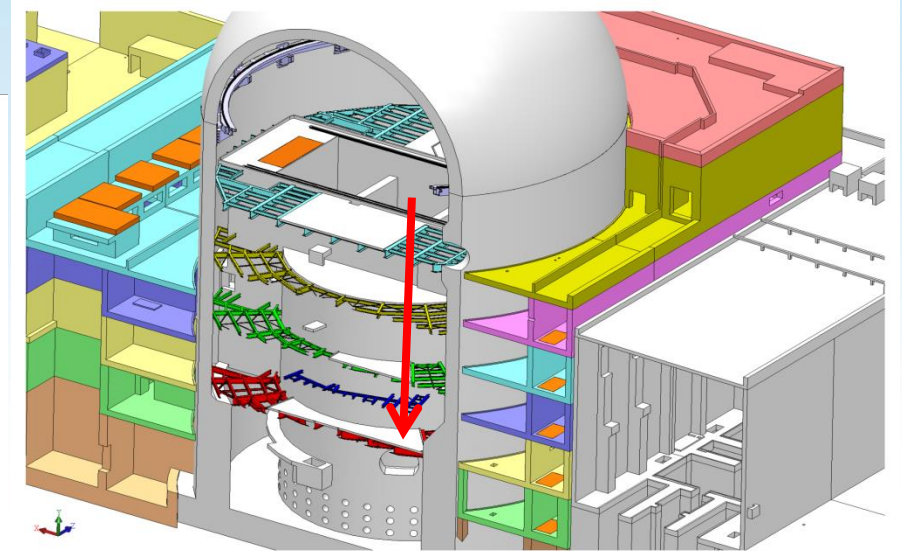
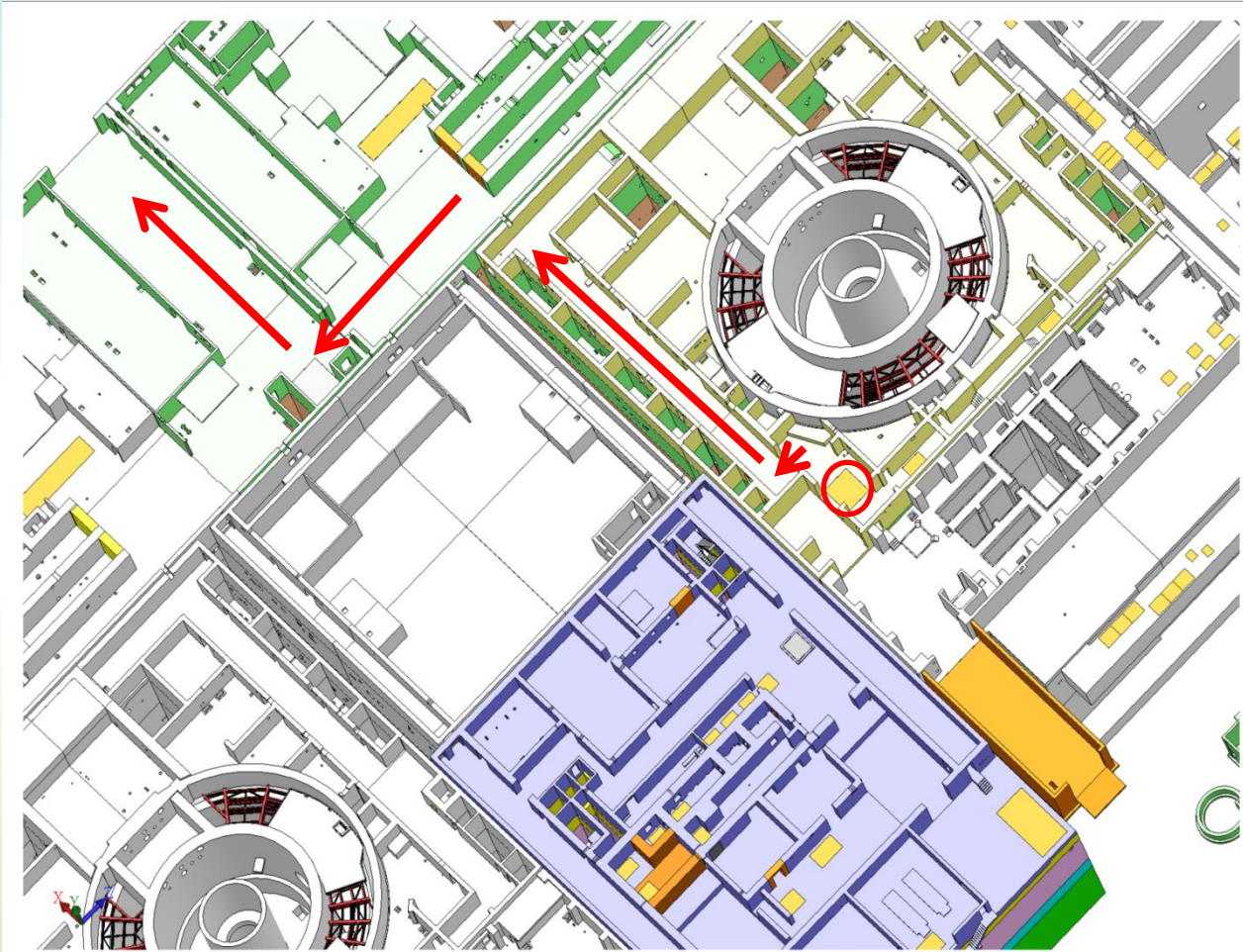


特性調查規劃與輻射劑量分析



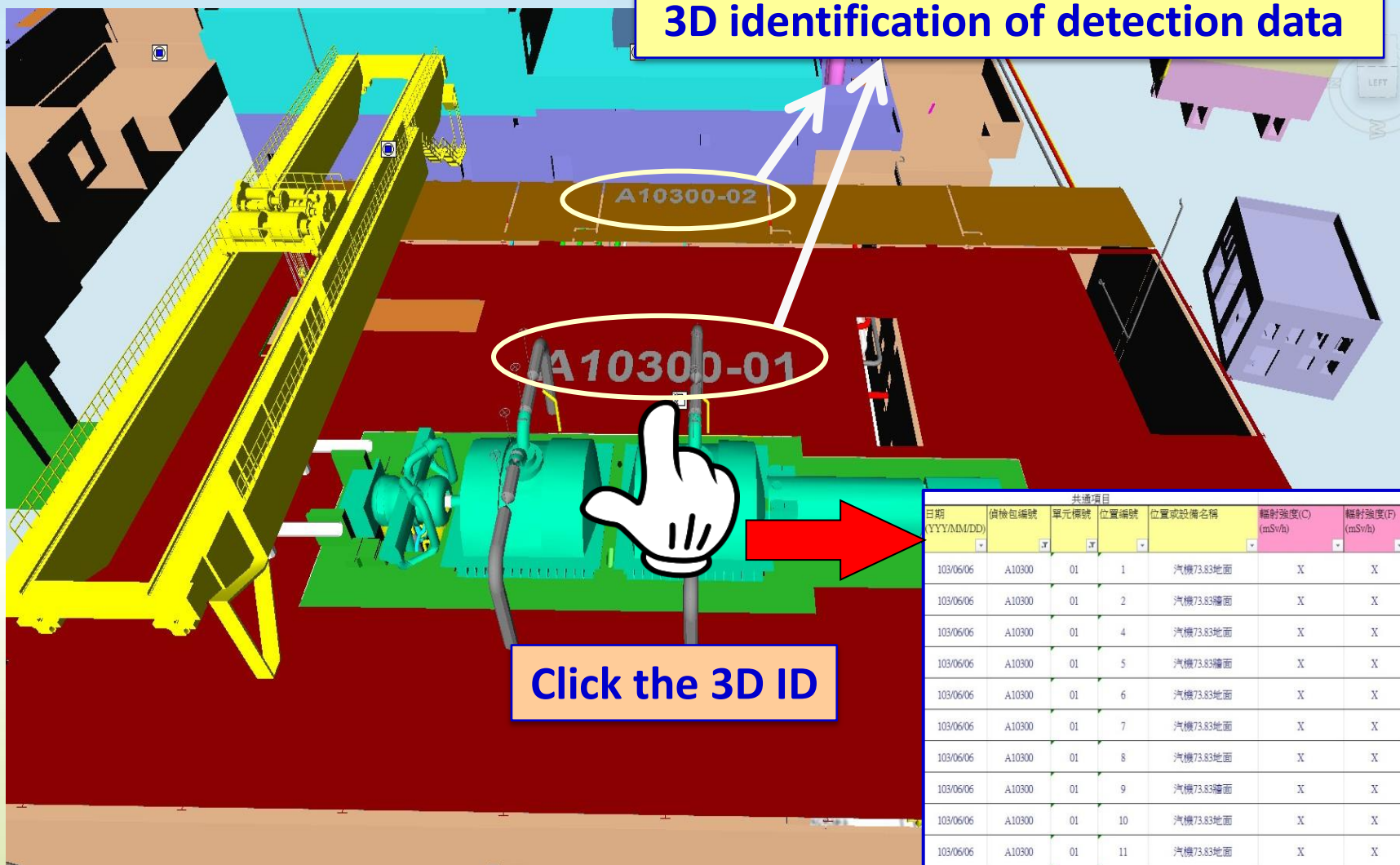
廢棄物盤點

Simulation of Disassembly Transport Route Planning



Integration of radiation characteristics survey data and 3D models

3D identification of detection data



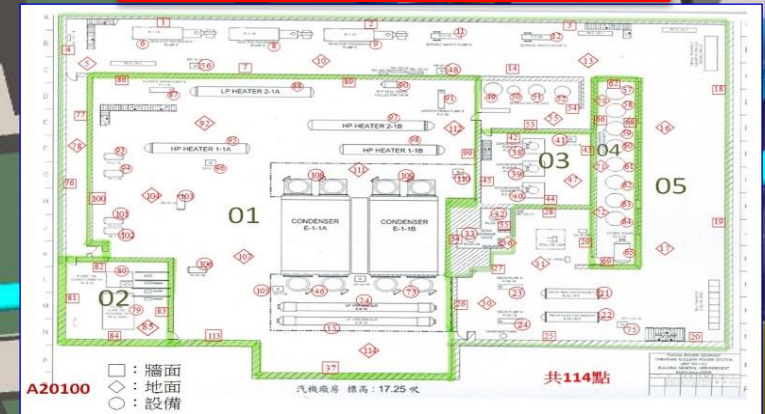
Click the 3D ID

共通項目						A類					
日期 (YY/MM/DD)	偵檢包編號	單元編號	位置編號	位置或設備名稱	輻射強度(C) (mSv/h)	輻射強度(F) (mSv/h)	輻射強度(S) (mSv/h)	背景	擦拭樣品編號	擦拭取樣結果 Bq/100 cm ² α	擦拭取樣結果Bq/100 cm ² β
103/06/06	A10300	01	1	汽機73.83地面	X	X	0.0029	0.00012			
103/06/06	A10300	01	2	汽機73.83牆面	X	X	X	0.00012			
103/06/06	A10300	01	4	汽機73.83地面	X	X	0.00029	0.00012			
103/06/06	A10300	01	5	汽機73.83牆面	X	X	X	0.00012			
103/06/06	A10300	01	6	汽機73.83地面	X	X	0.0002	0.00012			
103/06/06	A10300	01	7	汽機73.83地面	X	X	0.00015	0.00012			
103/06/06	A10300	01	8	汽機73.83地面	X	X	0.00022	0.00012			
103/06/06	A10300	01	9	汽機73.83牆面	X	X	X	0.00012			
103/06/06	A10300	01	10	汽機73.83地面	X	X	0.00038	0.00012			
103/06/06	A10300	01	11	汽機73.83地面	X	X	0.00016	0.00012			
103/06/06	A10300	01	12	汽機73.83地面	X	X	0.00012	0.00012			

Corresponding radiation characteristics survey data

Integration of radiation characteristics survey data and 3D models

Radiation Detection Data



日期 (YYYY/MM/DD)	共通項目			A類	
	偵檢包編號	單元標號	位置編號	擦拭取樣結果Bq/100 cm ² α	擦拭取樣結果Bq/100 cm ² β
103/05/08	A21600	01	1	MDA2.92E-01	MDA3.11E-01
103/05/08	A21600	01	2	MDA2.92E-01	9.64E-01±4.10E-01
103/05/08	A21600	01	3	MDA2.92E-01	MDA3.11E-01
103/05/08	A21600	01	4	MDA2.92E-01	MDA3.11E-01
103/05/08	A21600	01	5	MDA2.92E-01	MDA3.11E-01
103/05/08	A21600	01	6	MDA2.92E-01	MDA3.11E-01
103/05/08	A21600	01	7	MDA2.92E-01	MDA3.11E-01

共通項目					A類			
日期 (YYYY/MM/DD)	偵檢包編號	單元標號	位置編號	位置或設備名稱	輻射強度(C) (mSv/h)	輻射強度(F) (mSv/h)	輻射強度(S) (mSv/h)	背景 (mSv/h)
YYYY/MM/DD	文字	數字	數字	文字	數字	數字	數字	數字
103/05/08	A21600	01	1	聯合17.33 地面	-	-	0.000123	0.00015
103/05/08	A21600	01	2	聯合17.33 地面	-	-	0.00043	0.00015
103/05/08	A21600	01	3	聯合17.33 牆面	-	-	-	0.00015
103/05/08	A21600	01	4	聯合17.33 牆面	-	-	-	0.00015
103/05/08	A21600	01	5	聯合17.33 設備	0.00056~ 0.00078	0.0005	-	0.00015
103/05/08	A21600	01	6	聯合17.33 設備	0.00033~ 0.00036	0.00044	-	0.00015
103/05/08	A21600	01	7	聯合17.33 設備	0.00039~ 0.00061	0.00044	-	0.00015
103/05/08	A21600	01	8	聯合17.33 設備	0.00029~ 0.00042	0.00025	-	0.00015

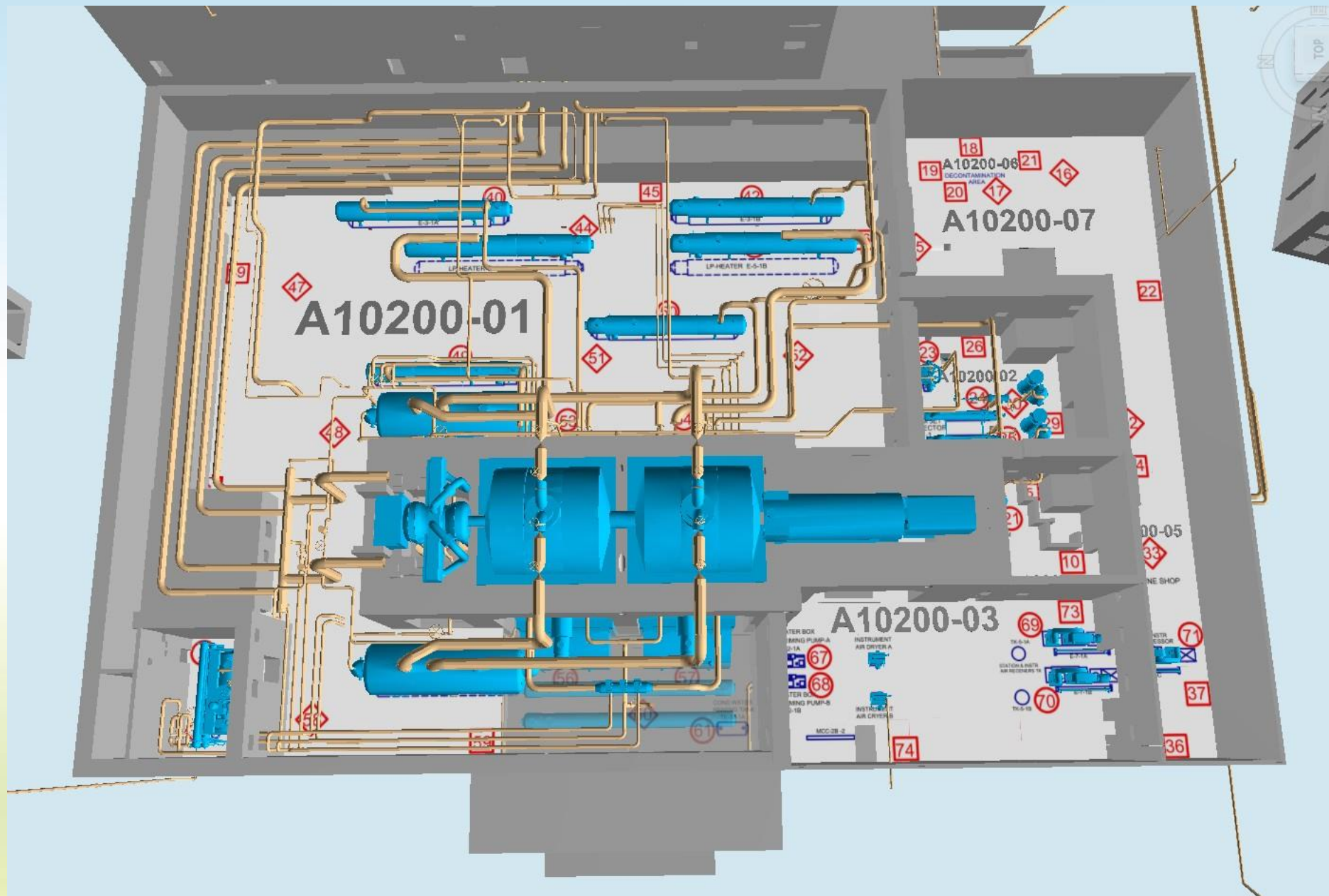
Embed Detection
Package ID and
Unit Label in 3D
Virtual
Environment

A20100-02

Display

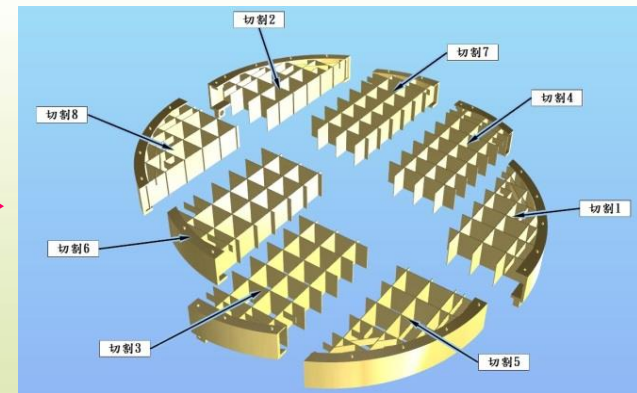
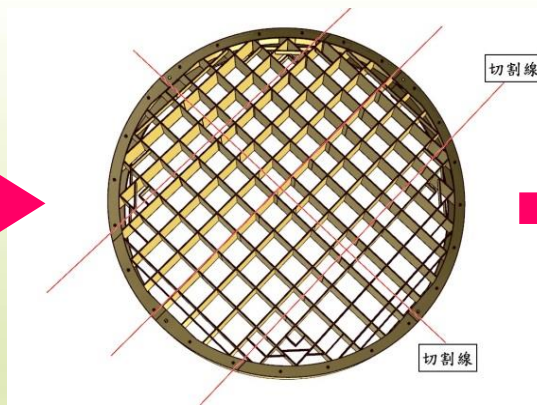
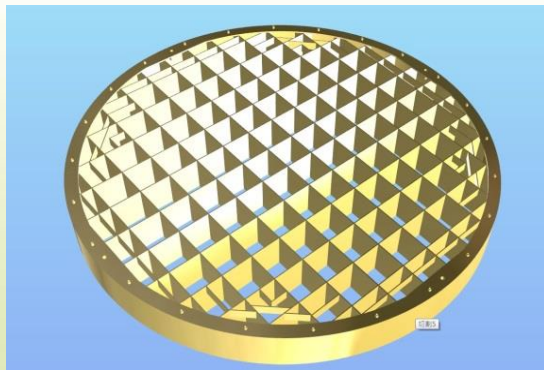
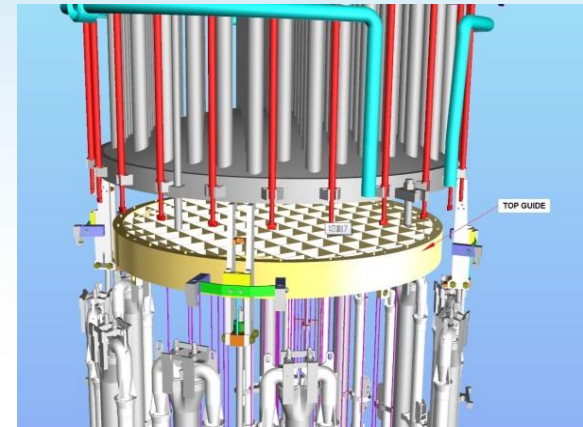
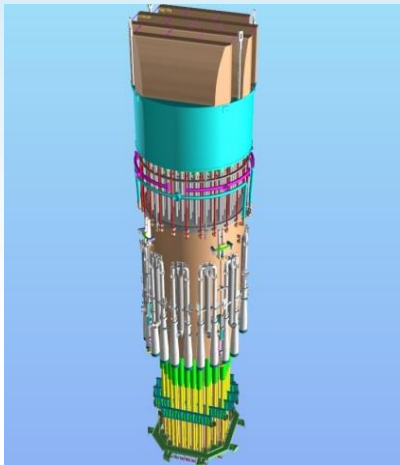
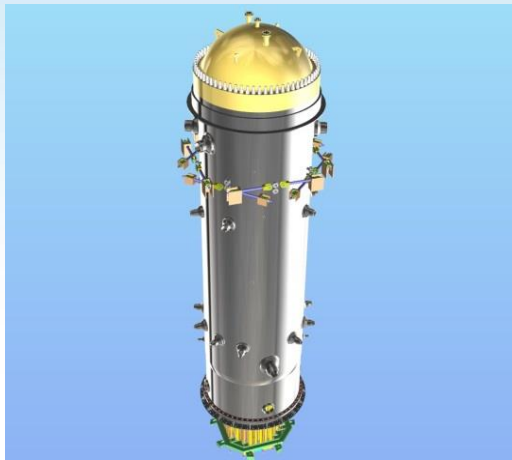


Integration of radiation characteristics survey data and 3D models



Reactor Vessel Disassembly Operation Planning

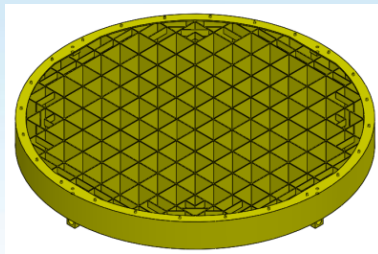
❑ Disassembly operation planning of reactor & internals



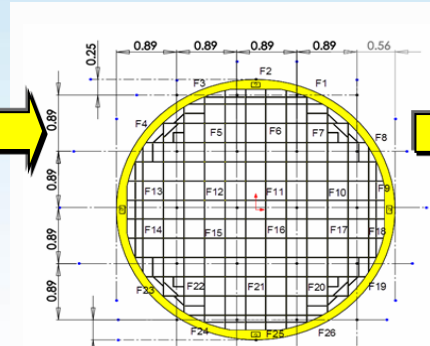
Top Guide Cutting Simulation

Reactor Vessel Disassembly Operation Planning

□ Disassembly operation planning of reactor & internals



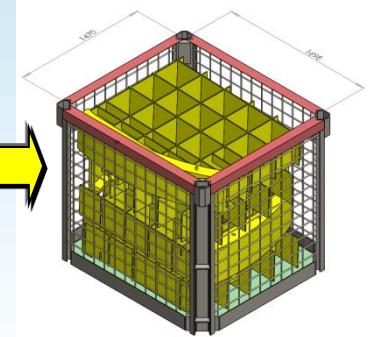
Top guide



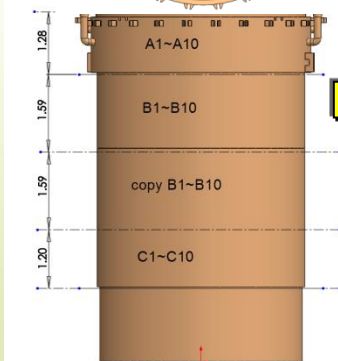
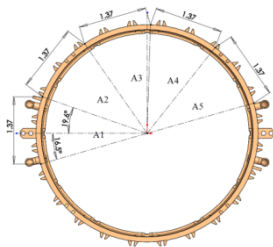
Layout of cutting line

提籃 編號	切割 件數	切割件 總重量 (kg)
1	2	410
2	2	463
3	2	339
4	2	344
5	2	339
6	2	339
7	3	573
8	5	783
9	6	913

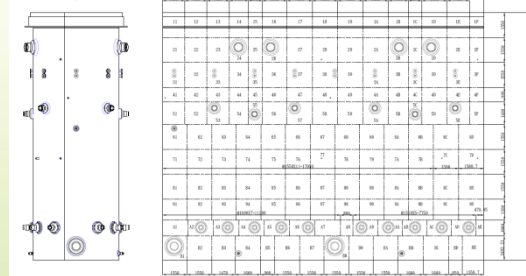
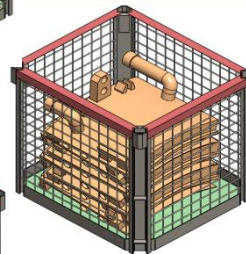
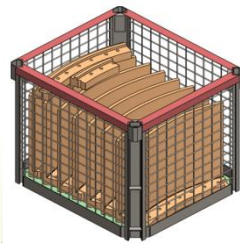
Cutting pieces count & statistics



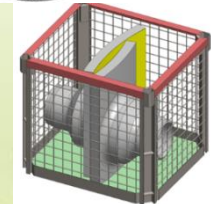
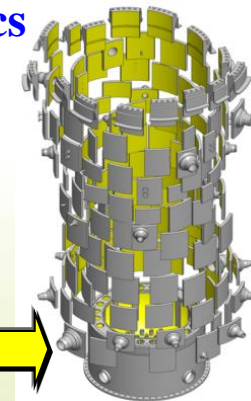
Pack Simulation



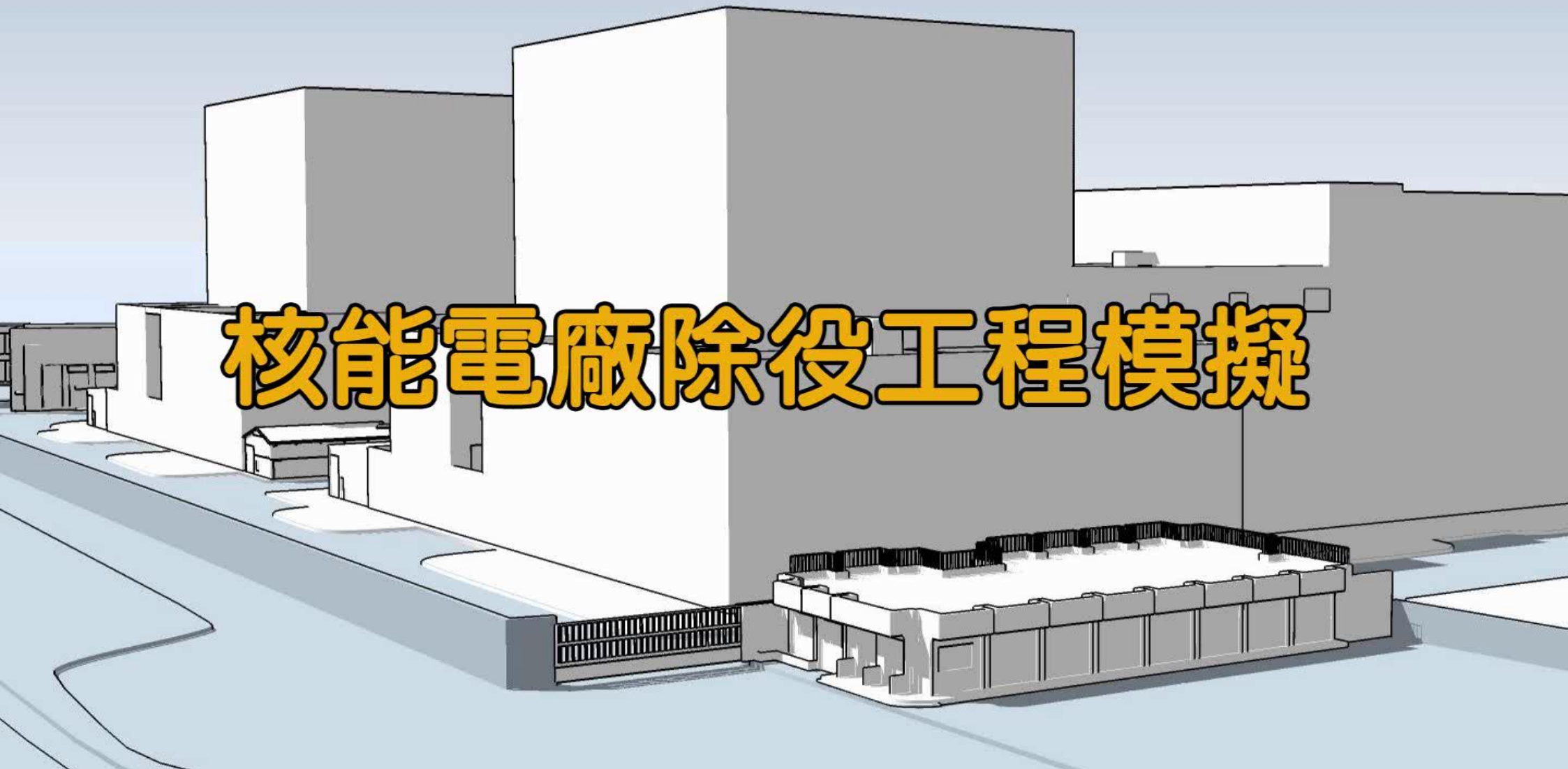
Core shroud



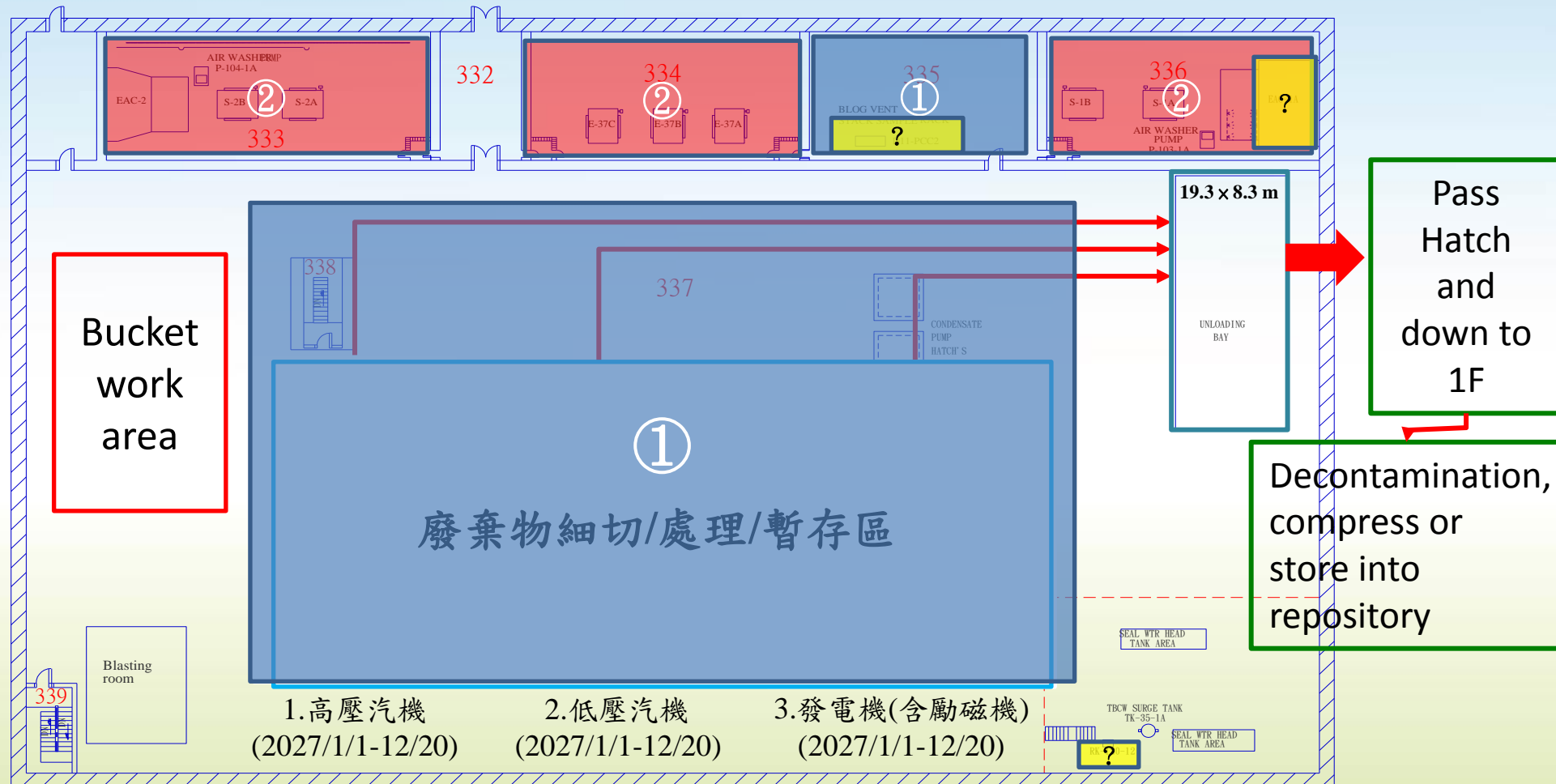
Reactor pressure Vessel
Shell Assembly



核能電廠除役工程模擬



Simulation of the Transport Route of Nuclear Waste in Turbine Building



①	1 st stage
②	2 nd stage
?	Not Sure

Simulation of the Transport Route of Nuclear Waste in Turbine Building



Conclusion

- By way of the construction of decommissioning information management system for the preliminary stage, various data are kept for further usage in future decommissioning stages.
- The 3D engineering information has been collected and utilized to help the estimation of the nuclear waste and cost of decommissioning.
- Introduction of new information technology to smoothly integrate decommissioning information system and 3D engineering information will benefit the decommissioning of the nuclear facility.