The Flood in the Unit 2 Reactor Building of the Lungmen NPP during Typhoon SINLAKU

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OUTLINES

- Sequence of Events
- The Affected Equipment
- Short-term Activities
  - Recovery Plan
  - Regulatory Activities
- Long-term Activities
- Conclusions

Sequence of Events

- On Sep. 13th & 14th 2008, Typhoon SINLAKU hit the northern Taiwan with strong wind and heavy rains. It caused the flood in the Unit 2 Reactor Building Radwaste Tunnel of the Lungmen NPP, which is still under construction.
- Some of the pumps failed to function due to offsite power outage in the evening of 13th. The flood level thus got higher and higher. （outside of RB）
- The flood overflew the sand bags and through the poorly sealed pipe （6 inches） towards the RB.

Sequence of Events （Cont.）

- The water flew through the hole into the RB, and flooded the pumps（not submersible pump） equipped at the basement （EL. -8200）. These 8 sets of non-submersible pump failed to function.
- The flood level eventually reached about 2 meters. （inside of RB）

Sequence of Events （Cont.）

- Morning of the 14th, flood of unit 2 of Reactor Building of the 4th NPP was identified
- Morning of the 15th, the TPC reported the flood to AEC on-duty center
- Immediately action（TPC）
  - Block the leak source
  - Got all available pumps to pump water out
  - On 16th, most of water was pumped out of the basement
  - Checked the flooded equipment thoroughly, and issued the NCR（ Non Conformance Report ）

The Affected Equipment

- The affected equipment：
  - CRD Pumps
  - HPCF Pumps
  - RCIC Pump, keep fill pump, drain pump
  - RHR Pumps, keep fill pumps
  - RHR HXs
  - RWCU backwash pump
  - RWCU pumps
  - RWCU HXs
  - AHUs
  - HCUs
  - Quenchers
  - others
- Total: 34 sets of water pump, 12 sets of motor, 7 sets of AHU, 103 sets of HCU, etc.

Recovery Plan

- **Repair**
  - MOV, AOV：repaired by LCO and supported by 3th NPP, Lungmen NPP
  - Motor：disassemble at outside factory
  - Pump：repair in the field
- **Quality and Safety：**
  - Refer to EPRI “ Guidelines for the Repair of NPP Safety-Related Motors”
  - Refer to INPO documents
  - Refer to the domestic and international experiences
  - Ask manufacturers to repair RCIC Pump, CRD Pumps

Recovery Plan （Cont.）

- **Preventive Actions**
  - Recheck the opening of all the buildings
  - Setup the mechanism to account for all the openings
  - Before typhoon, make sure all the openings are tightly sealed
  - Deploy diesel submersible pump to avoid pump failure due to flood

Regulatory Activities

- On Sep. 15, 2008, Received the event notification from TPC
  - Asked resident inspector to observe the recovery activities
  - Release the news in the public website
- On Sep. 16 & 17, 2008, Resident Inspector reentered the site to inspect the affected equipment
- On Sep. 24, 2008, TPC officially reported the event to AEC, AEC requested TPC to:
  - Review the effectiveness and the efficiency of typhoon contingency plan and response team to ensure the history will not repeat itself
  - Refer to the domestic and international experiences to setup the recovery plan including the acceptance criteria
  - Define the examination and maintenance procedures to ensure the environmental-sensitive equipment above the flood level can perform its intended safety function
  - Setup the special procedure to ensure the affected equipment will be compliant to the operability and reliability requirements

Regulatory Activities （Cont.）

- **Notification of Violation**
  - Regulations on Immediate Notification Requirements and Reportable Event Report for Nuclear Reactor Facilities
    - 2 hours Immediate Notification
    - 1 month document report
- **Implement the preliminary investigation report**
  - Root Cause investigation
  - Outline the activities of TPC and AEC
  - Send the report to the State-owned Enterprise Commission to investigate the staff's responsibility

Regulatory Activities （Cont.）

- State-owned Enterprise Commission
  - Insufficient anti-typhoon contingency plan
  - Improper staffing of anti-typhoon team
  - Inadequate emergency reaction

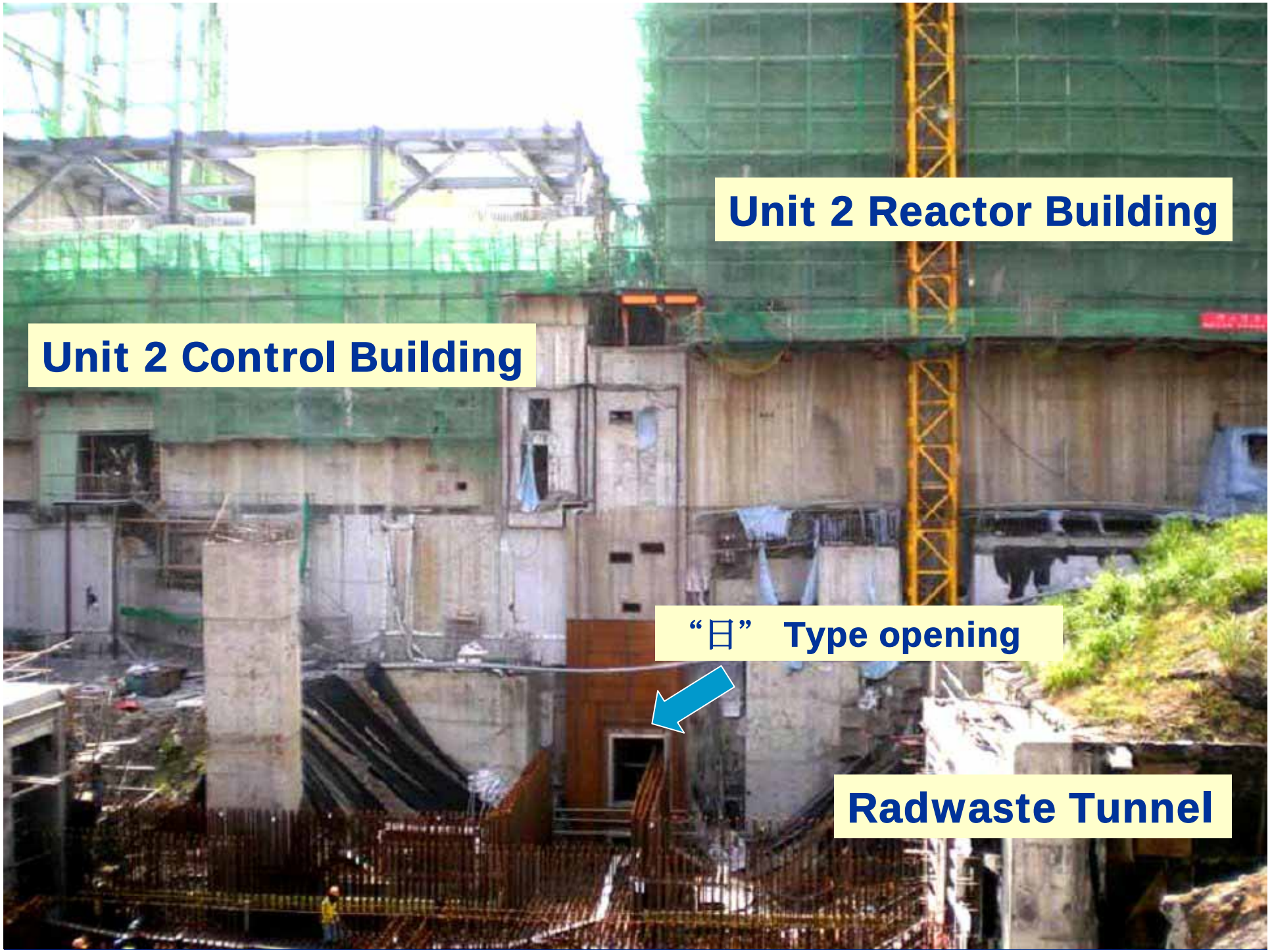
Long-term Activities

- All affected equipments, except HCUs, have been repaired according to the recovery plan
- TPC established 「 Special maintenance plan before turnover 」（including Post Construction Test phase）
- TPC set up 「Special maintenance plan after turnover 」（including Pre-operation test, Startup test, commercial operation phase）
- Site resident inspection（memorandum）
- Periodic inspection（Notice to Improve）
- Evaluate the PCT, Pre-op, Startup test result
- Enhanced supervision for at least 2 cycles after commercial operation

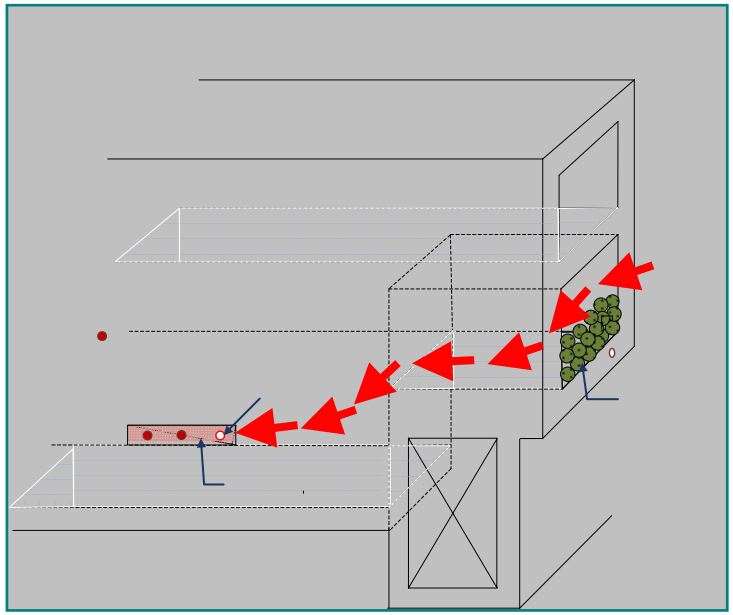
Conclusions

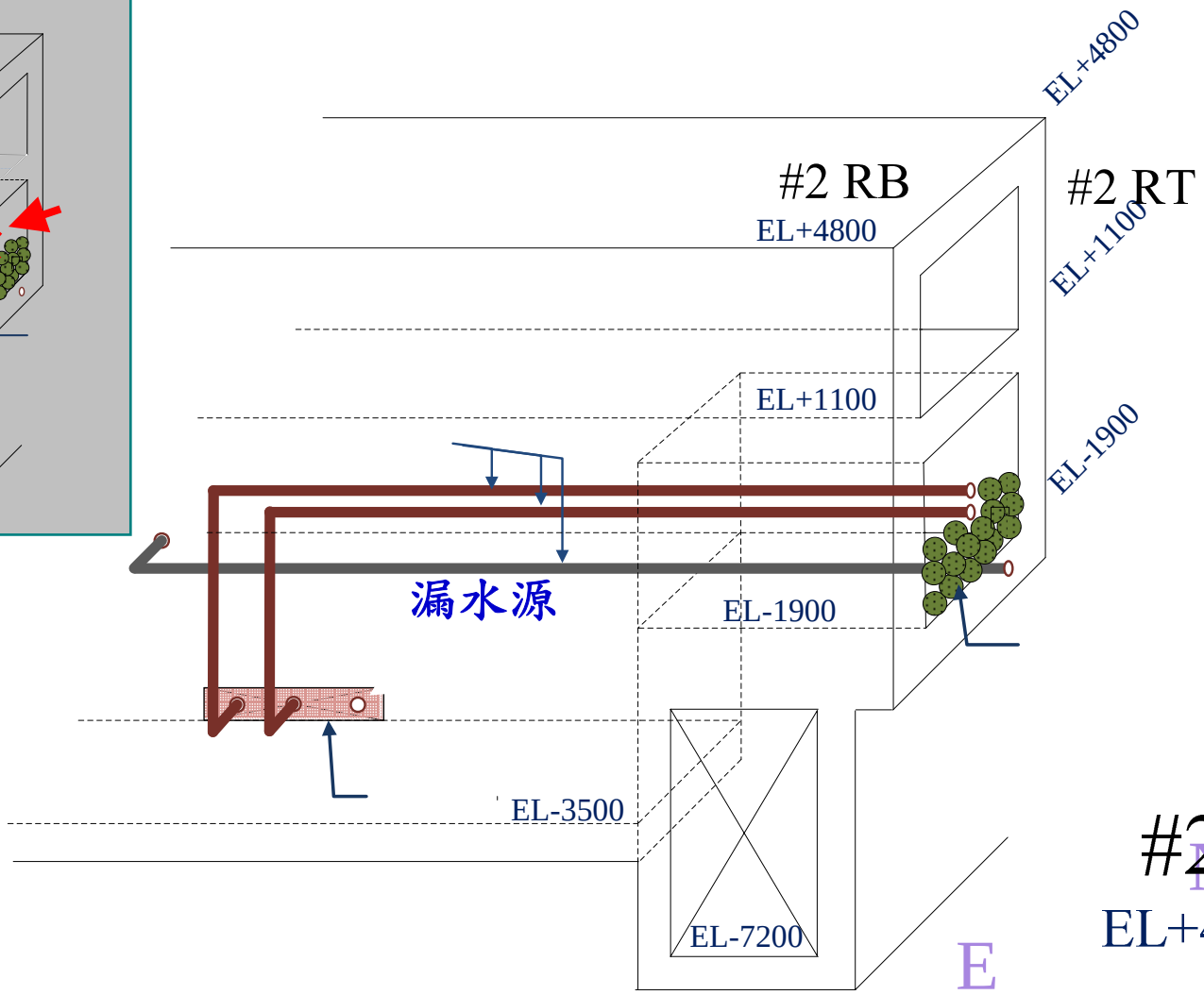
- Identify the root cause of the event to ensure the history will not happen again
- Review and oversight the recovery plan, special maintenance plan to ensure the plan will be effectively implemented
- Ensure the affected equipment can perform its intended safety function not only in testing phase but also in operating phase

Thank You
for
your attention


Unit 2 Reactor Building
Unit 2 Control Building
“目” Type opening
Radwaste Tunnel

RB EL.-8200 Flooding Sketch Map



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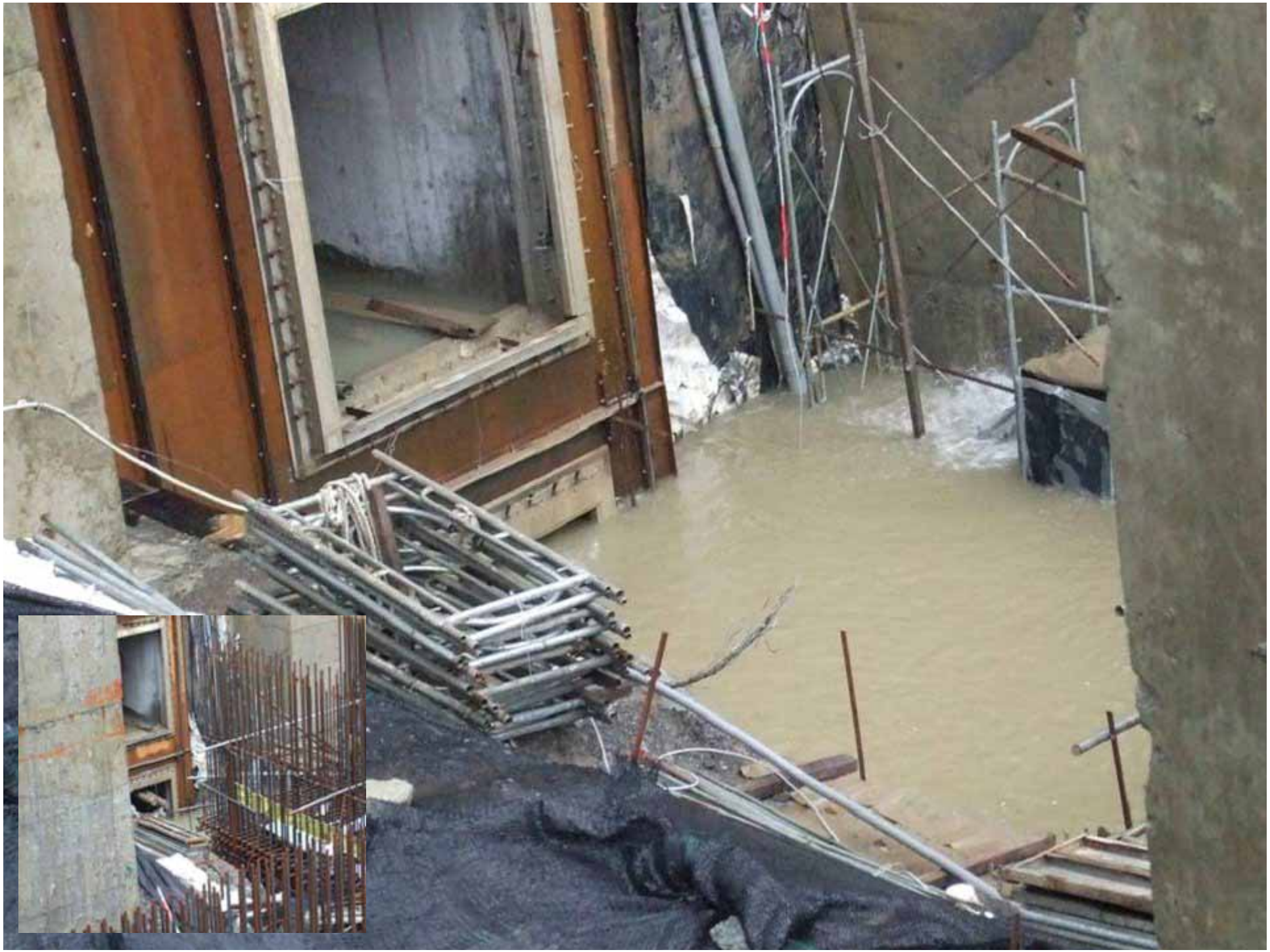
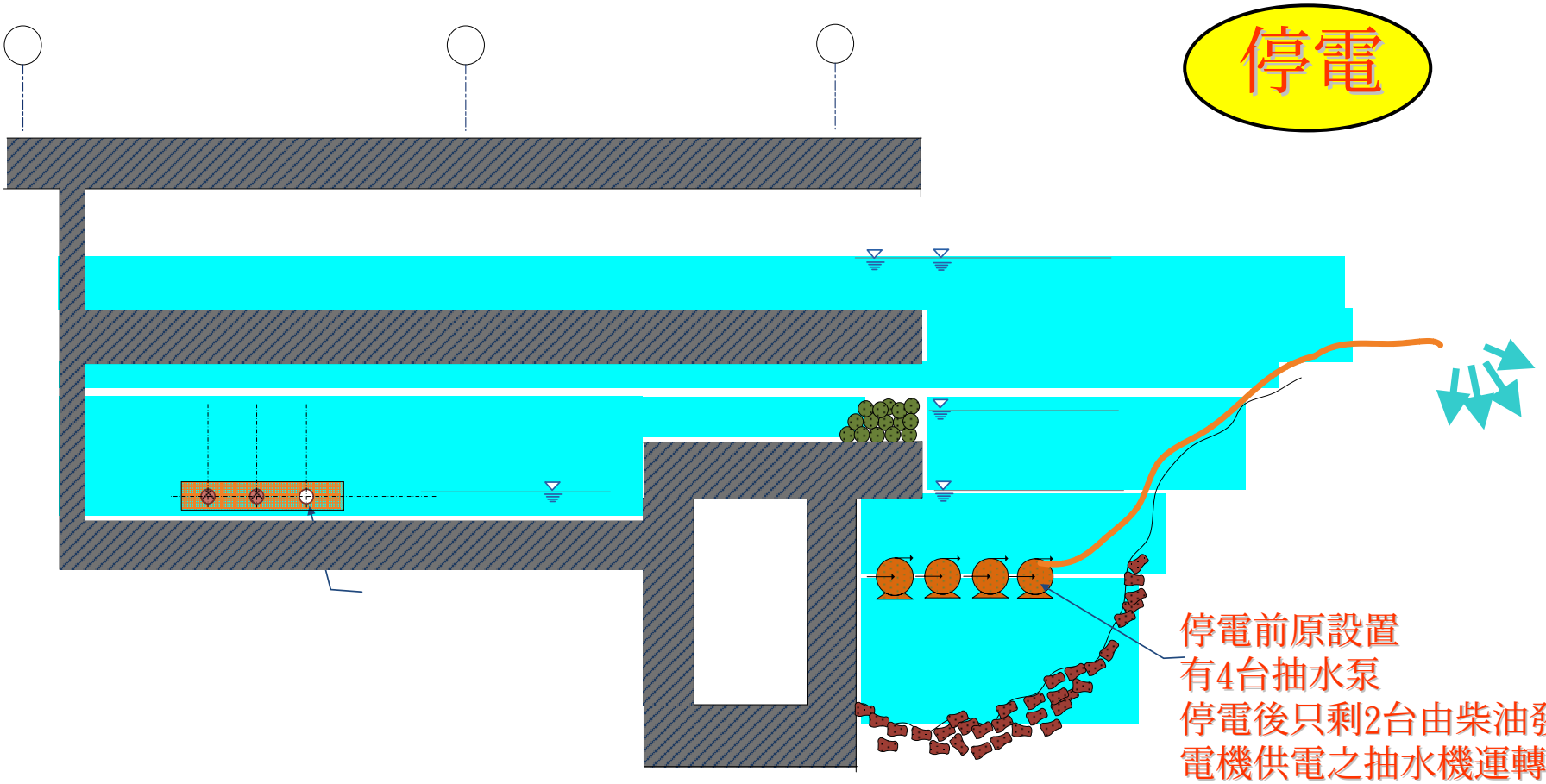
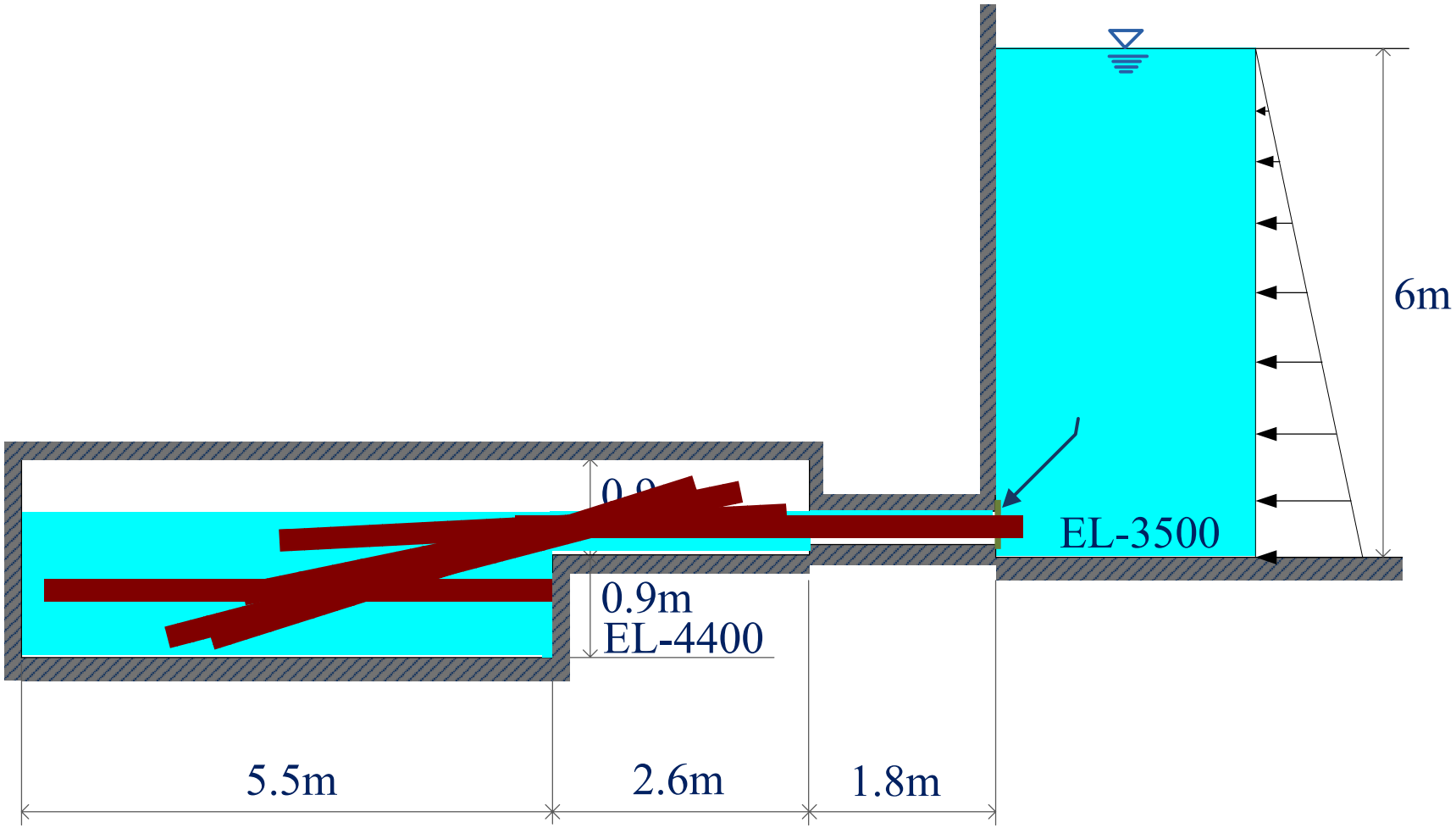


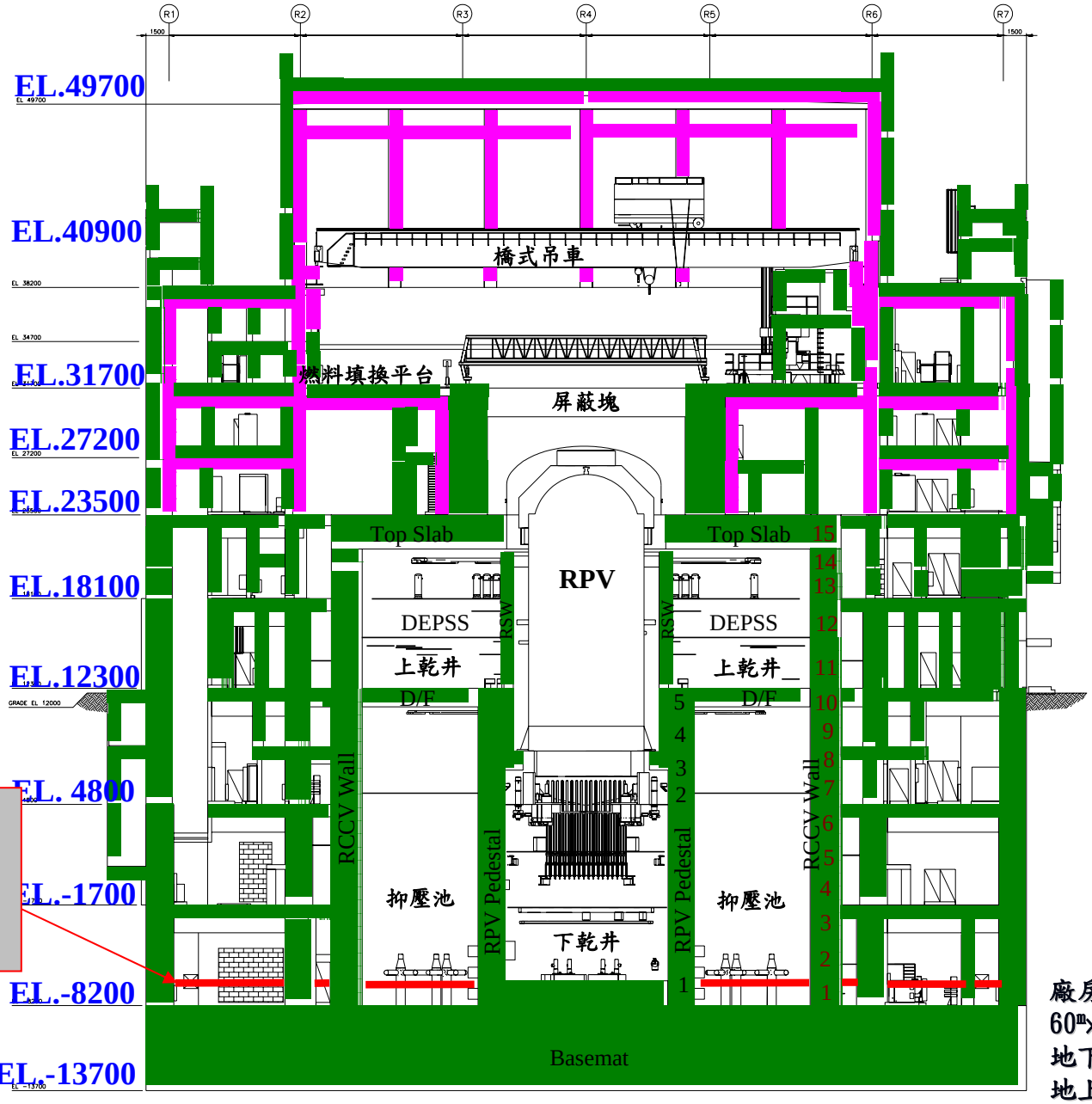
Typhoon SINLAKU Flooding Path



RB Room 149 Flooding Sketch Map

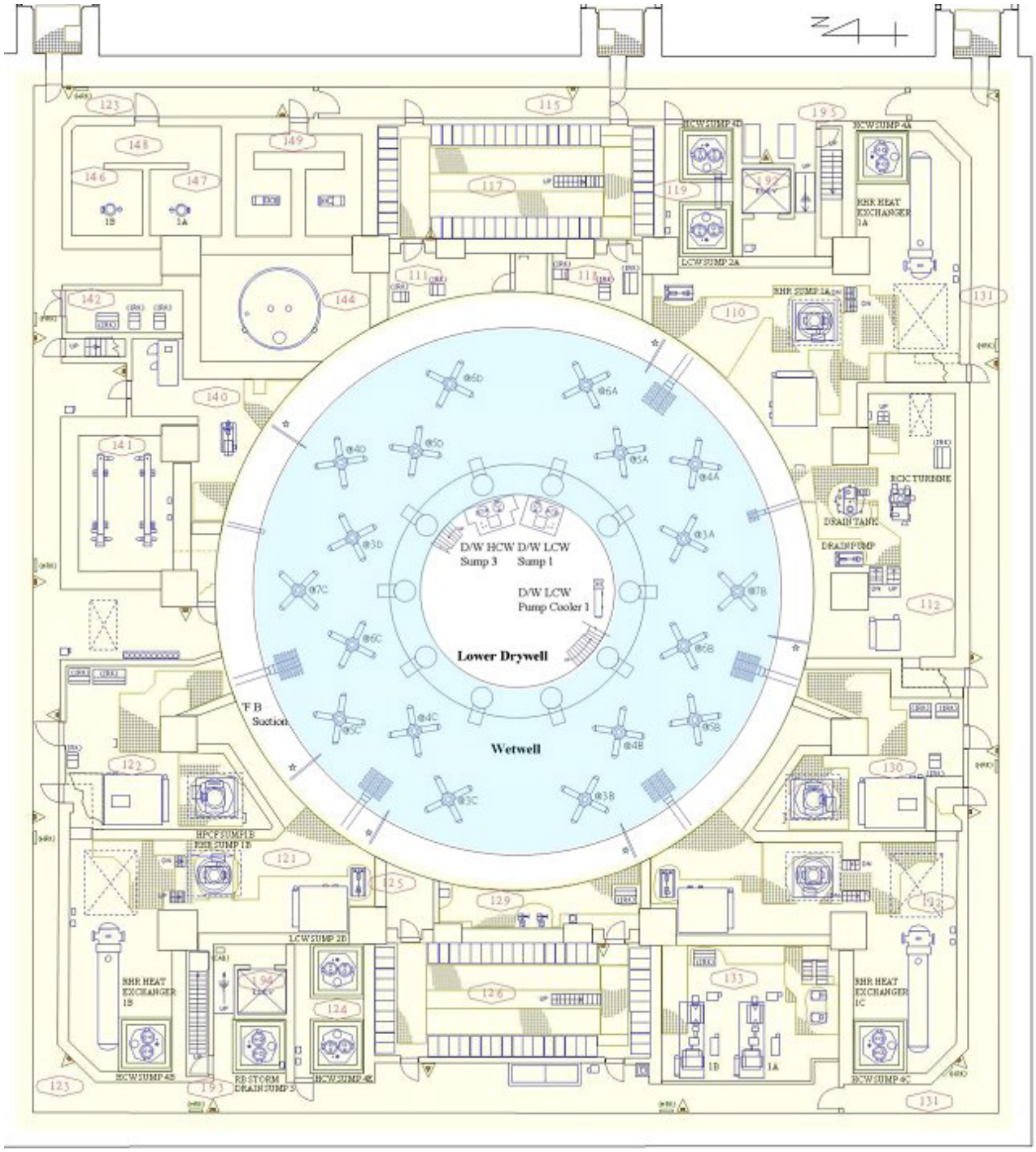



2008 9 16



Flooding Level: 2meters

廠房規模：
60m×57m ×63.4m(高)
地下3層(25.7m)
地上4層(37.7m)



編號	房間名稱
110	RHR PUMP RM A
111	INSTRUMENT RACK RM. DIV. 4
112	RCIC PUMP RM A
115	CORRIDOR A
117	CRD HCU RM, QUADRANT I/IV
118	INSTRUMENT RACK RM, DIV. 1
119	QUADRANT A SUMP RM
121	RHR PUMP RM B
122	HPCF PUMP RM B
123	CORRIDOR B
124	QUADRANT B SUMP RM
125	INSTRUMENT RACK RM, DIV. 2
126	CRD HCU RM, QUADRANT II/III
129	INSTRUMENT RACK RM, DIV. 3
130	HPCF PUMP RM C
131	CORRIDOR C
132	RHR PUMP RM C
133	CRD PUMP RM
140	SPCU PUMP RM
141	RWCU NONREGENERAITVE Hx RM
142	RWCU/SPDS Instr. RM
144	RWCU BACKWASH TANK RM
146	RWCU PUMP B RM
147	RWCU PUMP A RM
148	RWCU PUMP MAINTENANCE AREA
149	BACKWASH TRANSFER PUMP RM
192	ELEVATOR #1
193	STAIR #3
194	ELEVATOR #3
195	STAIR #1

反應器廠房 B4F
EL -8200

參考LM31113-1U71-M1001r6


HITACHI

EPRI

Topics:
Commercial-grade items
Electric motors
Maintenance
Specifications

EPRI NP-6407
Project Q101-9
Final Report
March 1990

Guidelines for the Repair of Nuclear Power Plant Safety-Related Motors (NCIG-12)

Prepared by
NUTECH
San Jose, California
and
Strategic Technology and Resources
Winchester, Massachusetts

UNIT:	LASALLE 1 & 2 (BWR)
DOC NO/LER	NO: 50-373/85045
EVENT DATE:	5/31/85
NSSS/AE:	GENERAL ELECTRIC/SARGENT & LUNDY
UNIT:	INDIAN POINT 2 (PWR)
DOC NO/LER	NO: 50-247/84011
EVENT DATE:	8/13/84
NSSS/AE:	WESTINGHOUSE/UNITED ENGINEERS & CONSTRUCTORS
UNIT:	PEACH BOTTOM 3 (BWR)
DOC NO/LER NO:	50-278/NA
EVENT DATE:	1/14/84
NSSS/AE:	GENERAL ELECTRIC/BECHTEL
UNIT:	DOEL 1 & 2 (PWR)
DOC NO/LER NO:	BELGIUM
EVENT DATE:	8/5/79
NSSS/AE:	ACEC WITH WESTINGHOUSE/TRACTION-ELECTRICITE
UNIT:	CRYSTAL RIVER 3 (PWR)
DOC NO/LER NO:	50-302/NA
EVENT DATE:	1/26/79
NSSS/AE:	BABCOCK & WILCOX/GILBERT COMMONWEALTH
UNIT:	OCONEE 3 (PWR)
DOC NO/LER NO:	50-287/76018
EVENT DATE:	10/9/76
NSSS/AE:	BABCOCK & WILCOX/DUKE POWER COMPANY

Fuel Building, BLAYAIS NPP, France