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EXPERIENCE OF TRR-1/M1 RESEARCH REACTOR FOR POOL REPAIRING

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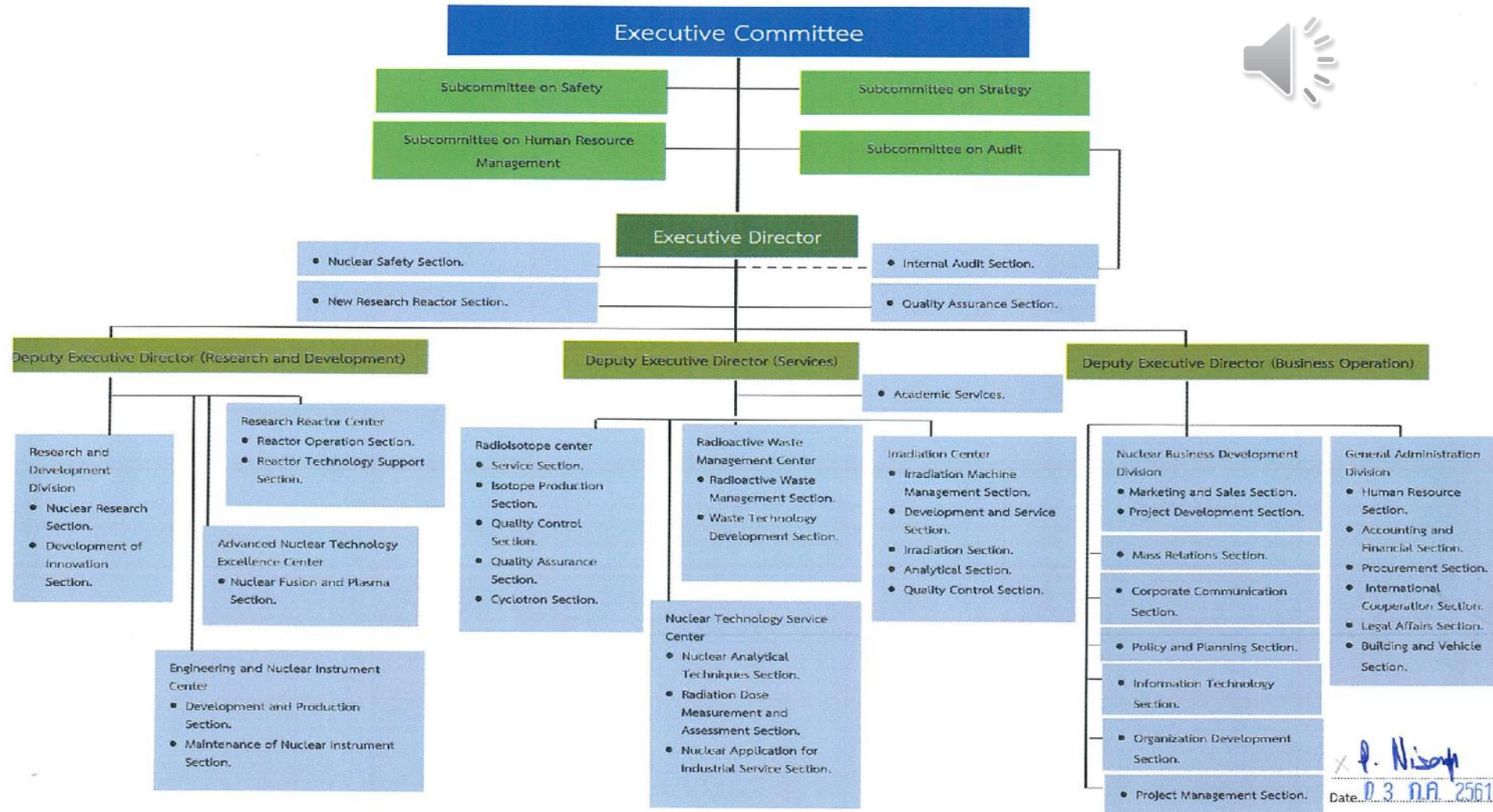
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TINT Organization Chart

THAILAND INSTITUTE OF NUCLEAR TECHNOLOGY (PUBLIC ORGANIZATION)

According to the resolution of the board of directors of Thailand Institute of Nuclear Technology in the meeting of No. 11/2017, November 14, 2017.



2. ACTIVITIES



- **International Cooperation**
- **Isotope preparation for medical use**
 - Medical isotope supply to 9 nuclear medical center/11 hospitals
 - Mainly I-131
 - Sm-153 EDTMP
 - Phosphorus -32
 - Kits for Tc-9m radiopharmaceuticals
- **Research and Development**
 - Conducting research and development
 - Creating a networks
 - Educating and providing
 - Presenting research
- **Regulation**
 - Nuclear material and Reactor
 - Radioisotope material
- **Service**
 - TINT'S Service Center
 - GEMs Irradiation Center
 - Radioactive Waste Management Center
 - Irradiation Center
- **Nuclear Technology Transfer**
 - Radiation Protection
 - Damage-free Inspection Technology
 - Academic Conferences on Science and Nuclear Tech.

3. TRR-1/M1 REACTOR

History of Thai Reactor



TRR-1 in 1962



Reactor Building, constructed in 1960



Reactor Building

Constructed in 1960



Width = 22 m.,
Long = 26 m.,
High = 20 m.



Thai Research Reactor-1 (TRR-1)



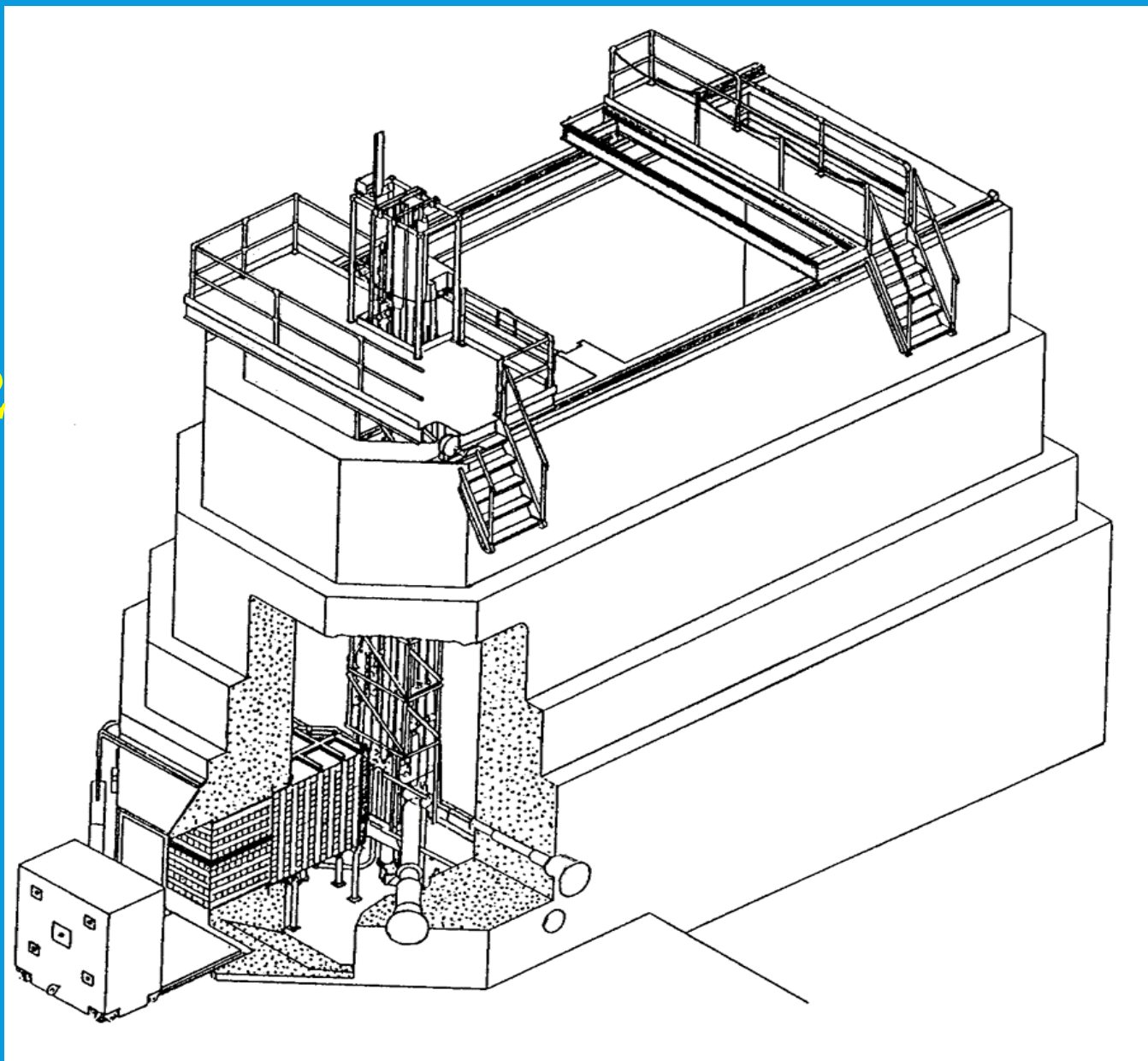
- Currtiss Wright Corporation (USA.)
- 1000 kW Power
- Critical on 27 October 1962
- U-235 with 90% enrichment Fuel (Curved plate type MTR fuel)
- Shutdown on 27 June 1975 (Operated for 12 years and 8 months)



ภาพถ่ายในห้องควบคุมเครื่องปฏิกรณ์ปรมาณู หน้าปัดต่างๆ เหล่านี้ จะแจ้งความเคลื่อนไหวของเครื่องปฏิกรณ์ปรมาณูในทันที

TRR-1

Critical on 27 October 1962



Reactor Pool

TRR-1/M1

Modification in 1977

Critical on 7 November 1977

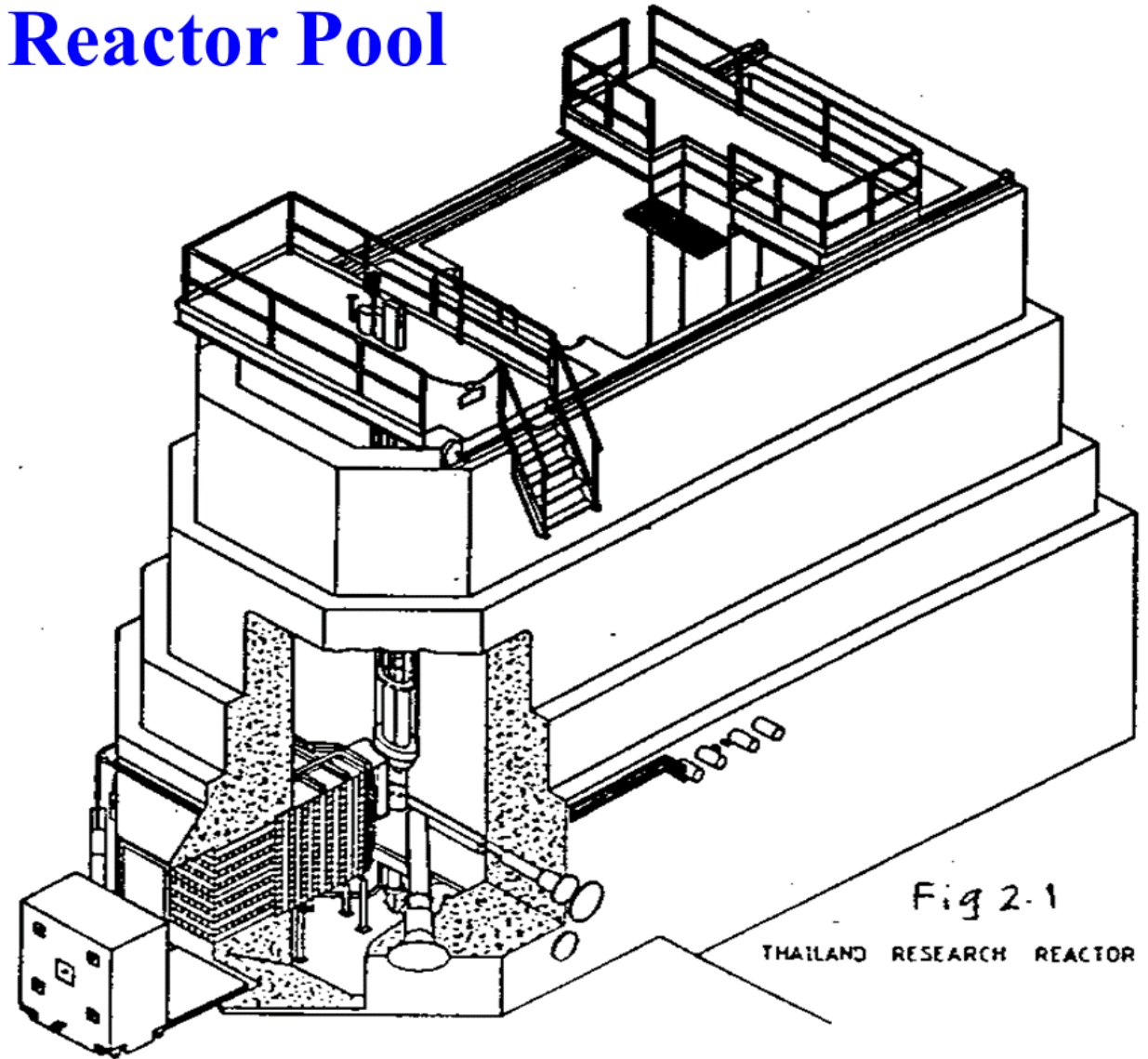


Fig 2-1

THAILAND RESEARCH REACTOR

General Information of TRR-1/M1 “Now”

- Open Pool type TRIGA Mark III Reactor
- Movable Core
- **Maximum Steady State Power 1.2 Mw**
- 20% Low Enrich Uranium
- Water cooled and moderated
- 5 Control Rods



Operation



- 10.5 month for Operation time
- 1.5 month Shutdown for Yearly Maintenance
- Operated at 1000 MW for 26 hrs/ wk.
- Operated week by week
- Monday – Tuesday Operation for 7 hrs., Wednesday Operation for 12 hrs for I-131 production
- Friday Reservation for Minor Maintenance work, Sample Loaded and Removed and Experiment Setup
- **We are in Fuel Shortage Situation**

4. REACTOR UTILIZATION

- **Gem Stone Colorization**
- **Isotope Production**
- **NAA**
- **Neutron Radiography**
- **Neutron Scattering**
- **PGNAA**
- **Training and Education**



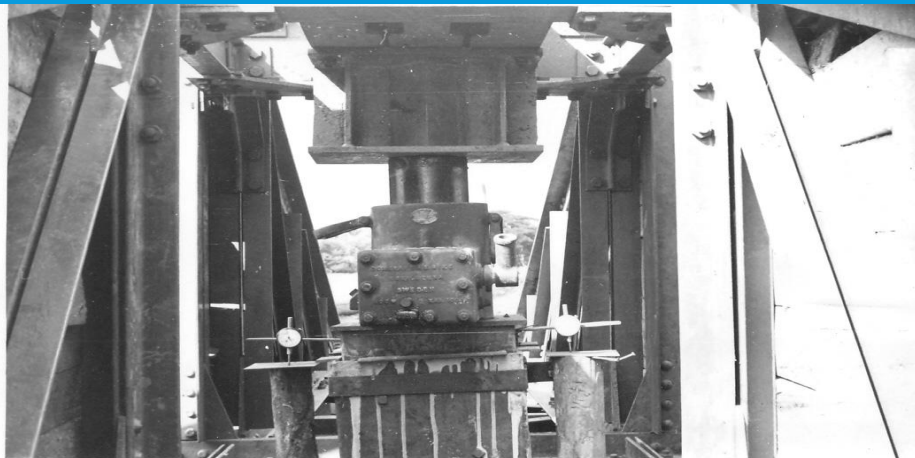
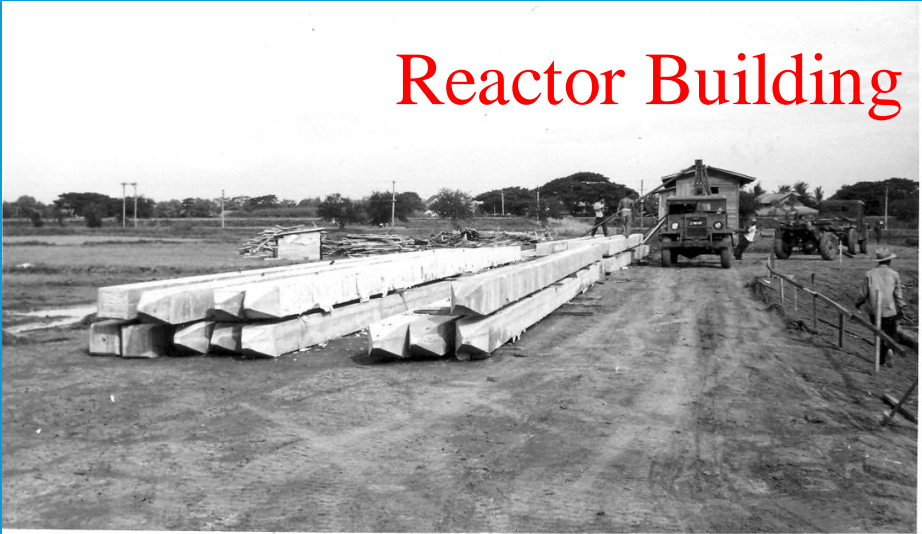
Irradiation Facilities : “InCore and Outcore”

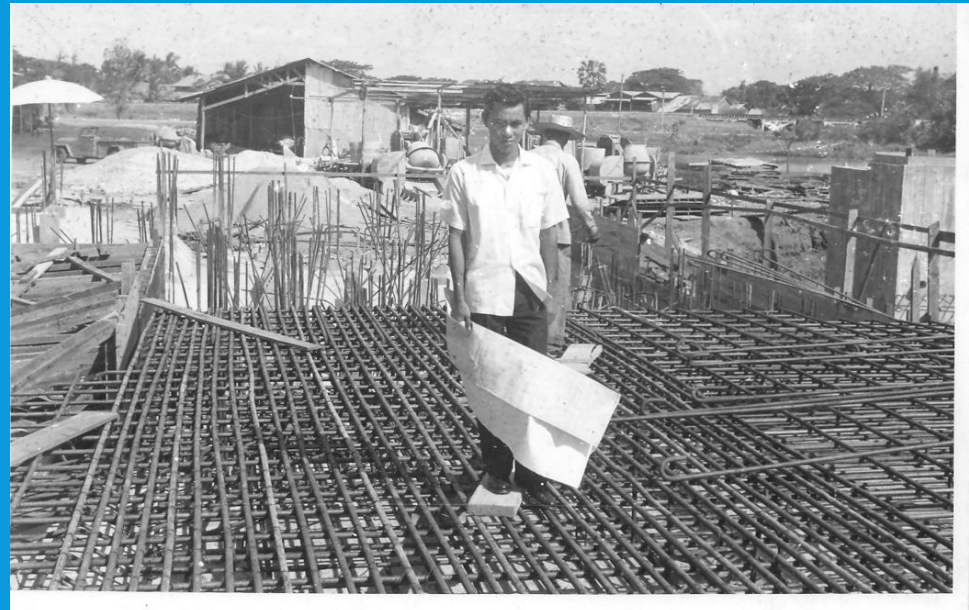
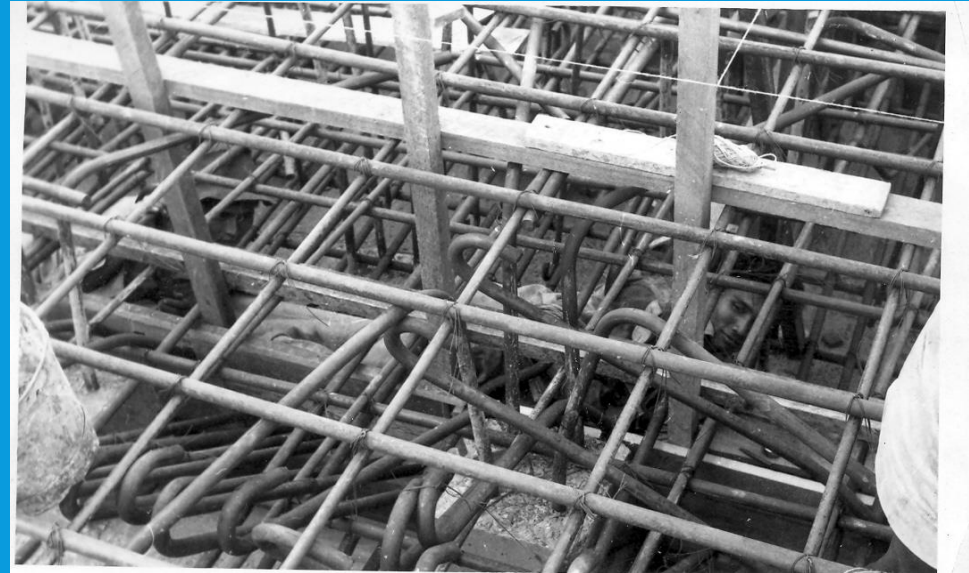


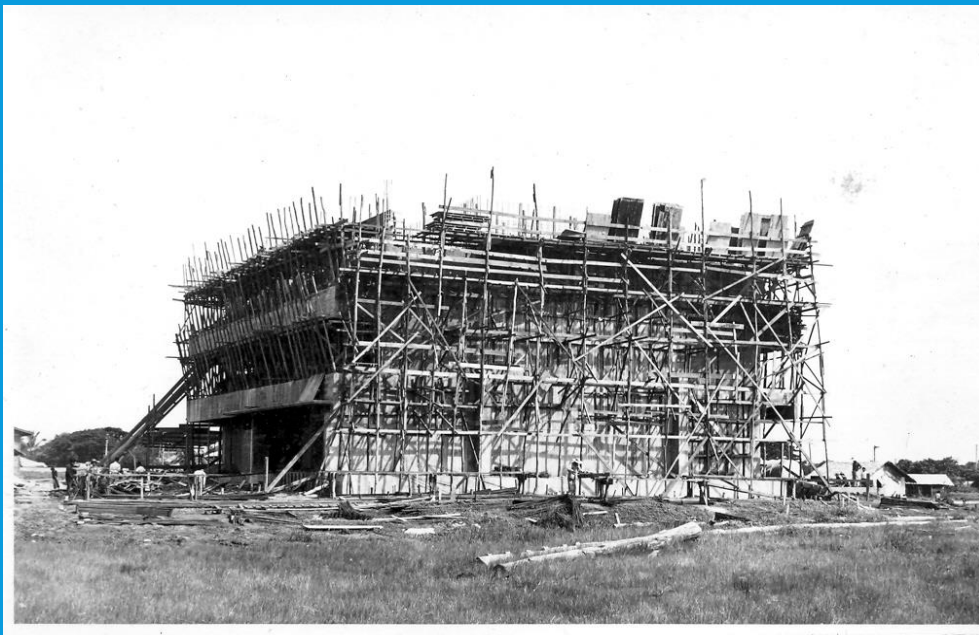
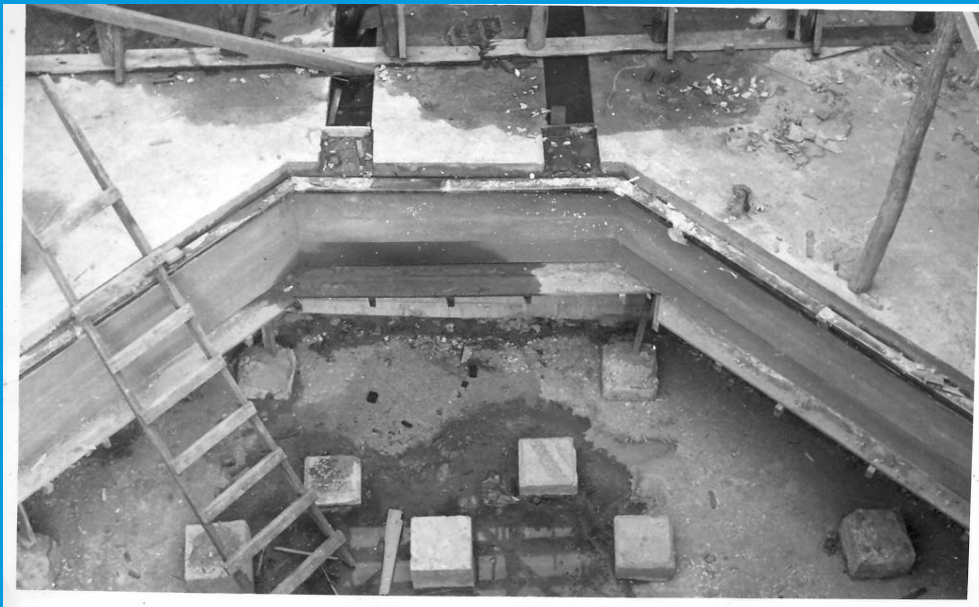
5. HISTORY OF TRR-1/M1 BUILDING



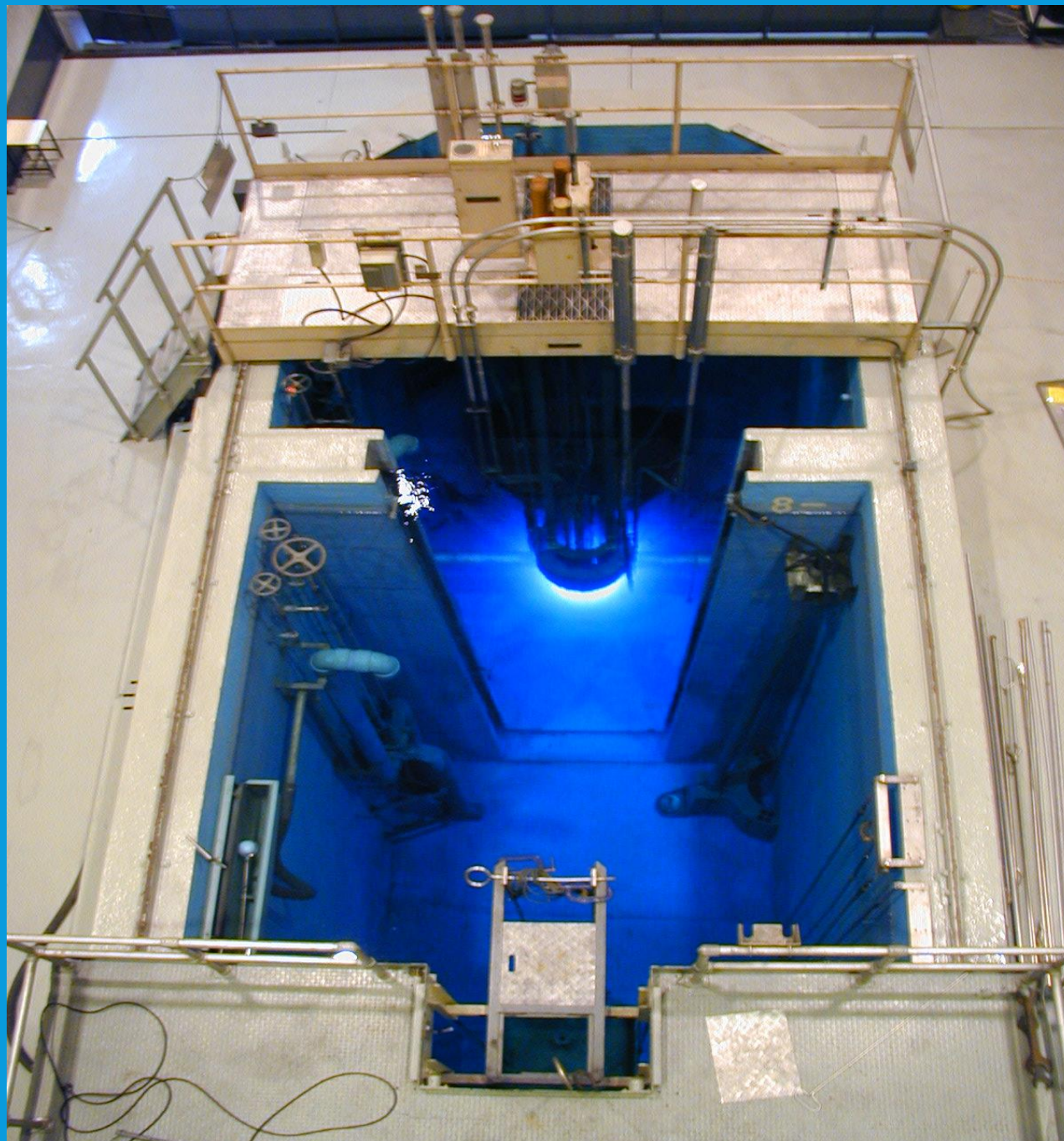
Reactor Building was constructed in 1960







Reactor Pool



Reactor Pool Description

- **High density concrete (3.5 g/c.c.) open pool**
- **3.5 m (W) x 12 m (L) x 8.5 m (H) Inside dimension**
- **Thickness = 1.35 m, Step Reduced, 45 cm. at the upper part**
- **The reactor pool can be separated into 2 part by water tight
Aluminum gate**
- **Inner surface was painted with epoxy**
- **Filled with water at 8 m level (245 cubic meter of water)**

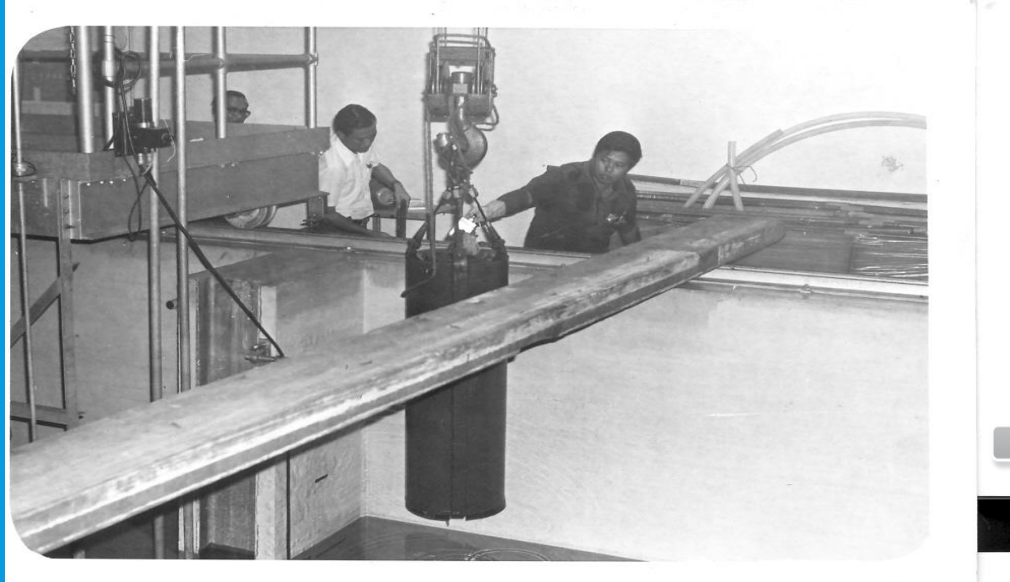


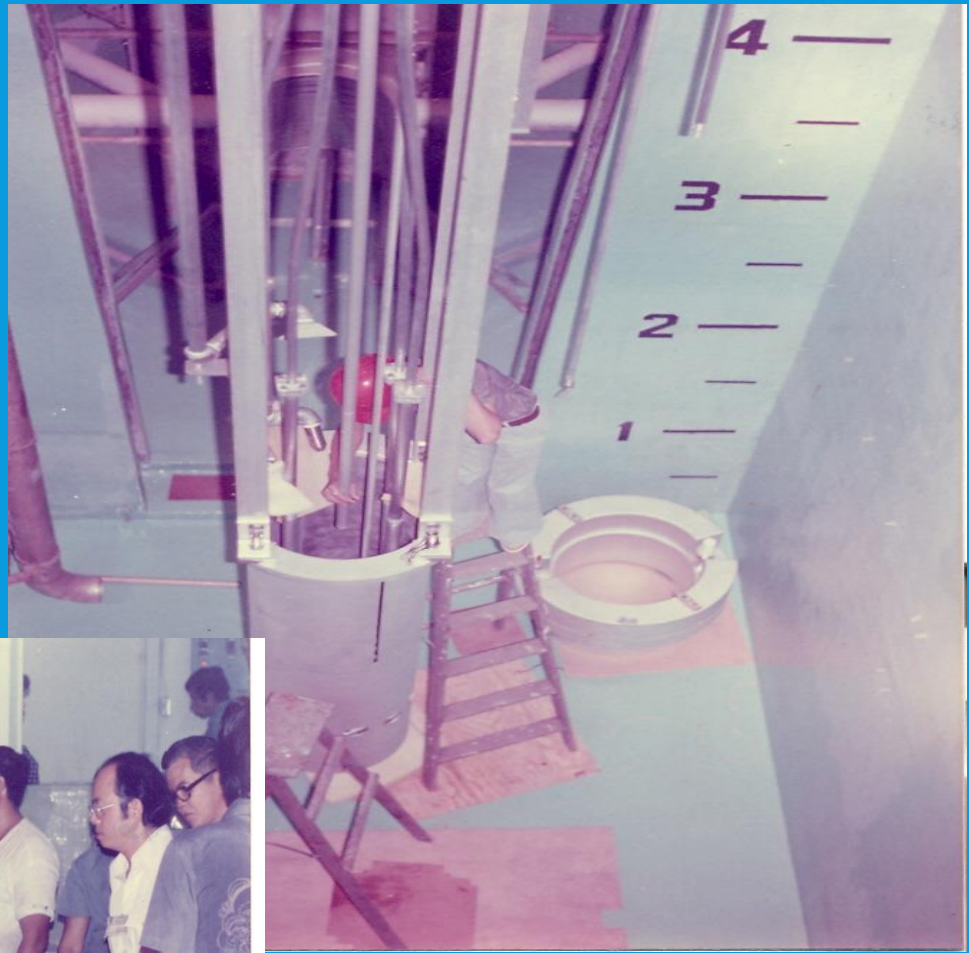
6. POOL REPAIRING



Repairing History

The reactor pool has been repaired and re-paint with the installation of TRR-1/M1 core (TRIGA Mark III) in 1975-1976





Reactor Pool

TRR-1/M1

Modification in 1977

Critical on 7 November 1977

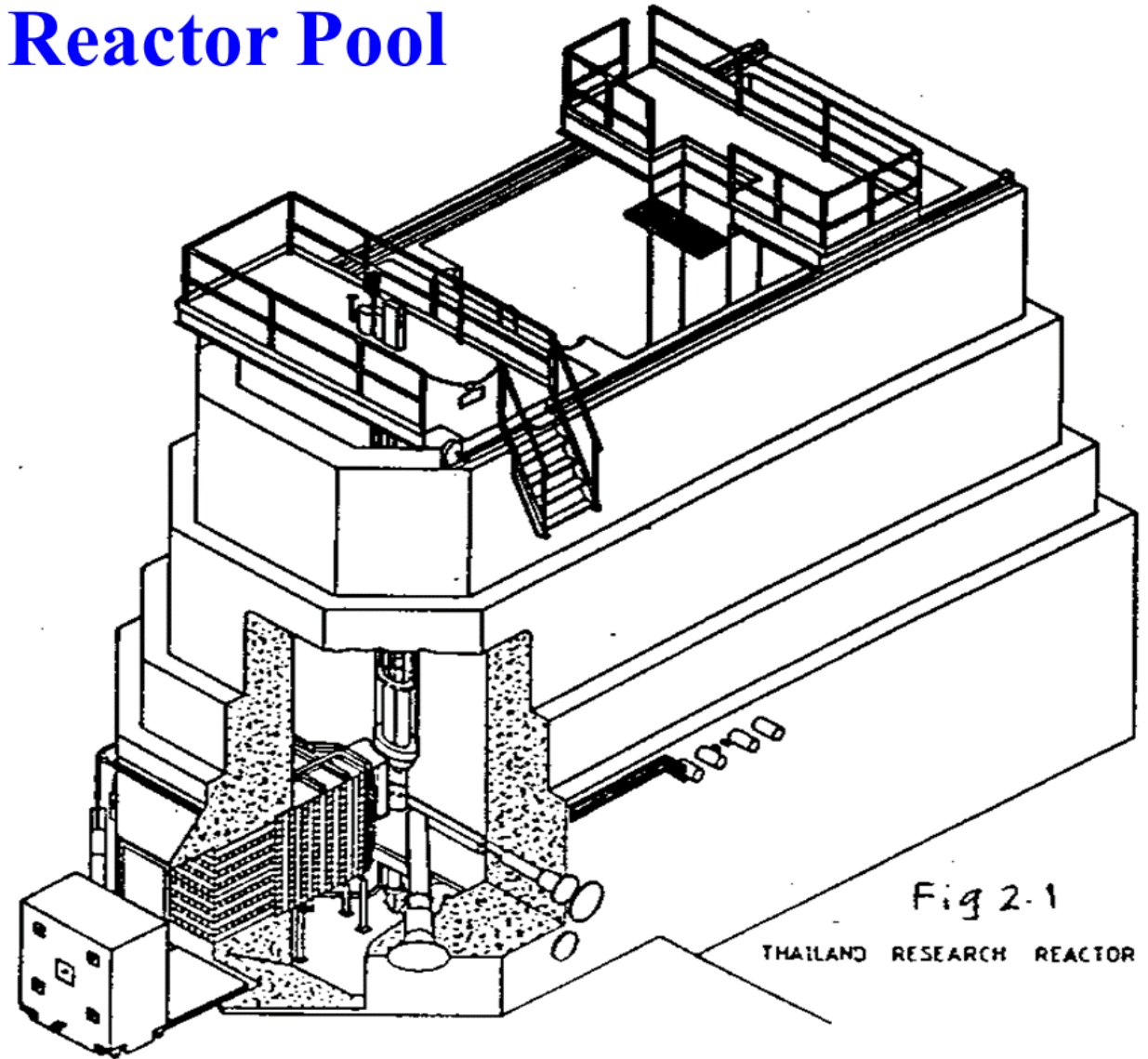


Fig 2-1

THAILAND RESEARCH REACTOR

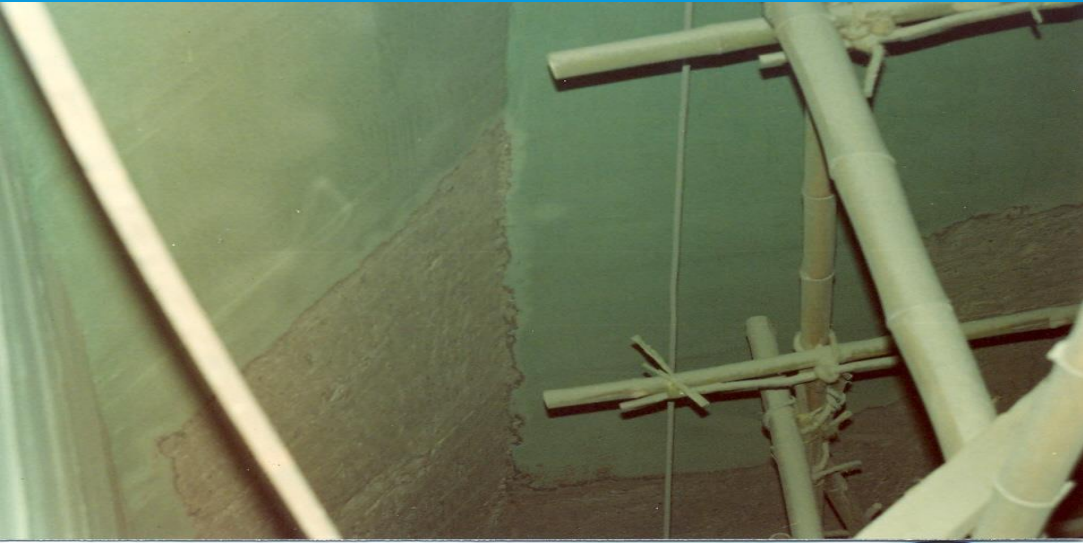
Reactor Control Console



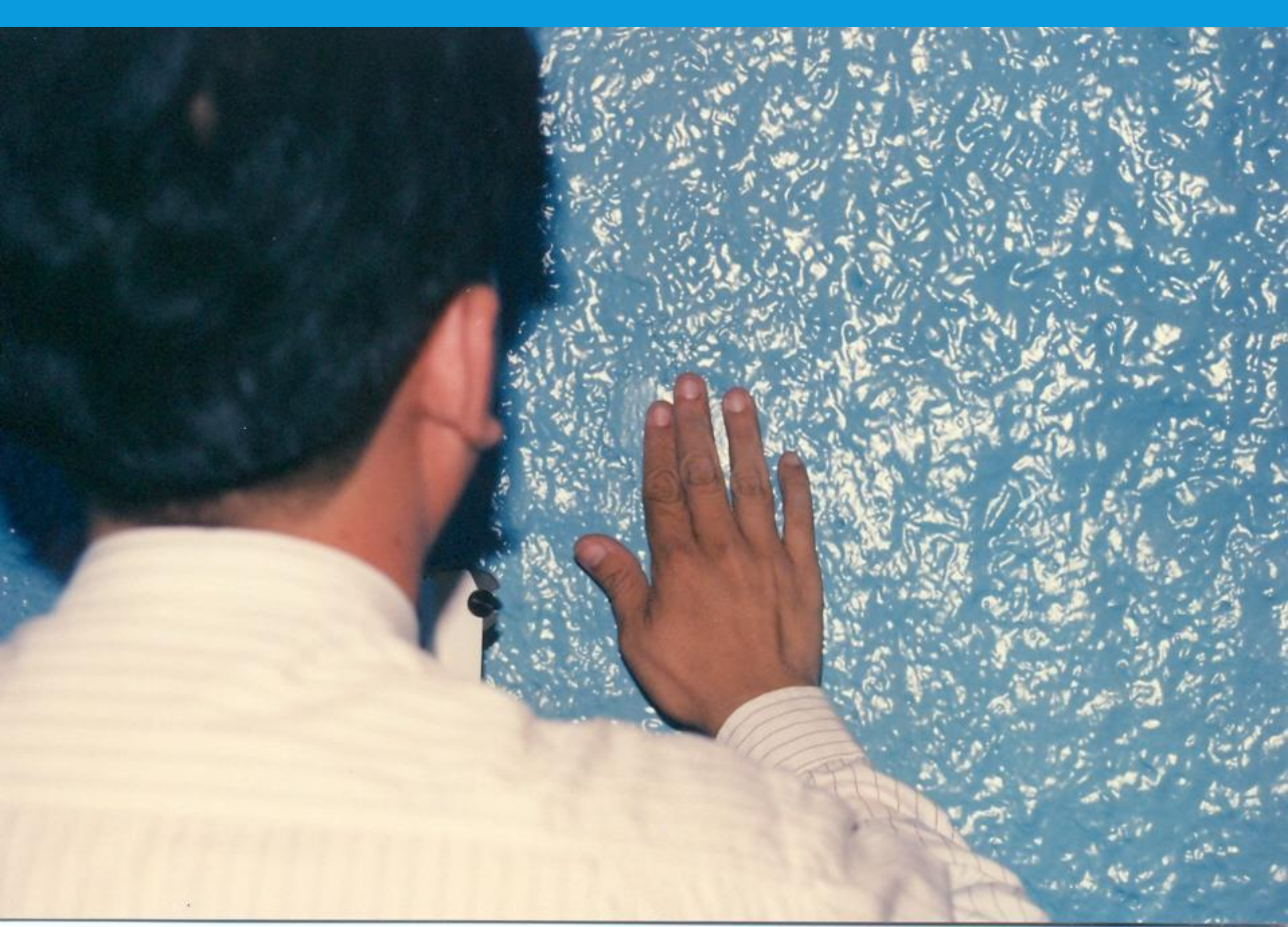
Pool Repairing 1991-1992 “Large-Small pool”



Repairing In 1991-1992, Both Big pool and Small pool by Sand Blasting







1992

**After finished
we found
bubble blow
out
from the wall**

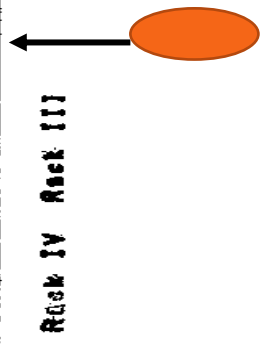
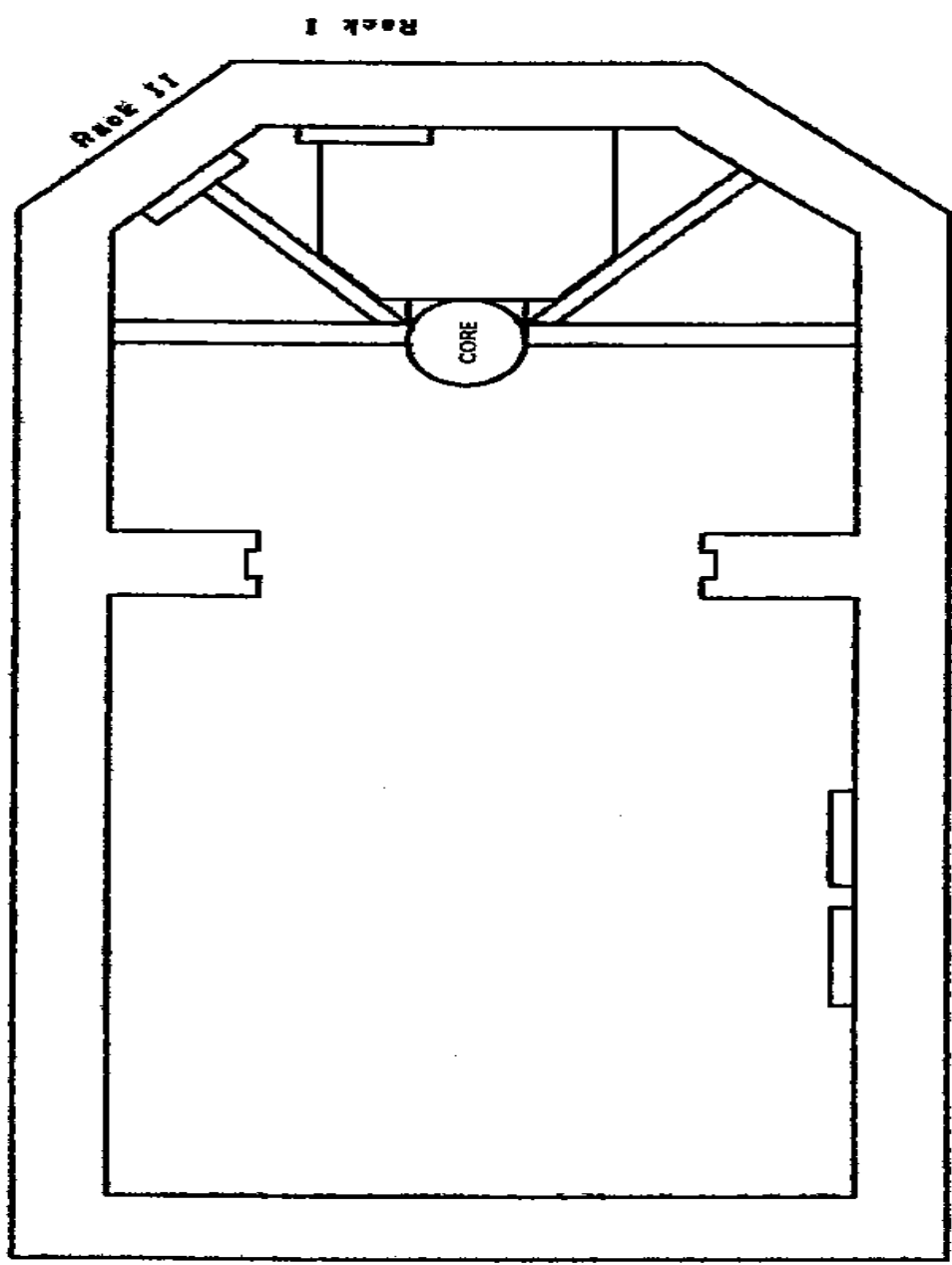


The Problem

Leakages was found in the end of 2004 at the location near the leakages in 1992

(large portion of the pool)






TRR-1/M1 POOL

Pool Repainting February 2006 “Large pool”



Pool Repainting Plan – February 2006 “Large pool”

| job | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | Remark | |
|--|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|--------|--|
| 1. Moving the fuels and radioactive sources to small section of the pool | █ | | | | | | | | | | | | | | | | | | | |
| 2. Install the water tight gate, reduce the water level at big pool section | | | █ | | | | | | | | | | | | | | | | | |
| 3. Radiation servey | | | |  | | | | | | | | | | | | | | | | |
| 4. Install of shielding, cleaning pool surface and marking the position to be repaired | | | | | | | | █ | | | | | | | | | | | | |
| 5. Drill and plugging with epoxy adhesive | | | | | | | | | █ | | | | | | | | | | | |
| 6. Primer painting | | | | | | | | | | | █ | | | | | | | | | |
| 7. Epoxy painting (3 layers) | | | | | | | | | | | | █ | | | | | | | | |
| 8. Inspection | | | | | | | | | | | | | | | | | █ | | | |

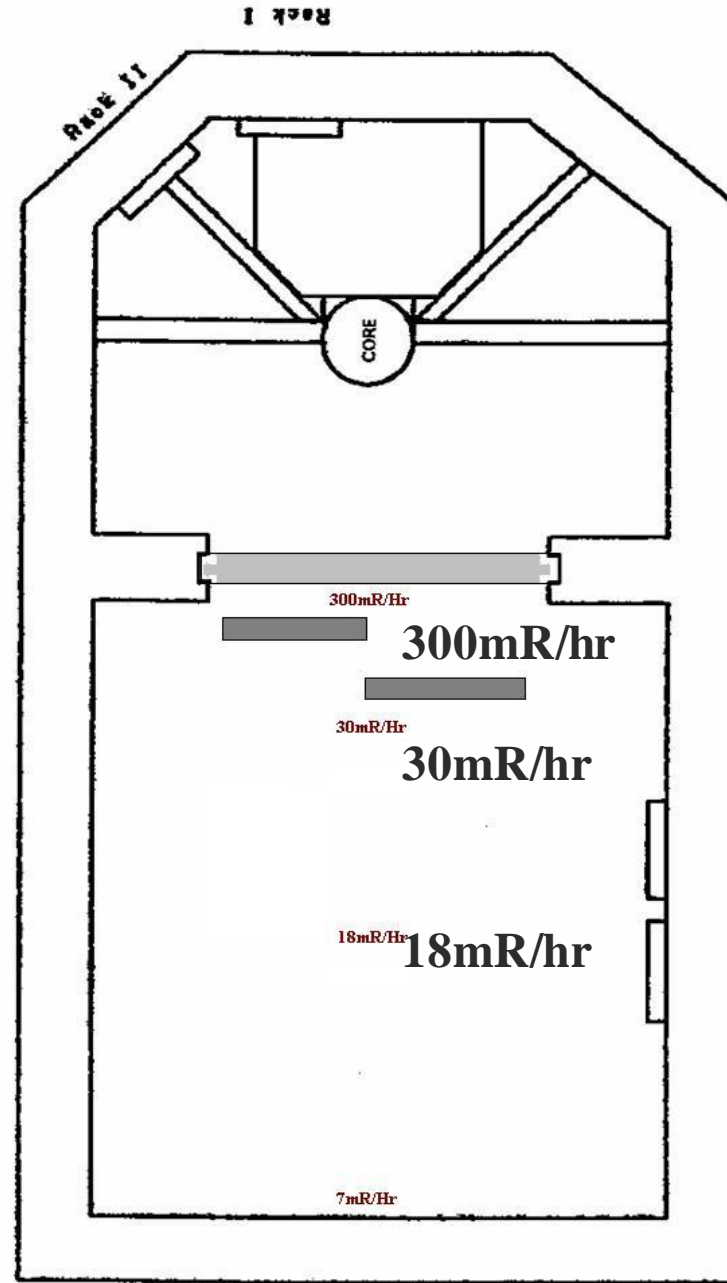
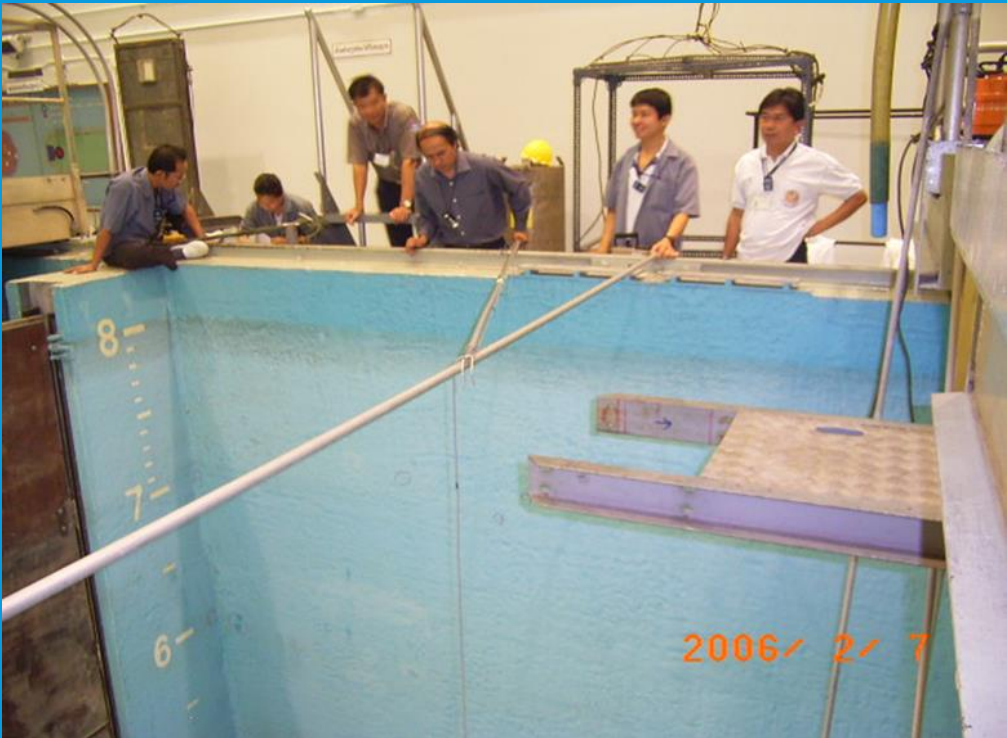
Radiation Shielding



Reduce the water level and clean the pool surface

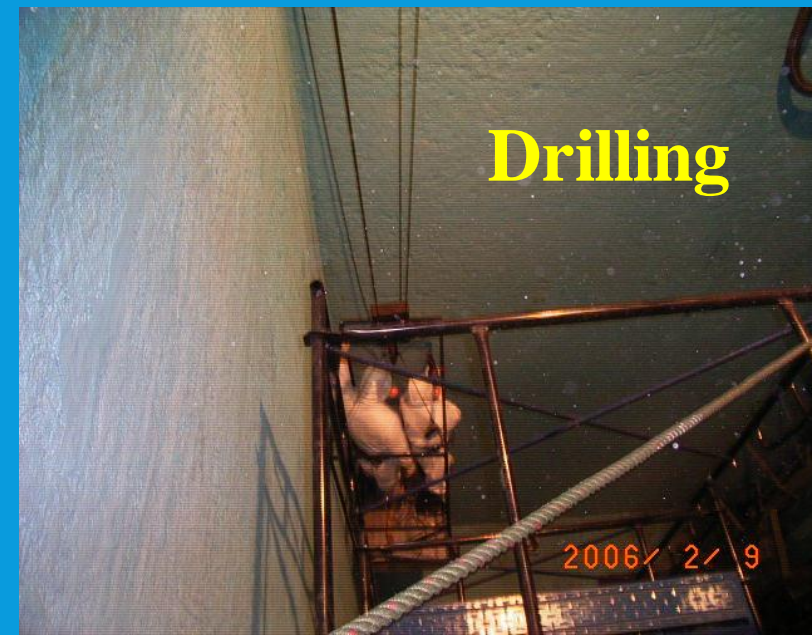


Dose Measurement



Rack IV
Rack III

TRR-1/M1 POOL





Plugging with epoxy adhesive

2006/ 2/10



Primer painting

2006/ 2/12



Epoxy painting

2006/ 2/14



2006/ 2/10



2006/ 2/12



2006/ 2/15

Re-inspection and repair



2006 / 2 / 16

Pool outer side repair



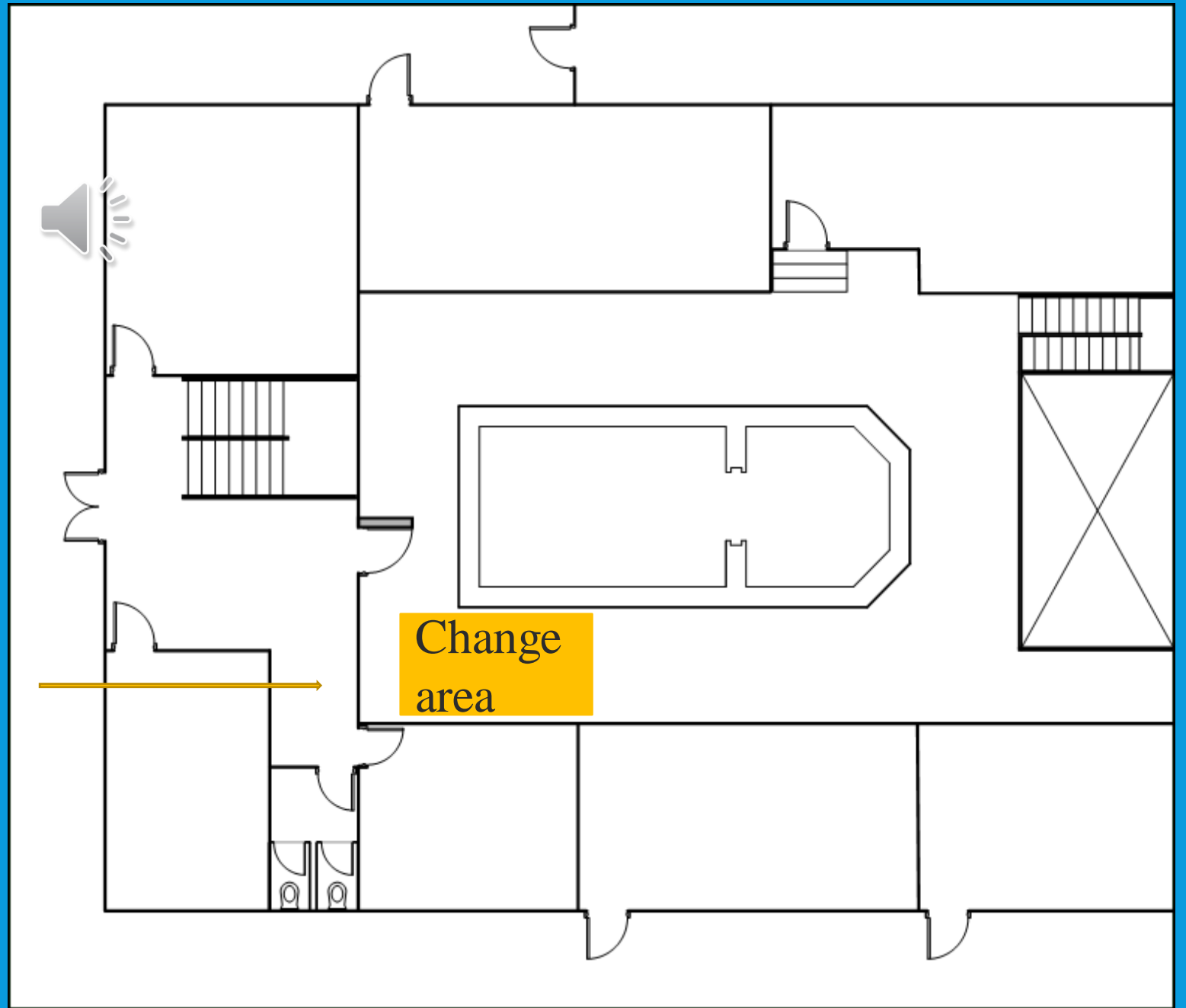
2006 / 2 / 19



2006 / 2 / 17



2006 / 2 / 20



Conclusion of 2006 pool repairing job

- **Repairing work takes 18 days**
- **56 workers involved, 35 went into the pool, 8 radiation safety officers, 13 support team**
- **Max. exposure = 174 μ Sv**

| | | |
|-------------------------------------|----------|-------------------|
| > 100 μ Sv | = | 4 peoples |
| 50-100 μ Sv | = | 13 peoples |
| 20-50 μ Sv | = | 13 peoples |
| < 20 μ Sv | = | 5 peoples |



Pool Repainting Feb.-Mar., 2012 “Small pool”



Pool Repainting Plan :

February – March 2012 “Small pool”



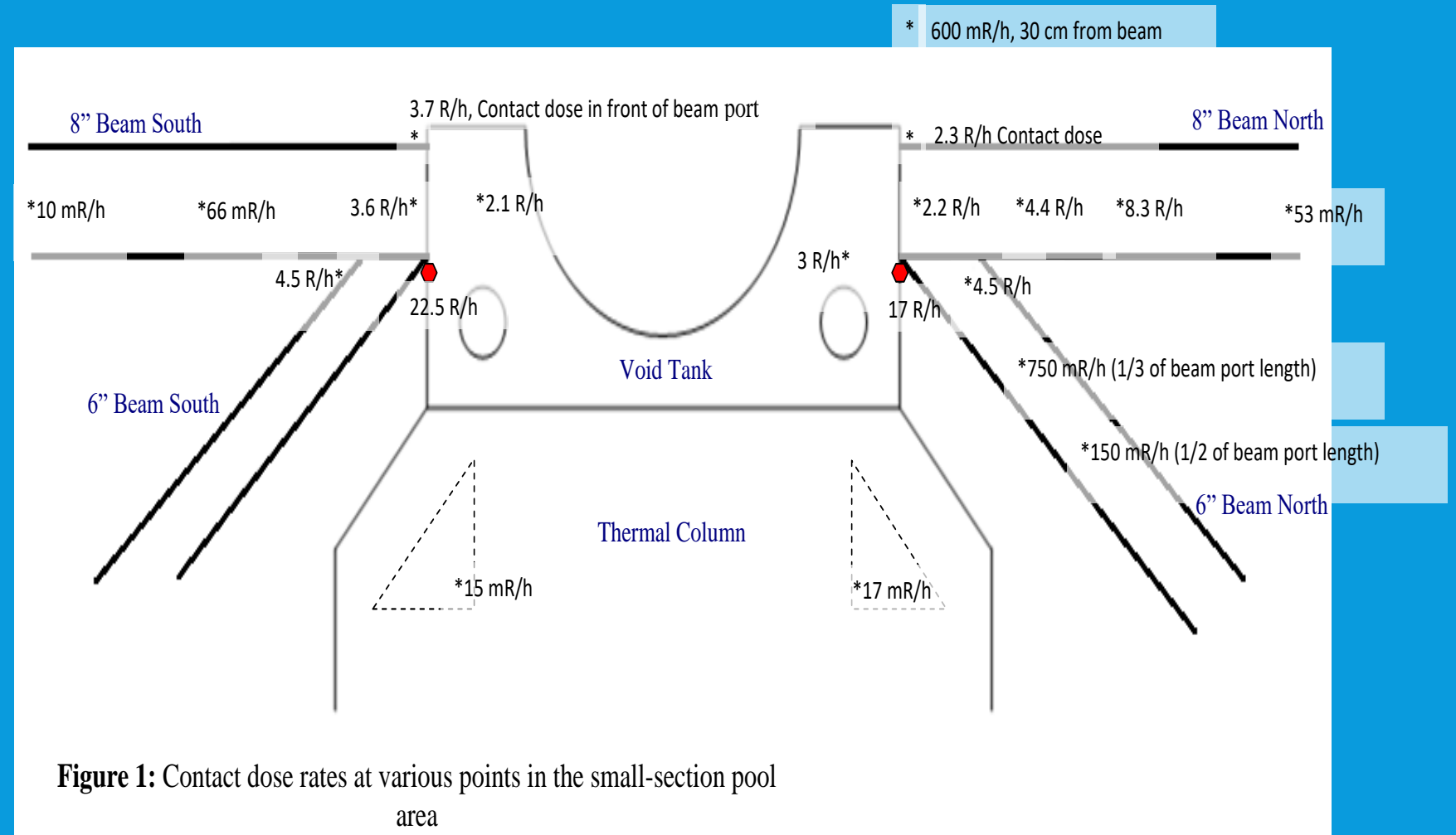
- Prepare For Water Drain
- Drain water down to approx. 3M
- **Hot source removal**
- Pool painting work (upper part)
- Empty reactor pool
- Preparation for lower part painting
- Pool painting work (lower part)
- Post-painting work

Hot Source Removal



Measurement Date: 24 November 2011

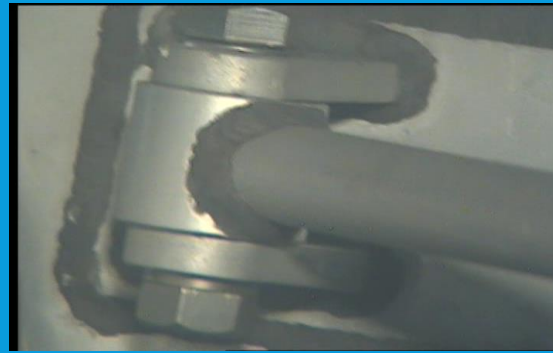
After we did “Dose Measurement” in 2011 we found some area have high Dose rate



Hot Source



The measured dose rate shows high radiation field in the in-pool area. There are two main hotspots (as shown in red) which have radiation dose of approximately 20 R/hr. These hotspots are from the bolts and nuts which align the void tank and neutron beams in their designed positions. It is believed that the bolts and nuts are made from stainless steel



Top-South Location (#1)



Top-North Location (#2)



Bottom-South Location (#4)



Bottom-North Location (#3)

all bolt-nut sets are in good physical condition except the bottom-south location which consists of rusty top washer. To minimize personnel contamination, the bottom-south location is the last of bolt-nut removal sequence.

Radiological zoning of the work areas

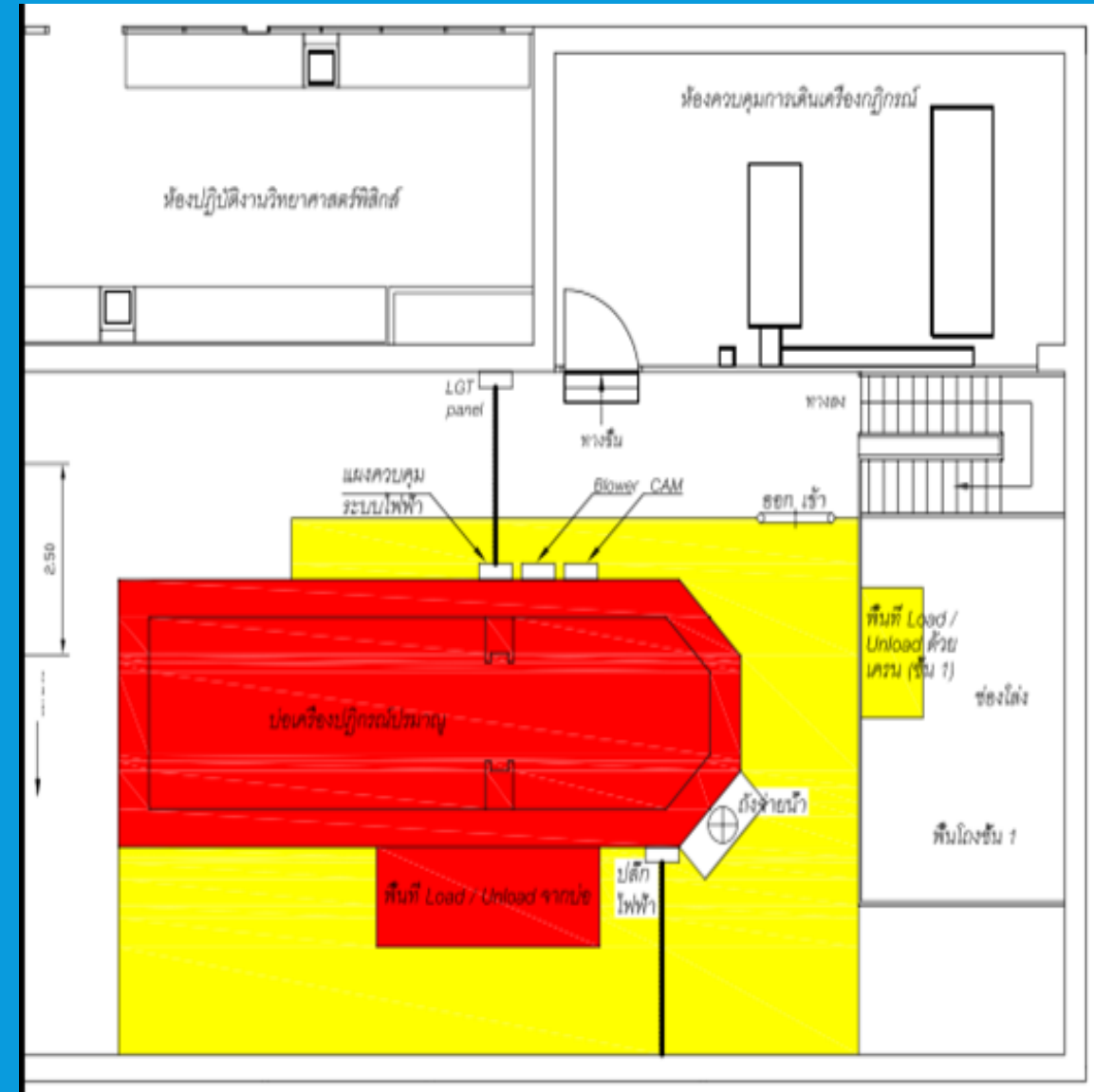
Zone I : controlled zone

Zone II : buffer zone

Zone III : clean zone



Each zone will be separated by use of physical rope barriers. Control of entry is enforced for each zone. A worker to enter the zone I shall wear proper protective clothing in order to avoid personnel contamination. When leaving from zone I to zone II, a worker is required to take off contaminated protective clothing and change shoe covers so that the spread of surface contamination is minimized. Also, contamination checks for personnel and equipment are performed by radiation safety staffs at the zone I & II exits.



Remove the hot source



Conclusion of 2012 pool repairing job

- Repairing work takes 23 days
- 35 workers involved, 15 went into the pool, 6 radiation safety officers, 14 support persons
- Max. exposure = 1.09 m Sv
 - > 100 μ Sv = 1 peoples
 - 50-100 μ Sv = 6 peoples
 - 20-50 μ Sv = 6 peoples
 - < 20 μ Sv = 22 peoples



** limited dose rate for the worker is not > 10 mSv

6. CONCLUSION



In everytime of pool repairing and repainting project we use our previously experience to adjust and adaptation technique for improve our work and the most important is Safety first for all the worker in the project

- In 1975-1976 the reactor pool has been repaired and repaint with the installation of TRR-1/M1 core (TRIGA Mark III)
- In 1991-1992 the reactor pool repairing and repaint “Large and Small pool”
- In 2006 the reactor pool repainting February “Large pool”
- In 2012 the reactor pool repainting Feb.-Mar., “Small pool”
- In 2021 the plan for pool repainting is coming but cause of Covid 19 so we are depending until August this year.



Thank you

www.tint.or.th

2006 / 2 / 11