KEMENTERIAN TENAGA, SAINS, TEKNOLOGI, ALAM SEKITAR DAN PERUBAHAN IKLIM

NUKLEAR MALAYSIA

'Teknologi Nuklear Pemacu Wawasan Negara'
'Nuclear Technology Propels The Nation Vision'

AGEING MANAGEMENT ACTIVITIES TOWARDS SAFE OPERATION OF REACTOR TRIGA PUSPATI (RTP) MALAYSIA

PRESENTED BY:

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MALAYSIAN NUCLEAR AGENCY

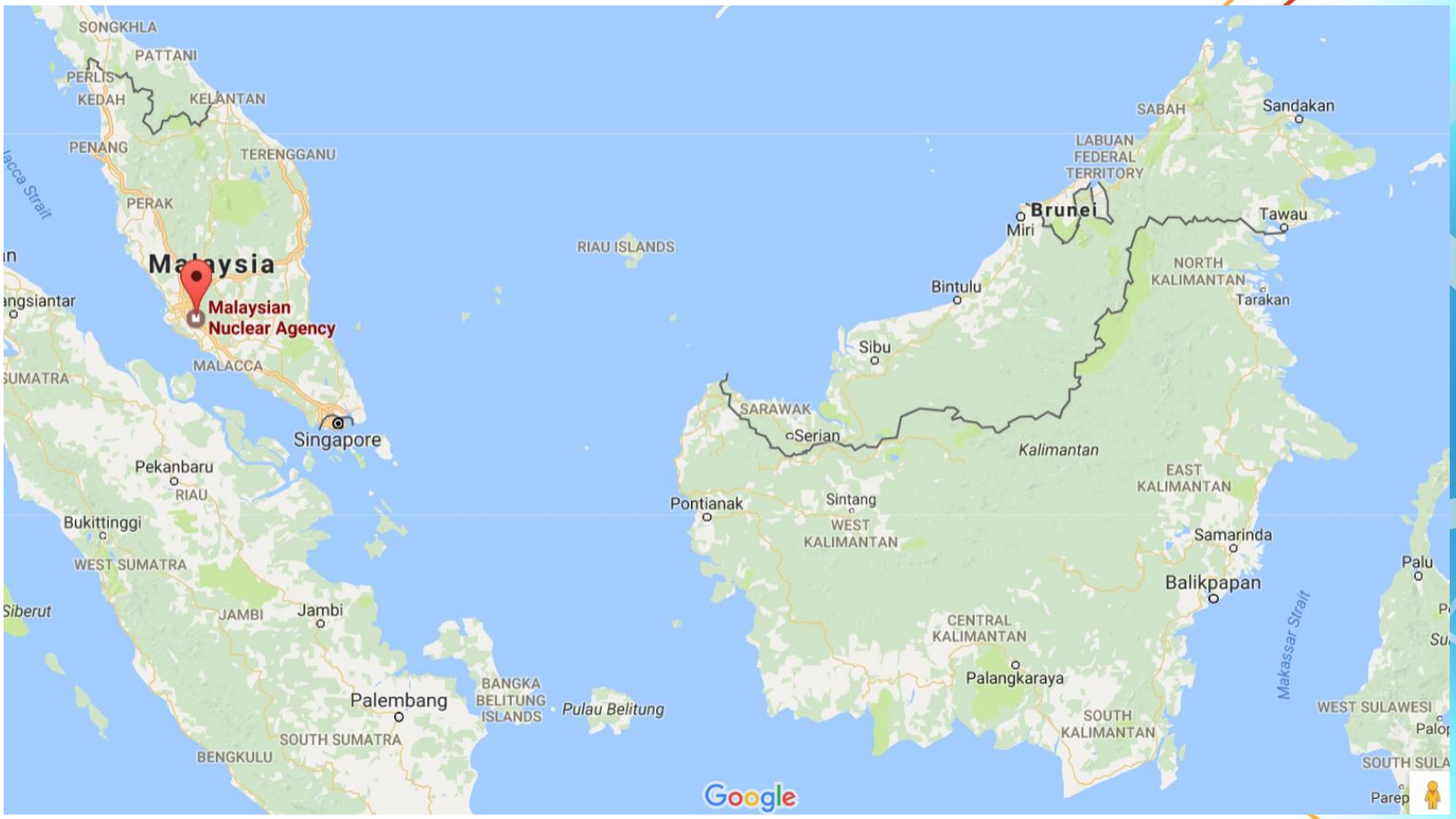
IAEA TECHNICAL MEETING ON RESEARCH REACTOR AGEING MANAGEMENT, REFURBISHMENT AND MODERNIZATION
CO-ORGANIZED BY IGORR AND IAEA

30 MAY TO 4 JUNE 2021, VIRTUAL EVENT VIA CISCO WEBEX

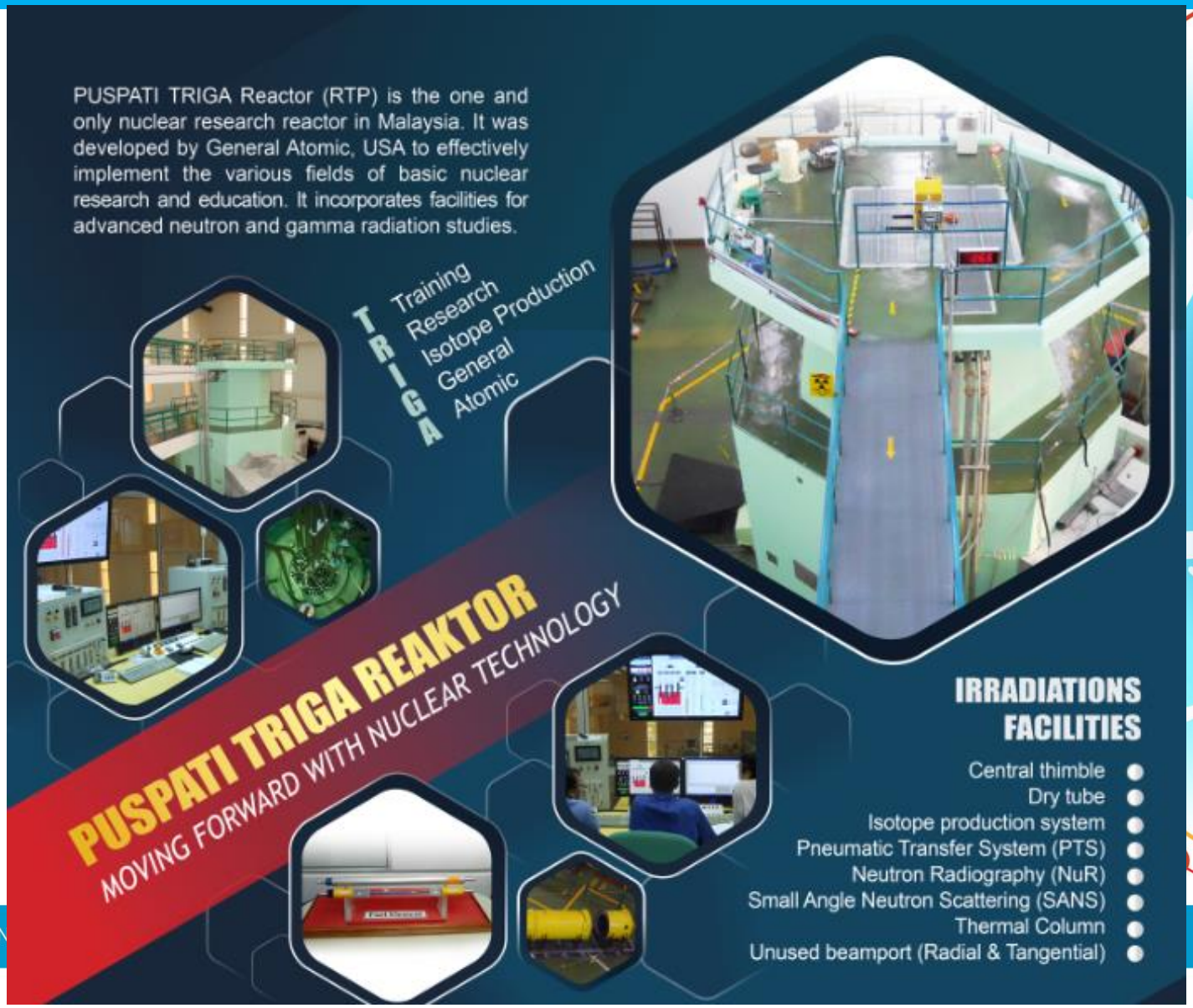
Outline

- Overview of Reactor TRIGA PUSPATI (RTP)
- Past Activities - Refurbishment and Modernization Activities
- Conclusion

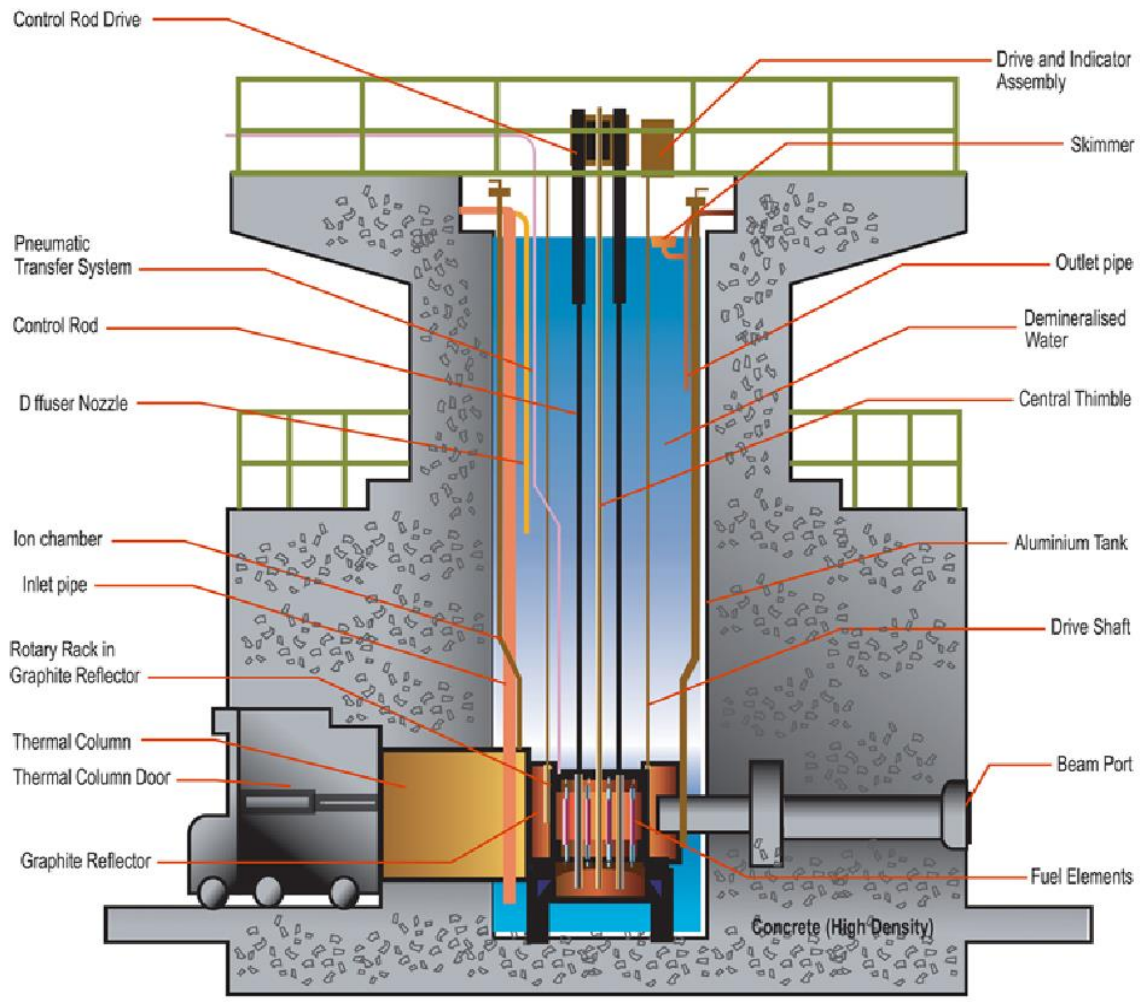
Overview of Reactor TRIGA PUSPATI (RTP) (1/7)



Overview of Reactor TRIGA PUSPATI (RTP) (2/7)



Overview of Reactor TRIGA PUSPATI (RTP) (3/7)



TRIGA MARK II Pool-type
First Criticality : 28th June 1982

Power
1MWth (Steady State)

Neutron Flux
1 x 10^{13} $ncm^{-2}s^{-1}$ (max)

Fuel
U-$ZrH_{1.6}$ (8.5%wt, 12%wt, 20%wt)
Enrichment 19.9%
Maximum Fuel Temperature 500°C

Coolant & Moderator
Demineralized water
Maximum Coolant Temperature 45°C

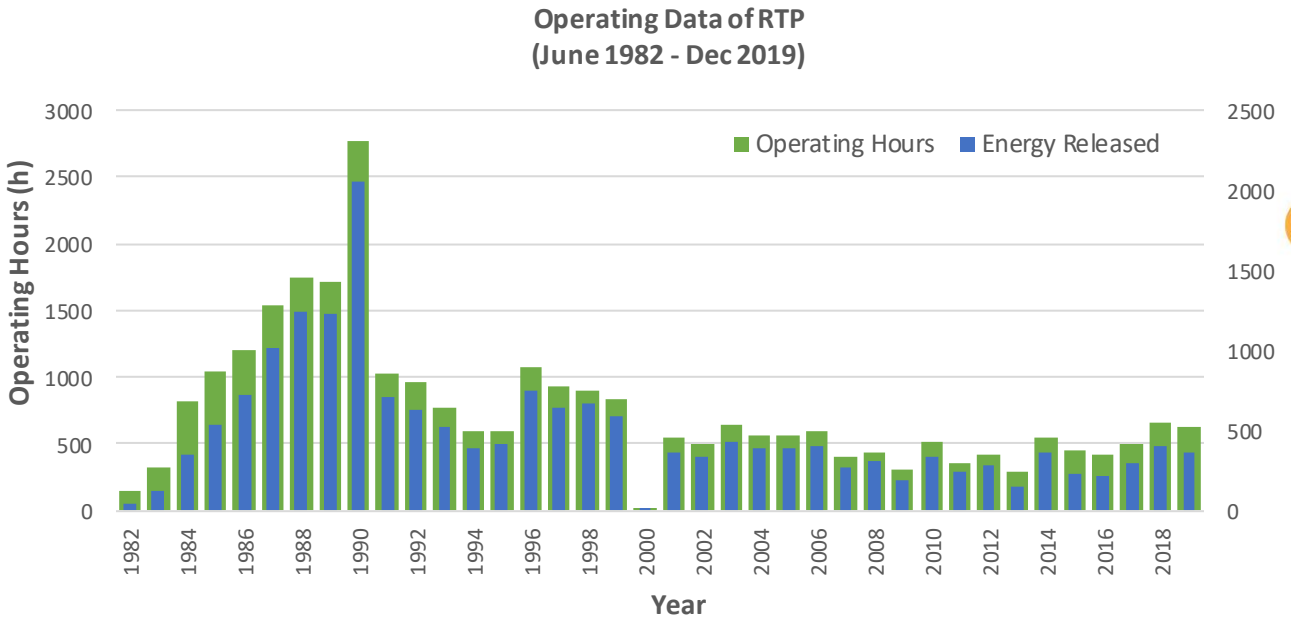
Core Cooling
Natural convection

Heat Rejection
Primary cooling system
Secondary cooling system

Reflector
Graphite

Control rod
B_4C
4 rods

Overview of Reactor TRIGA PUSPATI (RTP) (4/7)



Schedule for Operation:
Monday – Thursday
(6 hours/day; 4 days/week)

Standby: Friday

Current Status:
Operational

Accumulative operation time:
27,661 hours

Accumulative energy release:
18,235 MWhrs

Overview of Reactor TRIGA PUSPATI (RTP) (5/7)

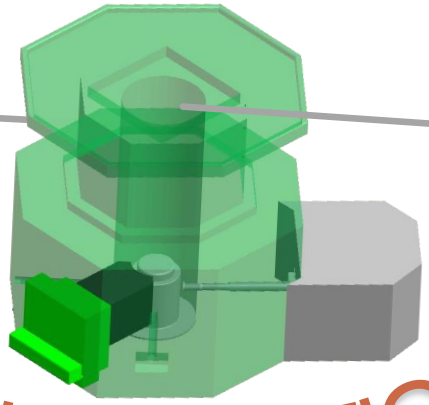
- ~1500hrs per year devoted for student training (UTM, UNITEN, UKM, Foreign Universities)
- ~10 PhD & 50 Masters graduated
- ~10 FYP (new)

Education & Training

- Small Angle Neutron Scattering (SANS) ~ 10 hrs per month
- Neutron Radiography ~ 5 hrs per month

Beam Utilization

- Rotary rack
- Pneumatic Transfer System
- Isotope Production System
- Central thimble
- Dry tube



Out-core Facilities

Prompt Gamma Neutron Activation Analysis (PGNAA)*

Boron Neutron Capture Therapy (BNCT)*

Neutron Diffractometer (ND)

Small Angle Neutron Scattering (SANS)

Neutron Radiography (NUR)

In-core Facilities

Analytical Analysis

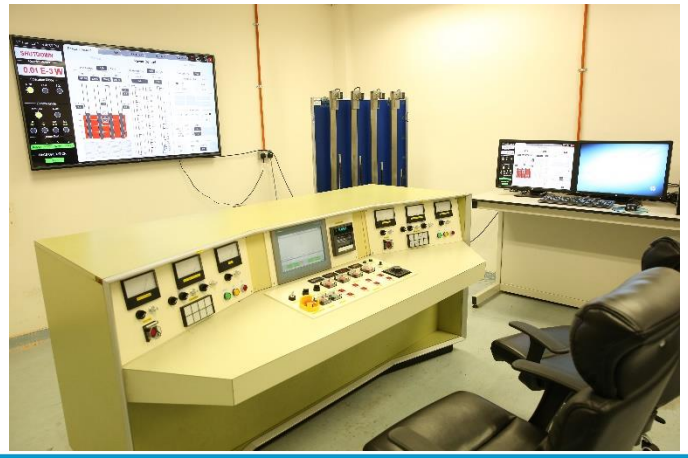
~36,000 of various samples irradiated per year including environment, lynas, marine, food, agriculture produce, etc

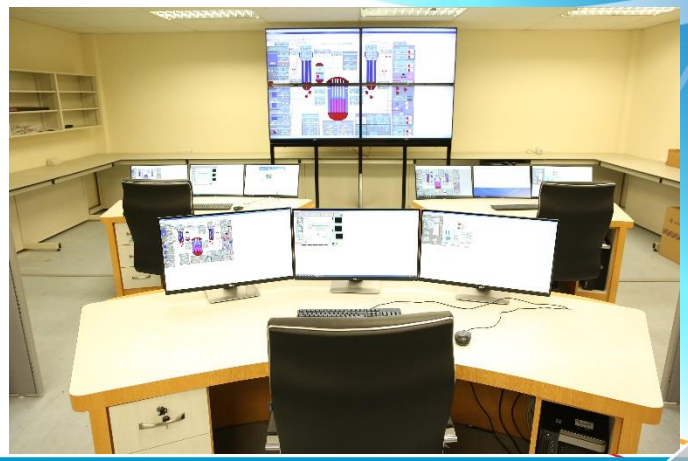
Radioisotopes Production

~*10,000mCi of various radioisotopes (P32, Mo99, Sm153, Au198, Ir192, Lu177, Br82, I131, etc) produced in 1995 – 2019 for medical, environment, industry, agriculture application

Overview of Reactor TRIGA PUSPATI (RTP) (6/7)

Reactor Instrumentation & Control Laboratory





Overview of Reactor TRIGA PUSPATI (RTP) (7/7)

Reactor Physics Laboratory

Reactor Thermalhydraulics & Safety Laboratory

Past Activities - Refurbishment and Modernization Activities (1/6)

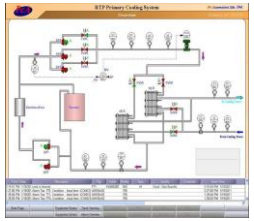
2013 ~ 2014
Reactor instrumentation and control system upgrading (ReDICS)

2017
Physical security system upgrading

Present

2015
- Spent fuel pool construction
- Electrical system upgrading
- Active Ventilation System upgrading
- Secondary cooling system upgrading

2010
Primary Cooling System Upgrading



2008 ~ 2009
Techno-economic studies

1984 ~ present
Reactor Utilization

1984 ~ 1996
Development of experimental facilities

First Criticality 28 June 1982

Human Resource Capacity Building and E&T

Past Activities - Refurbishment and Modernization Activities (2/6)

- **Techno-economic study**
  - RTP power upgrading from 1MW to higher power (2 or 3MW)
  - To enhance the utilization and to promote the use of advanced S&T in Malaysia
  - Several SSCs have been upgraded based on this study
- **Desktop study of Multipurpose Research Reactor (MPRR)**
  - To identify capability of MPR and its possible utilization to compare with expected utilization after upgraded to 2 or 3 MW
- **Refurbishment and Modernization**
  - Due to RTP ageing issues.
  - As a strategy to ensure availability and continuous safe operations of RTP.

Past Activities - Refurbishment and Modernization Activities (3/6)

- **Refurbishment and Modernization Project**

Year	System or Component	Type of Work Done
1986	Rack & Pinion Gear (Rotary Rack)	Repaired
1989	Primary Pump	Repaired pump and added 2 new units
1992	Pneumatic Transfer System (PTS)	Replaced In-core terminus
1994	Heat Exchanger	12 tubes plugged
1995	Secondary Cooling System	Replaced Cooling Towers
1999	Active Ventilation System	Refurbishment (Nov 99 -Jun 2000)
2010	Primary Cooling System	Replaced primary pumps and installed 2 plate type heat exchangers and SCADA
2013	Reactor Control Console	Modernization – Change analogue system to digital system
2016	Fission Chamber	Replaced with new one

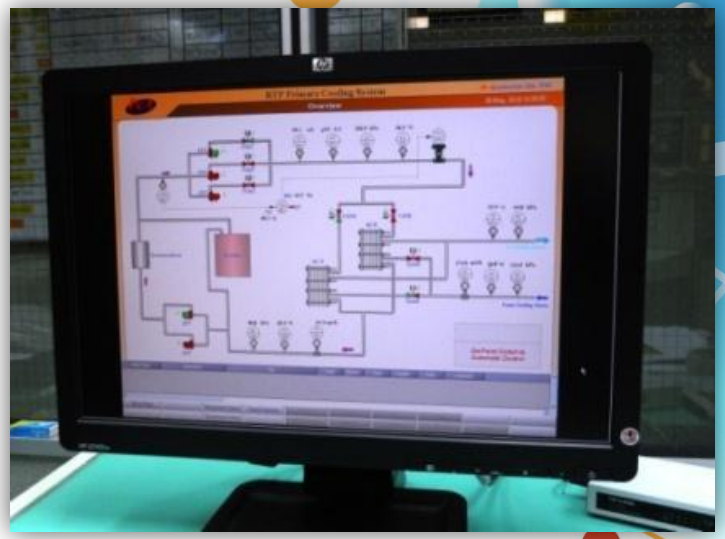
- **Divided into 3 phases**
  - ❖ Phase 1: Refurbish or replace with similar feature
  - ❖ Phase 2: Replace with enhance feature/capability
  - ❖ Phase 3: Replace with new feature/capability – modernisation

Past Activities - Refurbishment and Modernization Activities (4/6)

- **Phase 1: Refurbish or replace with similar feature**
  - ❖ Reactor SSC's that were found to malfunction were repaired or replaced with components of the same or similar features or capabilities
  - ❖ Carried out because replacement parts were available and easy to purchase
  - ❖ Minimal involvement of the reactor staff in the specification of design requirements as there were minimal new features incorporated in the design

Past Activities - Refurbishment and Modernization Activities (5/6)

- **Phase 2: Replace with Enhance Feature/Capability**
  - ❖ Refurbishment of reactor SSC's incorporated some enhanced or new features or capabilities
  - ❖ Due to the advancement of available technologies and the requirements of enhanced safety features
  - ❖ Higher level of involvement of reactor staff in defining the technical and safety requirement of the new system as well as during the installation and commissioning stage



New Plate Type Heat Exchanger and SCADA system

Past Activities - Refurbishment and Modernization Activities (6/6)

- **Phase 3: Replace with New Feature/Capability – Modernization**
  - ❖ Replacement of the original analogue control console with a digital control console
  - ❖ The analogue control console was facing ageing and obsolescence problems as it frequently failed and parts could not be purchased
  - ❖ New features such as reactor trip switches installed on the reactor top and reactor hall, seismic monitoring system, reactor water level monitoring system and enhanced fuel temperature monitoring system were added

Conclusion

- The refurbishment and modernization of RTP has been carried out to enhance the capability and to ensure the safe and reliable operation.
- Hence, the RTP upgrading projects have resulted in the safe operating records throughout 35 years of operations and more short and long term project planning in RTP will carry this safety record far into the future.
- Managing RTP upgrading projects are good practices for the engineers and scientists in Nuclear Malaysia to enhance and advance utilization and to be one of the TSO team in supporting NPP.

THANK YOU

Nuklear Malaysia