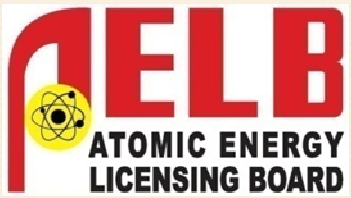
National Report: [MALAYSIA]



Ibrahim MUHAMAD & Ariff Shah ISMAIL

R²D²P: Workshop on "Safety Assessment"
Riso, Denmark; 04-08 October 2009

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Report Outline

- National Initiatives Related to the Improvements of Decommissioning Activities;
  - Legal and Regulatory Framework;
  - Decommissioning Planning;
  - Management of Transition Period;
  - Characterization Activities;
  - Decommissioning Fund;
  - Technology Identification.
- Decommissioning of Research Reactor;
  - Actual Status

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I. Legal & Regulatory Framework

- Regulatory Independence:
  - Regulatory Body: Atomic Energy Licensing Board (AELB);
  - Placed under the Ministry of Science, Technology and Innovation (MOSTI), Government of Malaysia;
  - Established under Atomic Energy Licensing Act (Act 304), headed by Director General which report directly to Secretary General of MOSTI;
  - Holding an “authority” as stipulated under the Act 304, and have a full power to manage it’s yearly budget and made regulatory decision.
  - Almost fully Independence.

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AELB Department within MOSTI

MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION

- NATIONAL SPACE AGENCY
- MALAYSIAN NUCLEAR AGENCY (Reactor Facility)
- ATOMIC ENERGY LICENSING BOARD (Regulatory Body)
- DEPT OF CHEMISTRY MALAYSIA
- DEPT STANDARD MALAYSIA
- MALAYSIAN METEOROLOGICAL DEPT
- MALAYSIAN CENTRE FOR REMOTE SENSING
- NATIONAL SCIENCE CENTRE

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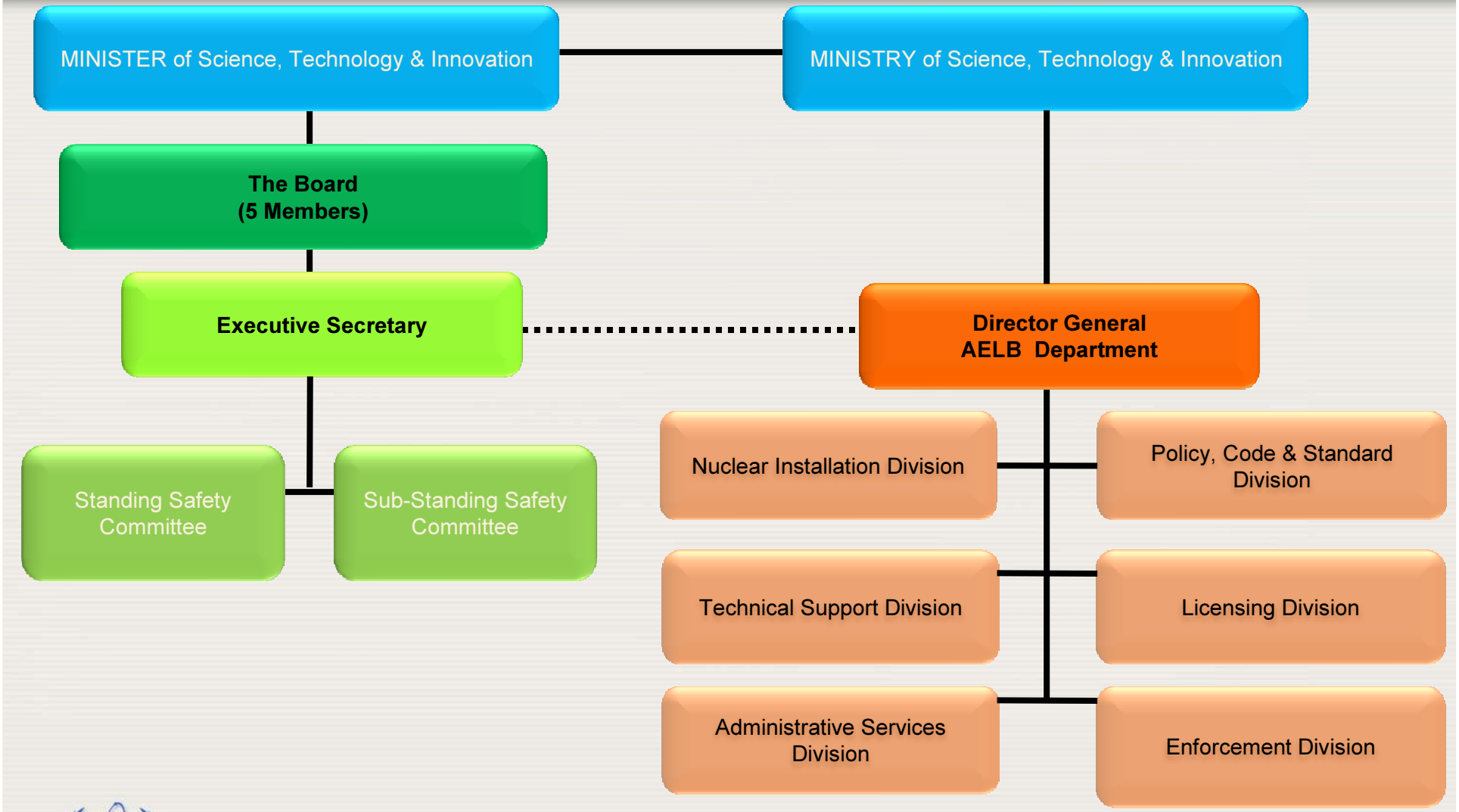
Independency of AELB department from the Board



Action taken towards fully Independency of AELB

Amendment of Current Act 304 : Under Revision

Atomic Energy Licensing Act 200_ (Projected Act)

"regulatory authority" means Director-General, head of the department in the Ministry responsible for matters under this Act acting as the Executive Secretary;

Part I : Preliminary

Section 2 : Application of the Atomic Act

The Atomic Act shall have the force of law on Malaysia and for that purpose shall be construed in accordance with the provisions of this Act.

Section 3 : Act binds the Government

(1) This Act shall be binding on the Government.

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Legal Requirement for Decommissioning

Amendment of Current ACT 304 : Under Revision

PART III : CONTROL AND AUTHORIZATION

- **Section 15 (1) – (3):** Authorization Requirements;

PART VIII : DECOMMISSIONING

- **Section 44 (1) – (8) :** Decommissioning Requirements;
  - **Sub-section (5) – (8)** : Decommissioning Plan;
  - **Sub-section (2) – (8)** : Responsibilities of Licensee in Decommissioning; and

- **Section 45 (1) – (2)** : Financing of Decommissioning.

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Legal Requirement for Decommissioning (cont'd)

- **Section 44 :** Decommissioning Requirements
- (1) Any nuclear installation shall not be decommissioned without prior approval by the regulatory authority.
- (2) …. shall perform a baseline survey of the site, including radiological conditions, prior to construction, to develop information for comparison with the end state after decommissioning.
- (3) …. shall prepare and maintain relevant documents and record for a specified period of time before, during and after decommissioning as determined by regulatory authority.
- (4) The regulatory authority shall evaluate the end state of the nuclear installation after decommissioning; activities have been completed to ensure that relevant regulatory requirements have been met.

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Legal Requirement for Decommissioning (cont'd)

- (5) The nuclear installation site shall not be released from regulatory control until the licensee has demonstrated that the end state in the decommissioning plan has been reached and that any other additional regulatory requirements have been met.

- (6) The licensee shall provide periodic reviews, updates, revisions and changes of the decommissioning plan shall follow the maximum time intervals between such reviews and updates as specified by the regulatory authority.
-
- (7) Any revision and updates of the decommissioning plan reflecting significant changes shall be approved by the regulatory authority.
-
- (8) The licensee shall submit the final decommissioning plan for approval and specified by the regulatory authority within an established period after the cessation of licensed activities.
-

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II: Decommissioning Planning

Possible Timeline

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Policy Decision	→						
Admin. Actions		→					
Fuels Removal			→				
Core Cooling off				→			
Dismant. & Decont					→		
Waste Disposal						→	
Final Rad. Survey							→

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Future Decommissioning Planning

- Project Scope
  - Plan: To decommission only certain facilities e.g.: reactor, Small Angle Neutron Scattering, Neutron Radiography, control room, pneumatic room facilities; or
  - Worst case = only reactor core
- Selecting the Decommissioning Strategy
  - Plan : deferred dismantling
- Economic Inputs to the Decision Process
  - Plan: 5 years budgeting with annual funding
- Project Initiation – Pre-Decommissioning (refer slide no.14)

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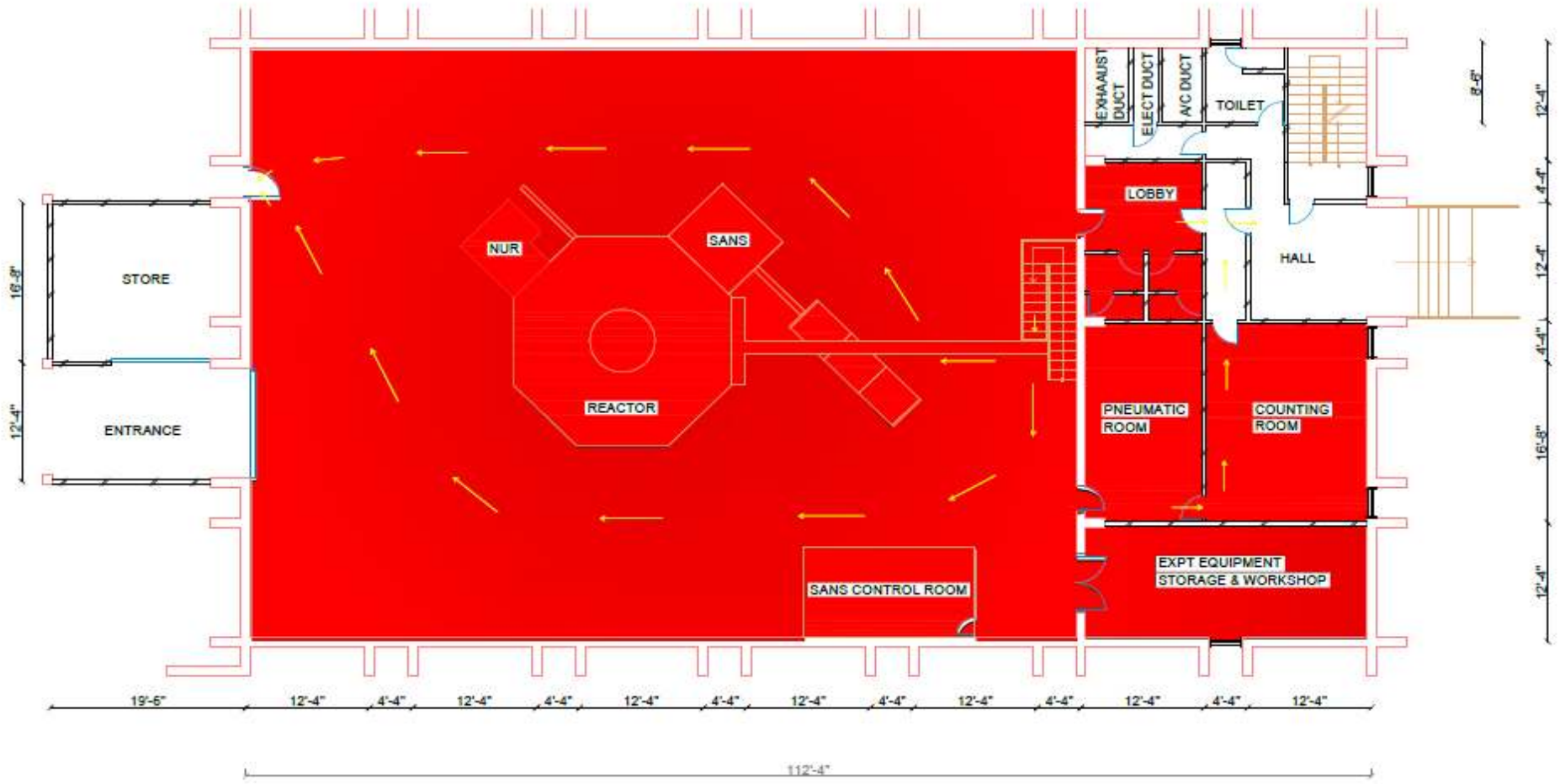
Future Planning (cont'd)



Documentation Establishment;

i. Detailed Design Studies – Post-Shutdown Design
ii. Planning
iii. Project Execution
iv. Project Controls
v. Project Closeout

Project Initiation Pre-Decommissioning (PLAN)

- Planning the transition of the existing staff from operations to decommissioning (Human capital development on going)
- Setting up a management organization (pending – staffing for decommissioning in near future will come from Radiation Safety and Waste Treatment Groups.
- Evaluating whether to use outside Contractor or to self perform the project (pending)
- Identifying resources and how to obtain them (government or private funding)
- Performing preliminary site characterizations to bound the scope of the work (only dose rate monitoring has been performed, PLAN to extent to other methods when necessary)
- Preparing baseline cost and schedule estimates to monitor and control expenditures (pending)
- Evaluating fuel disposition options – as appropriate (to send back fuel to the supplier)

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IV: Characterization Activities

Preliminary Studies – Post-Shutdown Pre-Planning ;

- Site characterization (only dose rate monitoring has been performed, PLAN to extent to other methods when necessary)
- Regulatory notifications and any required initial public
- Interactions (pending until decommissioning policy been made)
- Implementation of revised safety and authorization bases (pending until decommissioning policy been made)
- Staff reorganization (Human capital development on going)
- Bid specification preparation – as appropriate (pending until decommissioning policy been made)

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Facility Characterisation

Estimated RTP Radioactive Waste

Type of Waste		Volume (M^3)
1.	Concrete	200
2.	Aluminium tank	8
3.	Stainless steel & Aluminium Piping's	5
4.	Graphite	3
5.	Lead	3
6.	Fuel elements (Assuming each fuel element is converted into 0.5 M^3 of conditioned waste)	65
7	Miscellaneous	10
8	Treated water	25
Total estimated volume		**319**

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Options Characterization Strategy

- Plan Strategy – Analysis
  - Common Radionuclides Inventories (APPENDIX 2)
  - Equipment and Facilities Available (APPENDIX 3)

III: Management of Transition Period

- On going plan during operation;
  - Review, record incidents/abnormal operating events (done & continuously reviewed)
  - Regulations and government policy (done & continuously improved)
  - Record of significant system and structural changes (done: i.e. primary cooling system, reactor console, new plate type core?)
  - Safety considerations done and reviewed periodically: monitor radiological risk e.g. operation abnormality, spillage, safety/operation channel + industrial safety risk

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Transition from Operation to Decommissioning

- Issue(s) to be addressed;
  - Organizational modifications : retirement, diversify in organisation focus i.e. upgrading vs. Decommissioning, NPP vs. RR
  - Licensing during transition
- Operational Concern
  - Waste treatment centre (low level)
  - Waste disposal centre (low, medium and high)
- Social and economic modification : Will decommissioning of reactor be a back step in promoting nuclear technology? The hands-on expertise we have is only on decommissioning of old shell and tubes heat exchanger.

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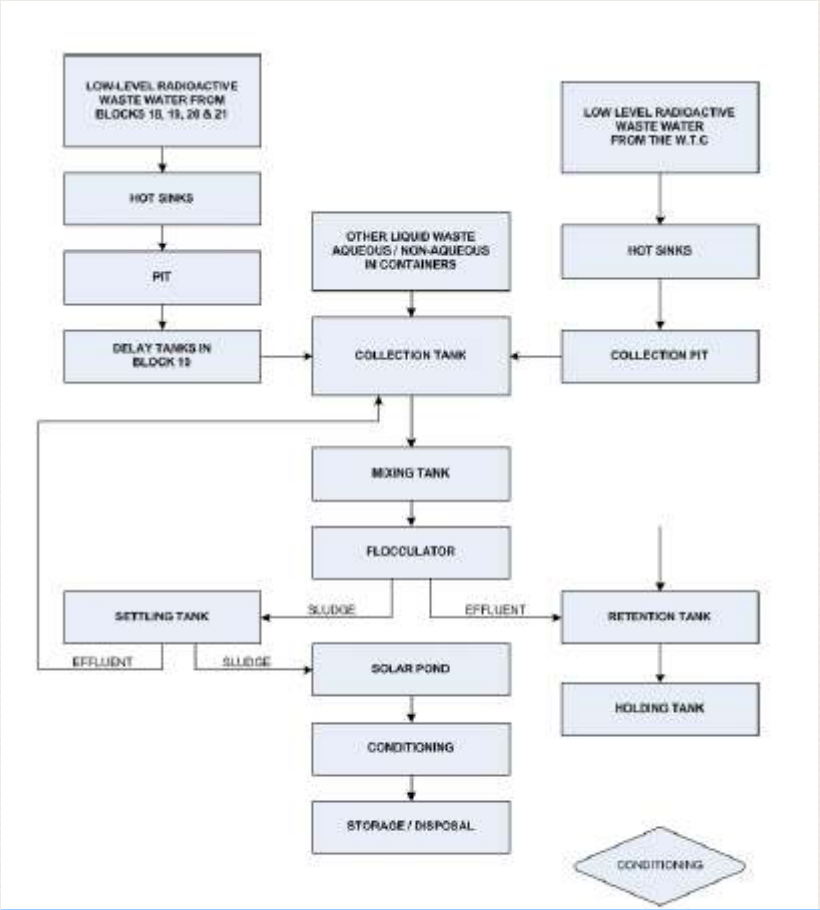
Transition from Operation to Decommissioning

Common Pit (for contaminated effluent)

In reactor hall floor, there are drains for liquid effluent flow down to the common pit – collection tank - waste treatment center



Process Schematic Flow :Low Level Effluent Treatment

Transition from Operation to Decommissioning

- **Activities that has been considered in Decommissioning plan;**
  - Irradiated and spent fuel storage facility:
    - AVAILABLE - Dry storage pit available, fuel handling tool
    - ON GOING - Spent fuel pool, transfer cask project
    - ISSUES – man power, knowledge, skills
  - Records review and archiving : turnover and archive – keep updating
  - General work areas clean-up : periodically conducted
  - General decontamination : locally able to perform general decontamination.

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Transition from Operation to Decommissioning

- **Other activities to be considered in Decommissioning plan;**
  - Radiological control – sealants, fixatives;
  - Ventilation system – use current ventilation system (HEPA filter);
  - Fire & flooding Protection – no special plan except for current protection systems;
  - Facility radiological scoping survey ;
  - Structural stability check – periodically checked

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Characterization Survey – Strategy 1

- **Conduct Historical Site Assessment on Reactor, Small Angle Neutron Scattering, Neutron Radiography, control room, pneumatic room**

No.	Items to be assessed	Status
1	Design drawing and as built drawing	(DONE and continuous review)
2	Construction materials	(DONE and continuous review)
3	Facility modifications	(DONE and continuous review)
4	Facility operating records	(DONE and continuous review)
5	Production schedules	Not Available
6	Routines survey	(DONE and continuous review)
7	Interviews with operator and support personnel	(DONE and continuous review)
8	Interview with retirees	Pending

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Characterization Survey – Strategy 1 (cont'd)

No.	Items to be assessed	Status
9	Event-log accident and unplanned events	(DONE and continuous review)
10	Review of security files for classified project	(DONE and continuous review)
11	Photographs	(DONE and continuous review)
12	QA document Review	(DONE and continuous review)
13	Confirm unexpected revelation with scoping survey	Pending

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Characterization Survey – Strategy 2

- Perform Sampling and Measurement

No.	Type of Survey	Status
1	Exposure dose monitoring (TLD)	Continuous dose monitoring at sites
2	Area radiation monitoring (ARM)	Continuous monitoring and review the data
3	Radionuclide and water chemistry analysis	Currently been done and will be continued.
4	Air sampling at designated locations	Can be started immediately after decision on decommissioning policy
5	Surface coating and paints	Can be started immediately after decision on decommissioning policy
6	Ion exchange resin analysis	Research has been started
7	Metal and wood samples	Can be started immediately after decision on decommissioning policy

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V: Decommissioning Fund

Act 304: Explain funding (Government, dedicated fund)

- **Section 44 (1) – (8) :** Decommissioning Requirements;
  - Sub-section (5) – (8) : Decommissioning Plan;
  - Sub-section (2) – (8) : Responsibilities of Licensee in Decommissioning;

- **Section 45 (1) – (2)** : Financing of Decommissioning.
  - Current RTP is owned by government – decommissioning fund is secured by the government.
  - Funding application will be prepared by the operator once the decision for decommission is made.

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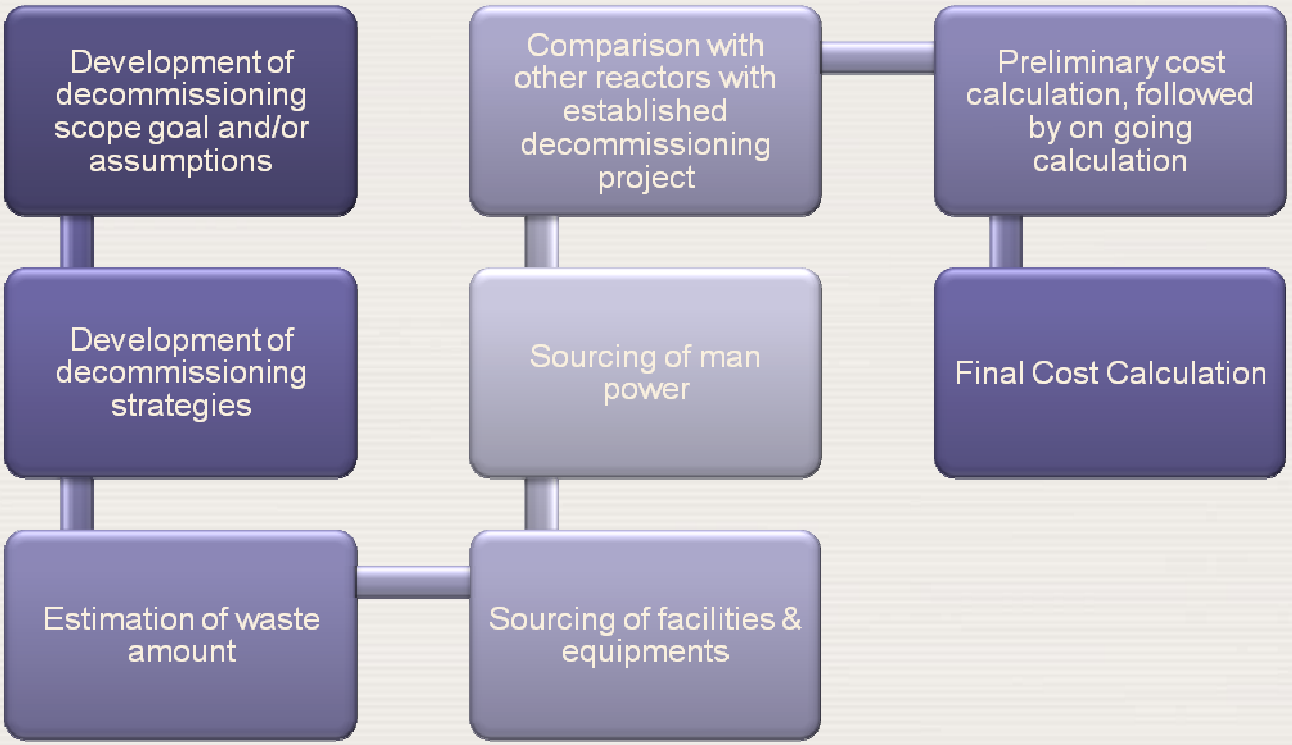
Decommissioning cost calculation / funding

- Explain actions for a cost calculation / timeline



Decommissioning cost calculation / funding

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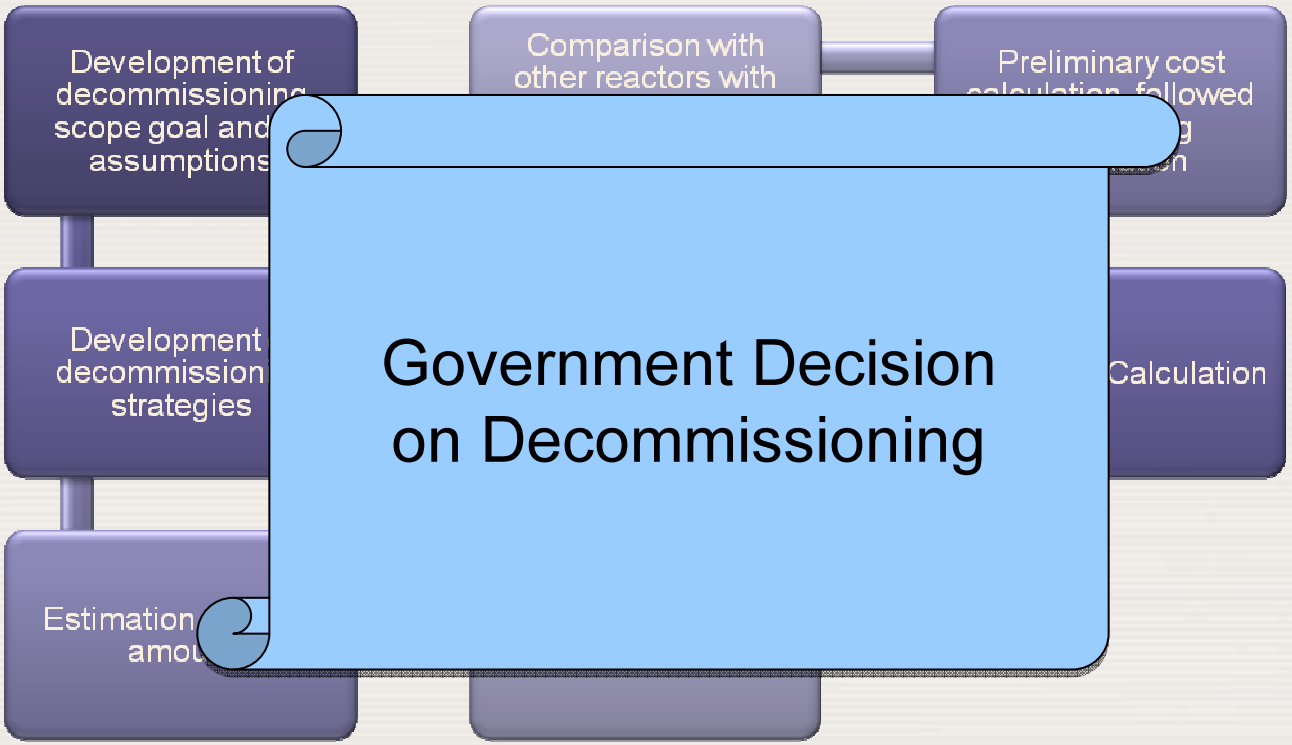

Development of decommissioning scope, goal and/or assumptions

- The decision on decommissioning of RTP is less likely to be announced soon. For capacity and capability building in decommissioning of nuclear facility, decommissioning goals and conditions have to be assumed.
- Short term scope that may be reasonable is to assume the need of decommissioning of reactor core. This is due reactor upgrading that involves change of core.

Development of decommissioning strategies

- Management of fuel – max. fuel burnup is about 30% (send back to US vs. storage in spent fuel pool and reuse, SOP in transferring fuel to pool etc.)
- Management of materials and waste / clearance – i.e. reactor core materials (selection of disposal techniques)
- Removal of reactor core from the reactor (how??)
- Characterisation of reactor core

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Waste Estimation

- Estimation on Waste Amount;
  - Reactor core materials and volume calculations;
  - Estimate time, schedule, necessary equipment & facilities using this data.
- Sourcing of necessary equipments and facilities;
  - Equipments and facilities for characterization survey, removal of reactor core, transportation of waste materials, decontamination of waste etc.

Sourcing Manpower

- Sourcing of manpower;
  - In-house man power + expert advisor vs. assign contractor
  - Management of man power – ALARA concept
- Comparison with other reactors, with established decommissioning project;
- Preliminary cost calculation, on going calculation;
- Final calculation

VI: Decommissioning Technologies

- Removing of reactor core – remove screws, nuts etc, conventional mechanical cutting techniques (TecDoc 395) available, but need guidance on safety measurements.
- Characterisation – conventional survey meters, wipe test, abrasion, scratch off, cutting etc.
- Decontamination
  - Decontamination not needed for reactor core – prepare for disposal

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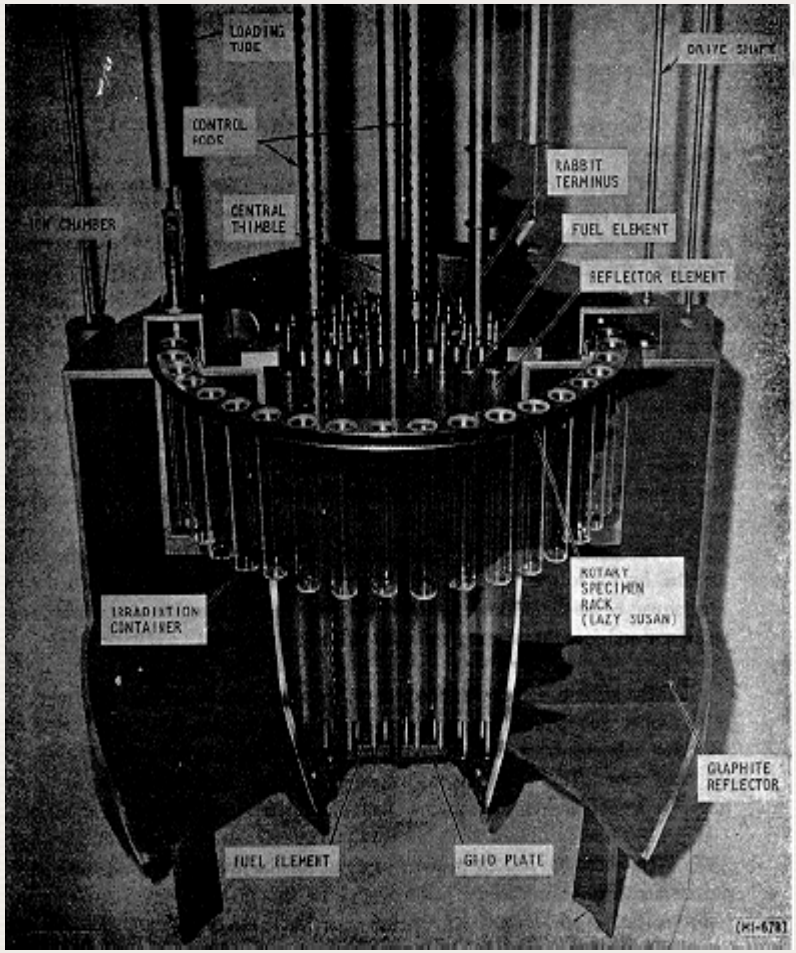
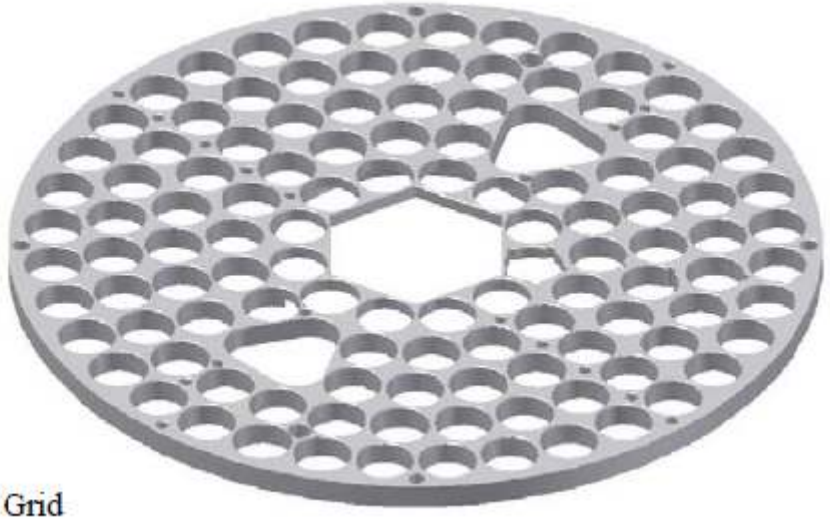
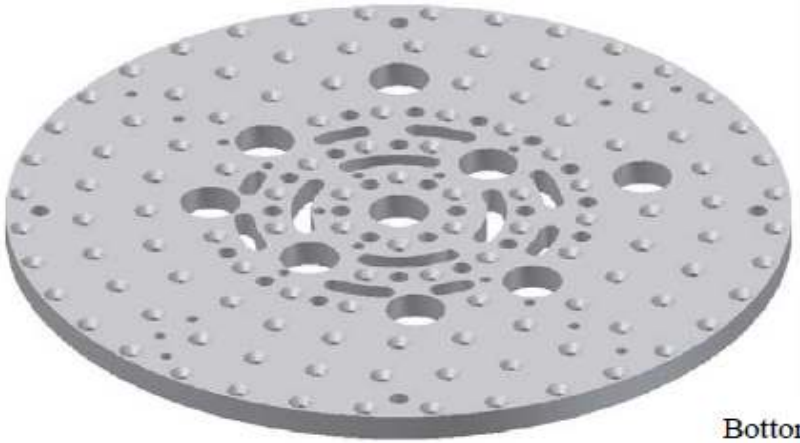
Component Identification





Top Grid



Bottom Grid

Figure 5.4 Top and Bottom Grid Plate

Actual Status of Decommissioning

- No intention to shutdown RTP, instead upgrading RTP in progress.
- The main objectives of RTP upgrading;
  - To increase reactor's flux and enable more type of researches to be conducted
  - To prolong the life span of the RTP – support NPP development
- Main components of RTP upgrading;
  - Change of primary cooling system
  - Fabrication of transfer cask and construction of spent fuel pool and
  - Analogue console will be changed into digital console
  - Possible change on core and fuel type – affecting decommissioning plan

Actual Status of Decommissioning (cont'd)

- Implications of upgrading project on decommissioning plan;
  - The decision on core and fuel type of RTP will be made only on 2012. Thus, decision on current irradiated fuel will only be made after 2012 (return back to supplier or reuse)
  - Spent fuel pool constructed and transfer cask fabricated could be used in decommissioning process.
- Future Plan for Decommissioning;
  - Initial Plan (available in SAR, Chapter 19)
  - Ongoing Plan (in progress)
  - Final Planning has yet to be made.

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Thank you

APPENDIX 1

- **Dose rate assessment (Mac-April 2010);**

Film ID	Location / Station No.	Dose (mSv)
STN1	Reactor Control Room	1.31
STN2	Reactor Platform	4.86
STN3	PAUS Platform	2.14
STN4	South Hall	1.79
STN5	Pneumatic Room	0.94
STN6	Store / Workshop	0.72
STN7	South West Hall	1.48
STN8	West Hall	1.63

APPENDIX 1

- **Dose rate assessment (Mac-April 2010) con'td;**

Film ID	Location / Station No.	Dose (mSv)
STN9	North West Hall	0.96
STN10	North Hall	1.78
STN11	North East Hall	2.11
STN12	East Hall	4.54
STN13	South East Hall	2.40
STN14	Basement	2.16

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APPENDIX 2

Radionuclides Inventories

Activated Materials in reactor Structures	Radionuclides in reactor Coolant	Contaminated Materials (Surface)	Noble Gas and Halogens in Reactor
• 3H, 14C, 22Na, 36Cl, 39Ar, 41Ca, 54Mn, 55Fe, 59Ni, 63Ni, 60Co,65Zn, 93Mo, 93Zr, 94Nb,108mAg, 110mAg, 125Sb, 133Ba, 134Cs, 152Eu, 154Eu, 155Eu, 166mHo	• Noble gases Kr, Xe – (Kr-85, Kr-87, Kr-88, Xe-133, Xe-135) • Halogens I, Br – (I-131, 132, 133, 134) • Metal Alkaline Cs, Rb – (Cs-134, 137, 138) • Noble Metal Ru, Rh, Pd, Mo, Tc – (Ru-103, Mo-99) • Actinides – U, Am-241 • Refractory Zr, Nb – (Zr-95, 9	• 90Sr, 99Tc, 106Ru, 129I, • 137Cs, 144Ce, 238Pu, 239Pu, 241Pu, 241Am, 242Cm, 244Cm, 232U, 233U, 234U, 235U, 236U, 238U	• Br-83, Kr-83m,Br-84, Br-85, Kr-85m,Kr-87,Kr-88,Kr-88, Kr-89,Kr-90,kr-91,I-131, Xe-131m,I-131,Xe-131m,I-132,I-133,Xe-133,I-134,I-135,Xe-135m,Xe-135m,I-136,Xe-137,Xe-138, Xe-139, Xe-140

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APPENDIX 3

- **Equipment and Analysis Facilities Available in Nuklear Malaysia**
  - **Alpha Spectrometry**
  - **Gamma Spectrometry**
  - **X-ray Spectrometry**
  - **ICPMS**
  - **Liquid Scintillation**