0. INTRODUCTION

The Research Reactor Decommissioning Demonstration Project (R2D2P) was developed to provide a platform for training and exchange of information, experience and good practices on the decommissioning of research reactor, including in particular “hands-on” experience. The scope included all aspects of the decommissioning process of research reactors, from establishing a legal and regulatory infrastructure to the final release of the facility from regulatory control, including the management of decommissioning waste. The project lasted from 2006 to 2015 and is coming to a close now. At this time it is very valuable to find out how much participating countries benefited from the project and which progress they had made during the duration of the project. In order to find this out, national reports should be provided before the final workshop, to be held on 28 September – 02 October 2015 in Eureka (Humboldt Bay), USA.

The outcome of the project is well documented in the various workshop papers on the following Agency website:

http://www-ns.iaea.org/projects/r2d2project/overview.asp?s=8&l=68

These documents should be used as a benchmark for the preparation of the national reports.

1. IDENTIFICATION

1.1 Country Name: INDONESIA

Please provide information on the current Situation in Table 1.

<table>
<thead>
<tr>
<th>Names of facilities</th>
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<tbody>
<tr>
<td>Facilities still requiring a decommissioning plan</td>
</tr>
<tr>
<td>MPR-30 Reactor, Serpong (Decommissioning Plan is in progress)</td>
</tr>
<tr>
<td>Facilities having a decommissioning plan</td>
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<tr>
<td>Facilities with a decommissioning plan reviewed by the regulator</td>
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<tr>
<td>Facilities shutdown and awaiting decommissioning</td>
</tr>
<tr>
<td>None</td>
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<tr>
<td>Facilities being under decommissioning</td>
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<tr>
<td>None</td>
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</tbody>
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* Please include all research reactors and give multiple answers, if necessary
1.2 Current Licensee and Regulatory body:

[Please provide the names of the organizations and describe the responsibilities of operator and regulator for decommissioning and show that the regulatory body is independent of the operator]

Act No. 10/1997 on Nuclear Energy regulates the roles and functions of:

- **BATAN (National Nuclear Energy Agency):** as the executive organization, performing research and development, promotion, uranium mining, production of nuclear fuels and radioisotopes for R&D, and radioactive waste management;
  - BATAN and other Operator is responsible to perform decommissioning of its facilities.
- **BAPETEN (Nuclear Energy Regulatory Agency):** as the regulatory organization, performing regulation development, licensing, and inspection for safety, security and safeguards.
  - BAPETEN is responsible to perform licensing, related approval and inspection for decommissioning (including dismantling and environmental remediation) and provide statement of regulatory release.

**Independency of BAPETEN:**

- Act No. 10/1997 on Nuclear Energy separates Promoting Organization (BATAN) and Regulatory Body (BAPETEN). It also grants that the Chairman of BAPETEN reports directly to the President of Republic of Indonesia;
- Regulatory decision is based only on technical issues. Licensing process is performed in accordance to Government Regulations, BAPETEN Chairman Regulations, and written technical procedures.
- BAPETEN finance is not depends the licensing fees. All BAPETEN budget is requested directly to the Ministry of Finance, with approval only from the National Agency for Development Plan, which is not BAPETEN’s licensee. All licensing fees go to the reserve of Ministry of Finance.
- BAPETEN has the authority to perform public consultation and/or to publish any public statement directly.
- BAPETEN can organize any international or bilateral cooperation with approval only from Ministry of Foreign Affairs, and acknowledge this cooperation to Ministry of Finance and the National Agency for Development Plan.
- **NOTE:** Indonesia received the IAEA IRRS Mission 2-14 August 2015.

2. LEGAL AND REGULATORY ASPECTS

2.1 Has your national legal and regulatory framework been changed from 2006 up to now? If yes, please explain the details of such changes. [Be as short as possible and as long as necessary.]

Yes. **BAPETEN has established BAPETEN Chairman Regulation (BCR) No. 4/2009 on the Decommissioning of Nuclear Reactor and BCR No. 6/2011 on the Decommissioning of Fuel Cycle Facilities. Both of these documents are adopting the IAEA SRS No. 45 (2005).**
2.2 Have those changes been influenced by the R2D2Project? Please explain why those changes have been made. [Be as short as possible and as long as necessary].

Yes. The idea of establishing BCR No. 4/2009 and No. 6/2011 based on the IAEA SRS No. 45 (2005) came from the active participation of BAPETEN high level management to the R2D2P activities.

The following aspects are of particular interest: 1) clear allocation of responsibility of licensee and regulatory body for decommissioning, 2) ensuring the independence of the regulatory body, 3) development of licensing requirements/regulations, 4) establishing a clearance policy with quantitative data for clearance and the same for the release of buildings and sites. Any other item may be reported.

1) Clear allocation of responsibility of licensee and regulatory body for decommissioning:
   a. Licensee submits:
      i. Decommissioning Plan (updated periodically) for approval by BAPETEN,
      ii. Final Decommissioning Plan for obtaining Decommissioning License from BAPETEN,
      iii. Decommissioning Safety Procedures and any revision to the Final Decommissioning Plan for approval by BAPETEN, and
      iv. Reports on Decommissioning Implementation, Radioactive waste Management, Environmental License Implementation, and Final Monitoring Survey for obtaining Statement of Regulatory Release from BAPETEN.
   b. Licensee performs all decommissioning activities, while BAPETEN conducts necessary inspection and enforcement.

2) Ensuring the independence of the regulatory body: (See point 1.2 above)

3) Development of licensing requirements/regulations:
   Requirements for obtaining Decommissioning License:
   a. Administrative requirements
   b. Technical requirements, such as Final Decommissioning Plan, Radiation Protection/Safety Programme, Emergency Preparedness and Response Plan, and Management System (QA/QC).
   c. Financial requirements. [NOTE: Financial assurance for decommissioning is one of the requirements for obtaining Commissioning License from BAPETEN]

4) Establishing a clearance policy with quantitative data for clearance and the same for the release of buildings and sites:

Clearance levels is established in BCR No. 16/2012 on Clearance Level (based on the IAEA BSS-115) in accordance to Government Regulation No. 33/2007 on the Safety of Ionizing Radiation and Security of Radioactive Sources (adopting BSS-115 and the Code of Conduct).

5) Others:
a. Without losing its independency, the regulator has to intensively communicate with the operator to discuss many issues in decommissioning: end state, strategies, technologies, and radioactive waste management, including transport of the waste.

b. The Licensee may utilize decommissioning company (TSO) to implement their decommissioning plan. However, the existing regulation in Indonesia, adopting the IAEA SF-1 principles, stated that the main responsibility for safety and security during this decommissioning activities remains to the Licensee.

3. DECOMMISSIONING PLANNING

3.1 Is a decommissioning plan (DP) in place or in preparation? /If so, please describe the details. /When was the DP established and / or amended? /Has the work on the DP been influenced by the R2D2P? /If so, describe the points which were influenced.]

- Yes. TRIGA-2000 reactor has submitted their first version of the Preliminary Decommissioning Plan to BAPETEN in 2012, and followed by Kartini Reactor in 2014. Currently, the MPR-30 reactor is in its progress to finalize their Preliminary DP.

- Yes, DP been influenced by the R2D2P. TRIGA-2000 reactor enhanced the decommissioning plan documents started in January 2014 with information gained from R2D2P workshops and the assistance of the IAEA staff and the experts through TC Project INS/9/024, “Preparing a Decommissioning Plan for the Bandung TRIGA-2000 Reactor.”. The idea of TC Project was formulated by the Operator during an R2D2P workshop. The regulatory body then endorsed this activity to the National Liaison Officer. Activities agreed in this TC Project are mainly based on R2D2P. Hence, it can be said that the development of Decommissioning Plan document in Indonesia is highly influenced by the R2D2P.

3.2 Has progress been made on the following issues relevant to a DP: [Please describe the progress for each facility in your country.]

3.2.1 Characterization: [describe the progress in the detail from 2006 up to now. / Has the work been influenced by the R2D2Project? /If so, describe the points which were influenced.]

- Yes. With the knowledge gained during the R2D2P workshops and interaction with experts in the TC projects, characterization and inventory of material radioactivity of TRIGA-2000 reactor has been continually updated since January 2014. The characterization and inventory here can be divided into:
  - Radioactivity of structures, systems and components of the reactor: Tank reactor, reactor, beam-port, and the entire irradiation facility located in the reactor tank.
  - Contamination of the soil surface: the surface soil outside the reactor building can contain radioactive materials that might be occurred during the operation, or caused by decontamination or dismantling activities.
  - Noted that the characterization process also considers the calculation of all TRIGA-2000 fuel burn-up (A total of 125 spent fuels).
3.2.2 Cost estimation and funding: [describe the progress in the detail from 2006 up to now. / will funds be available when needed and how is that ensured? / Has the work been influenced by the R2D2P? / If so, describe the points which were influenced.]

- Yes. Cost estimation and funding for decommissioning of TRIGA-2000 reactor were developed with the information taken during the R2D2P workshops and Data Analysis and Collection for Costing of Research Reactor Decommissioning (DACCORD) meetings, and experts assistance during the TC projects.
  - In the first version of Preliminary Decommissioning Plan submitted in 2012, cost estimate was calculated based on general construction cost for demolition.
  - In April 2013, a TRIGA-2000 staff participated in the IAEA Interregional Practical Workshop on Cost Estimation for Decommissioning. In December 2013, another staff attended the 2nd Annual Meeting of the DACCORD Project. Then, in November 2014 staff also takes part in the 3rd Annual Meeting DACCORD Project.
  - Hence, with the above experiences and the TC Project activities, the current cost estimates for decommissioning of TRIGA-2000 Reactor Bandung is calculated using the CERREX with ISDC as the guideline. TRIGA-2000 management commits to periodically update the cost estimation, as it is also required by national regulation.

3.2.3 Safety assessment: [describe the progress in the detail from 2006 up to now. / Has the work been influenced by the R2D2P? / If so, describe the points which were influenced.]

- Yes. Safety assessment for decommissioning of TRIGA-2000 reactor was developed with the knowledge gained from the R2D2P workshops and intensively from the TC projects implementation. In this instance, the safety assessment were carried out systematically by implementing several stages:
  - Develop decommissioning activities in accordance with the decommissioning option selected.
  - Identify the various issues related to safety and potentially occur during decommissioning activities and make a technical assessment
  - Identify possibilities accidents and incidents that may occur during decommissioning and make technical evaluations
  - Evaluation of the impact of decommissioning on workers and communities, both during normal decommissioning process as well as in accident
  - Comparing the results of the analysis with the relevant safety criteria
  - Taking action to prevent and reduce the impact.

3.2.4 Is the management of decommissioning waste integrated into the decommissioning activities, i.e. clearance of waste and materials, processing, storage and disposal of radioactive waste?
[Describe the progress in detail from 2006 up to now. Has the work been influenced by the R2D2Project? / If so, please provide the details.]
• Yes, in the planning of decommissioning plan documents, the management of decommissioning waste is integrated into the decommissioning activities.
• Yes, with the knowledge gained from the R2D2P workshops and with the assistance of experts during the TC projects, TRIGA-2000 developed their decommissioning activities and requirements such as:
  o Implementation of decommissioning activities shall consider the impact to the environment.
  o Decommissioning activities that could give impact to the environment are removal of spent fuel from the reactor core, dismantling and decontamination of reactor components, and the management of radioactive waste.
Decommissioning of Bandung TRIGA-2000 reactor will generate various wastes: radioactive waste (both in solid and liquid state), non-hazardous waste, and materials that have been cleaned;
  ▪ Radioactive waste: spent fuel elements, rotary specimen rack, reflectors, reactor tank and its components, neutron sources, control rods, resin, and other active components.
  ▪ Non-hazardous waste: secondary cooling system components such as cooling towers, secondary pump and piping system.
  ▪ Materials that have been cleaned: most of the primary cooling system components such as piping that are outside the reactor tank.

3.2.5 Infrastructure (Records Management and Quality Management System etc.): [describe the progress in detail from 2006 up to now]

• Bandung TRIGA-2000 reactor core components are placed in a reactor tank surrounded by the reactor shielding.
• Four pieces of pipe beam (beam-port) installed in the structure of this shielding. Beam-port penetrate the concrete walls, the water tank and the graphite reflector
• At the bottom of the shielding structure fitted thermal column made of graphite. The housing of the thermal shielding penetrate the concrete column and leads to the outside of the reflector
• Decommissioning activities at the reactor structure could be done after all fuel elements removed from the reactor core.
• Classification of the structure with the status of non-contaminated or contamination is determined based on:
  o The measurement of radiation exposure on the surface of the structure;
  o Contamination testing using structure surface contamination monitoring devices; and
  o Smear test if necessary.

3.3 Regulatory review: [Has the DP mentioned above been reviewed/authorized by the regulatory body? If so, has the review been influenced by the R2D2Project? describe the points which were influenced.]

The Preliminary DP document Bandung TRIGA-2000 reactor has been submitted to Regulatory Body. The document has been reviewed in accordance to BCR No. 4/2009 on Decommissioning of Nuclear Reactor (Based on the IAEA SRS No. 45). The regulatory body and the operator agreed that the
document is open for improvement, especially with knowledge gained during the TC Project and from the R2D2P workshops.

3.4. Licensing of a decommissioning project: [Has a project been licensed? / describe the progress in detail from 2006 up to now]

• No application of decommissioning license is submitted to the regulatory body at this time.
• However, the Preliminary DP document for TRIGA-2000 reactor is expected to be completed in December 2015. The submission of this document to the regulatory body is a part of License of Operation requirements. As mandated by the existing regulation, the DP Plan should be updated periodically every 5 years. A Final DP Plan shall be a requirement for obtaining Decommissioning License.
• The Preliminary DP document for TRIGA-2000 is a model for the other two reactors. Kartini Reactor already submits its Preliminary DP in 2014, and currently is under review by the Regulatory Body. The MPR-30 reactor is in its progress to finalize their Preliminary DP.

4. IMPLEMENTATION

Implementation of a DP: [Please describe the progress made in the implementation of a DP in your country by facility. /Is the progress in line with the DP up to now? / Has the implementation been influenced by the R2D2Project?/ If so, describe the points which were influenced.]

• No implementation of decommissioning plan at this time.

Regulatory oversight: [Has the regulatory oversight such as inspections during the project implementation been carried out? /If so, please describe the context. / Has the oversight been influenced by the R2D2Project?/ describe the points which were influenced.]

• N/A.

5. PLANNED FUTURE ACTIVITIES / STRATEGIC DECISIONS

Please report planned future activities and strategic decisions, including items that are still pending and where a decision is planned to be taken (when?).

• For TRIGA-2000, it will be operated until all available fuels are used. Beyond that, the options are: To redesign the reactor with plate-type fuel based on MPR-30 reactor experience, or to perform decommissioning.
• Should decommissioning is chosen, then the end-state could be green field as encouraged by the existing regulation, or to use the facility as a museum or training facility. Decommissioning scenario for TRIGA-2000 reactor would be limited to the inside part of the reactor building, while other facilities located in the same site will not be dismantled and will still be used.
• Considering that radiological inventory with high level of radioactivity is dominated by nuclear waste from the components of the reactor, and that the annual funding is proposed through the regular budget of BATAN, then the most feasible dismantling option for the future would be deferred dismantling of eight to ten years. After this time period, it could be followed by the physical dismantling of the reactor and other auxiliary components, but not including the supporting laboratories around the reactor building, because the facility can still be used to support education facility. Demolition activities is also planned to be implemented after ten years after the reactor shutdown declared permanently.

• The implementation of the dismantling of the reactor is estimated to be carried out about ten years after the shutdown of the reactor is declared permanently.

6. OTHER ITEMS

Please report any other item in the area of research reactor decommissioning which is important to you and has not been addressed by the topics above, including progress of other activities, e.g. Technical Cooperation Projects.

The preliminary environmental impact assessment around the reactor building has been carried out with some important findings as follows:

• Gamma-emitting fission radionuclide (Cs-137, Am-241 and Co-60) was not detected in samples of ground water, surface soil, and the soil at site of the Bandung TRIGA-2000 reactor. Only natural radio nuclides were identified in ground water samples;

• Ambient radiation exposures at the TRIGA-2000 reactor site at some points are higher than background radiation exposure. The maximum exposure at:
  o the storage of radioactive waste resulted from the upgrading of TRIGA-2000 reactor in year of 2000: 0.23 µSv/hour,
  o solid radioactive waste storage: 1.24 µSv/hour,
  o liquid radioactive waste management sites: 0.93 µSv/hour, and at
  o the environmental radiation research and calibration building site: 1.8 µSv/hour.

• The fact that gamma-emitting fission radio nuclides were not detected in the environmental samples indicates that there are no significant fission radionuclide contaminations at TRIGA-2000 reactor facilities.

• In the TC Project, we TRIGA-2000 have organized three expert missions in the form of high level discussion, and technical workshops. In October 2015 there will be a final wrap-up expert mission. Topics covered in the three workshops were on the:
  o EIA, preliminary decommissioning plan, and environmental remediation;
  o Inventory database and characterization survey for decommissioning; and
  o Decommissioning technologies, waste and spent fuel management, Continuing characterization data, and discussion on the decommissioning plan documents with Regulatory Body staff.
  o Noted that regulatory body staff and the other two reactor staffs were also participated in these three workshops organized at the TRIGA-2000 Reactor.
For HRD in decommissioning, three reactors staffs have joined decommissioning program training organized by the IAEA and PNRI in Manila, Philippines, June 2014. Three other staffs were also sent to ANSTO Australia for Scientific Visit programme to review and learn from a reactor that has been decommissioned and at a reactor to be decommissioned in the near future. These staffs also participate in the International workshop on how to perform the characterization and how to dismantle parts of SSCs that have a high radiation. On April 2015 two staff have participated SCK.CEN fellowship in Belgium, learning dismantling process of reactor components and involved in the decommissioning process on BR3 reactor in Belgium.

7. CONCLUDING REMARKS

How much input has been received through the R2D2Project? [Please specify the importance of the R2D2Project in your national work on decommissioning of research reactors in your own words. Was it justified to spend the money for the execution of the R2D2Project and to dedicate the vast amount of time to the project workshops?]

- Regulatory infrastructures for decommissioning of nuclear reactor are available in Indonesia, and they’re adopting international standards. The development of these infrastructures was highly influenced by the participation of senior regulators in the R2D2P workshops.
- The R2D2P workshops, attended by high level Indonesian officials both from operator and regulator sides, have created a better understanding and awareness on the importance of developing Preliminary DP document and direction on how to improve this document; and provided valuable information on strategy, process and technology options in decommissioning.
- The R2D2P workshops have encouraged the operator to seriously develop the Preliminary DP document through TC Project, and this project is proven its effectiveness, not only for TRIGA-2000 staffs, but also for other reactor staff and regulators.
- The Bandung TRIGA-2000 reactor has submitted their Preliminary DP to the regulator. This document is also under enhancement, based on knowledge gained in the R2D2P workshops and the TC Project.
- Without losing its independency, the regulator has to intensively communicate with the operator to discuss many issues in decommissioning: end state, strategies, technologies, and radioactive waste management, including transport of the waste.