REGULATORY CONTROL OF AGEING RESEARCH REACTOR IN
INDONESIA
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ABSTRACT
According to the requirements of BAPETEN, safety review (SR) to the report on ageing
assessment should be carried out for the license renewal applications of research reactors
that have been operated more than 25 years. Ageing management is one of the important
safety factors to be reviewed for license renewal applications. In order to assess continued
operation of a research reactor from the reactor safety standpoint, a methodical approach
should be taken. Such an approach will utilize data from the ageing management program
and should incorporate the following considerations: A safety review of the reactor tailored
to establish the actual status of the systems regarding degradation from ageing or other
specific mechanisms; An overview of the potential refurbishment needs, by establishing a
comprehensive list of systems and components, categorizing and prioritizing them; A
selection of the critical items and identification of the relevant ageing mechanisms in order
to perform a preliminary evaluation of the critical items; The establishment of the technical
feasibility of the refurbishment program; and The identification of further studies and
inspections to refine the preliminary assessment. This paper described the regulatory
control of ageing research reactor in Indonesia, including the rules and regulation, the
licensing process and the periodic review of ageing management.

Keywords: ageing management, research reactor, review.

1. Introduction
The Nuclear Energy Regulatory Agency (BAPETEN) was established as an autonomous
body reporting to the President of Indonesia by Act No. 10 Chapter II, article 3 regarding
institution, known as the Nuclear National Act, which came into force on year 1997, and is
empowered to regulate and control the nuclear activity. BAPETEN is conducting the safety
regulation and inspections related to nuclear and radiation safety, in nuclear facilities,
including research reactors. Its implies implementing three major activities: establishing the
laws and safety standards of nuclear and radiation safety in the fields of research reactors;
licensing of the research reactors; and inspections (or the license conditions tracking,
inspection and application of sanctions). The rules and regulations of nuclear energy are
described in regulations hierarchy.

In the field of radiological and nuclear safety control applied to research reactors,
BAPETEN regulatory activities are directed at controlling three research reactors; Triga 2
MW (th) Research Reactor in Bandung, Kartini 100 KW (th) Research Reactor in
Yogyakarta and RSG – GAS 30 MW (th) Research Reactor in Serpong. All those research reactors are managed by BATAN and they are over 25 years old.

In Indonesia, research reactors that have been operating for more than 25 years undergo a systematic safety reassessment at the request of the safety authority. For such a reassessment, the applicant has to provide updated safety documents for the installations for example;

1. The SSCs feasibility to operate
2. Ageing management Program
3. A yearly maintenance report
4. Feasibility report for operation every 5 years
5. Preparation of decommissioning program

2. The rules and regulations

Regulatory policy, for continued operation of an Research Reactors, requires utility to demonstrate that the system, structure and components will function without impairment of safety margin in all operational states during the service life of an Research Reactors. The requirements related to ageing management are specified in the various regulatory documents issued by BAPETEN as shown in figure 1.

BAPETEN evaluates documents related to ageing, which specially provide criteria that can be implemented to research reactors in Indonesia. Acceptance criteria for establish the safety requirements related to ageing is a main issue in ageing management for research reactors in Indonesia. It is very difficult to regulate the acceptance criteria without representative data due to the unique characteristic for individual reactor and Lack of

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**FIG: 1. National Legislation Hierarchy**

- **LAW**
  - Nuclear Energy Act 10 Year 1997, Chapter II Articles 3
  - Basic principles in safety arrangement for the development and beneficial use of nuclear energy.

- **Government regulations**
  - Government Regulation “Nuclear Reactors Licensing” No. 43 Year 2006
  - Regulations based on law

- **Presidential Decree**
  - Regulations based on law
  - 2. Decree Of The Bapeten Chairman “Ageing Management Of Nuclear Installation” (Draft)
document control when the reactor was constructed makes it be more difficult.

3. The licensing Process of Ageing Management

The licensing process for the Research Reactors in Indonesia is governed by the Government Regulation No. 43 Year 2006 on “Licensing For Nuclear Reactors”. As per the requirements of this Government Regulation, the operating organization is required to establish certain programs with respect to plant life management, before authorization is issued to a Research Reactors license application.

As per the regulatory policy of BAPETEN, Authorization for operation of Research Reactors is issued for a specified period. Renewal of Authorization for operation beyond this shall be subject to a comprehensive Periodic Safety Review of the Research Reactors, as per the guidelines given in BAPETEN Safety Guide on Periodic Safety Review for Renewal of Authorization of Research Reactors. Presently Periodic Safety Review of Research Reactors is performed at a periodicity of once in five years for Indonesian Research Reactors. The Periodic Safety Review aims to assess the plant vis-à-vis the current safety requirements, to identify and evaluate the shortcomings and take corrective actions as necessary. One of the important aspects of this review is to determine whether Research Reactors ageing is being effectively managed, so that the required safety margins are maintained and whether an adequate ageing management program is in place for future operation of the Research Reactors.

4. Status of Research Reactor in Indonesia

BAPETEN regulatory activities are directed at controlling three research reactors; Triga 2 MW (th) Research Reactor in Bandung, Kartini 100 KW (th) Research Reactor in Yogyakarta and RSG – GAS 30 MW (th) Research Reactor in Serpong. All those research reactors are managed by BATAN and they are over 25 years old. All reactors are in operation, here is the detail of long time operation periods:

(a) TRIGA 2000 : 34 years old
(b) Kartini : 26 years old
(c) RSG-GAS : 18 years old

Decommissioning would not be a best choice, but ageing problems are crucial and ageing would be the main issue for continued operation. Table 1 shown detail of research reactors in Indonesia.
Table 1. Research Reactor In Indonesia

<table>
<thead>
<tr>
<th>Details</th>
<th>TRIGA 2000 Reactors</th>
<th>Kartini Reactor</th>
<th>G.A. Siwabessy MPR (RSG-GAS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Bandung, West Java</td>
<td>Yogyakarta (Central Java)</td>
<td>Serpong, Banten (West Java)</td>
</tr>
<tr>
<td>Type</td>
<td>TRIGA reactor</td>
<td>TRIGA reactor</td>
<td>Multi Purpose Reactor</td>
</tr>
<tr>
<td>Thermal Power</td>
<td>2000 kW</td>
<td>100 kW</td>
<td>30 MW</td>
</tr>
<tr>
<td></td>
<td>First critical at 1964</td>
<td></td>
<td>First critical at 1987</td>
</tr>
<tr>
<td></td>
<td>(250 kW)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upgraded to 1000 kW on 1971</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upgraded to 2000 kW on 2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>License</td>
<td>Valid up to 2016</td>
<td>Valid up to 2010</td>
<td>Valid up to 2020</td>
</tr>
</tbody>
</table>

5. Efforts to Approach the Ageing Management Related On the Regulation

5.1. The SSCs Feasibility to Operate

The SSCs Feasibility to Operate is to obtain information on behavior of the components, as identified for ageing management purpose, under reactor environment and to undertake necessary studies/experiments with respect to their residual life assessment. The utility has to demonstrate that the required resources and infrastructure for this activity is being provided.

The categorization of components, structures and systems susceptible to ageing should be based on factors such as importance to safety, repair ability or replace ability. One example of such categorization of components is as follows:

a. Category I: Equipment of primary importance, not redundant, not easily repairable or replaceable (reactor tank, primary coolant system piping).
b. Category II: Equipment of primary importance, but redundant or can be easily inspected or repaired (e.g. electric power supply, control rods).
c. Category III: Equipment not primarily important but not easily inspect able or repairable (e.g. primary water purification system).
d. Category IV: Other equipment (e.g. auxiliary diesel generators).

The assessment to the feasibility of operation and the evaluation of Systems, Structure and components (SSCs) capability were accomplished by BAPETEN and by organization operation for the verification of the capability of old nuclear facility in order to guarantee the operation license that the research reactor is still feasible to be operated and to avoid any accident occurred due to incapability of SSCs.
Here is an example of Categorization of SSCs important to safety (Kartini Reactor):

b. Experimental facilities connected to reactor core: inner part of beam port, thermal column, thermalizing column.
c. Primary cooling system: primary coolant, demineralizer, primary pump, pipe and valve, reactor tank.
d. Instrumentation & control system: neutron detector, control element and mechanism, data acquisition and control system, cables, etc.

5.2. Ageing Management Program

The probability of a component, system or structure failure resulting from ageing degradation normally increases with the time of exposure to service condition unless counterm easures are taken. The objective of the management of ageing is to determine and apply these countermeasures. The management of ageing includes activities such as protection, repair, refurbishment or replacement, which are similar to other activities carried out at a reactor facility during routine maintenance and testing or when a modification project takes place. However, it is important to distinguish between these different activities, because the management of ageing requires the use of methodology which will detect and evaluate deficiencies produced by the service conditions and will lead to the application of countermeasures for prevention and mitigation of the deficiencies. One approach to this methodology is a determination that the reactor systems and components can perform their safety functions during their service life and under the service conditions. This can be achieved through appropriately selecting systems and components which should be subjected to surveillance activities and included in a long term ageing detection program, through data collection and through evaluation of the potential ageing effects. The above activities will be accompanied by countermeasures for prevention and mitigation of the ageing effects to ensure an adequate level of safety for the reactor facility.

To manage ageing it is necessary to understand how ageing affects the components and materials which are used to achieve overall safety of the reactor. Surveillance Program- to verify and ensure that the provisions made in the design to ensure safety margins continue to exist and the safety of the plant does not depend upon untested or unmonitored components, systems or structures.

In-service Inspection (ISI) Program- to examine plant components and systems for possible deterioration in their integrity to assess the safety margins and their acceptability for continued operation of the plant and to take corrective measures as necessary. Systems, Structures and Equipment (SSE) important to safety of the plant are identified in the In-service Inspection manual, which gives the requirements with respect to (a) frequency of inspection (b) method of inspection and (c) the acceptance criteria.
Performance Review Program- to identify and rectify gradual degradation, chronic deficiencies, potential problem areas or causes. This includes review of safety-related incidences & failures of SSE of the plant, determination of their root causes, trend, pattern and evaluation of their safety significance, lessons learned and corrective measures taken.

Tecdoc-792 “Management Of Research Reactor Ageing” are used on Discussing the ageing problems activities have been performed (by operating organizations): (i) Categorization of SSCs important to safety related to ageing, (ii) In-service inspection for some components.

Here is the operating organization of research reactor activities related to ageing management:

a. TRIGA 2000 Reactor has experienced with ageing problems when upgraded to 2000 kW and the reactor tank was replaced with new one.
b. Kartini Reactor has performed ISI for reactor tank/liner.
c. RSG-GAS has performed ISI for reactor tank by visual inspection (under water camera), and the result will determine furthermore testing.

5.3. A Yearly Maintenance Report

The IAEA Code of the Safety of Nuclear Research Reactors: "Components important to safety may require special attention to prevent ageing effects from causing unexpected failures. In such cases a preventive maintenance philosophy is one of the approaches which should be adopted."

Decree of the BAPETEN Chairman “Safety Provision on Research Reactors Operation” (Adopted From Safety Series No. 35-S2) “A preventive maintenance should be implemented to prevent ageing effects from causing unexpected failures of components important to safety”. IAEA Safety Requirements No. NS-R-4 is under preparation to be implemented in the regulatory system in Indonesia.

Preventive maintenance is utilized to detect and mitigate degradation and failure of components, structures and systems, and includes repair, replacement and refurbishment activities. Traditionally, the preventive maintenance program is scheduled according to manufacturers' recommendations, warranty requirements and facility staff experience. This applies quite well for standard equipment and optimization of timing may be done as experience with this equipment grows.

For the research reactor components and systems exposed to environments which accelerate ageing effects, information from the literature and the experience from older facilities may be utilized to develop the preventive maintenance program based on predicted failure rates. The maintenance program should be periodically reviewed following analysis of accumulated data.
As stated on the License Condition periodically the research reactor operating organization have to report to BAPETEN a maintenance report. BAPETEN review the maintenance report. Maintenance report objective is to ensure that (i) Safety Status of the Plant is not adversely affected due to aging, deterioration, degradation or defects of plant structures, systems or components since commencement of operation and (ii) their functional reliability is maintained in accordance with the design assumptions and intent over the operational life span of the plant.

5.4. Feasibility Report for Operation Every 5 Years

Operating conditions (or modes) have already been defined as part of service conditions which affect ageing processes. Periodic evaluation of operational experience may reveal the need to change operating conditions such as operation mode, core arrangements and chemical parameters of fluid.

The frequency of inspections is also a parameter which requires optimization. Too high a frequency of inspection and maintenance work or tests may also accelerate ageing and an assessment of this effect is required.

As stated on the License Condition every 5 (five) the operating organization of research reactor have to make a feasibility report for operation. BAPETEN review the feasibility report for operation. Feasibility report for operation. objective is to ensure that (i) Safety Status of the Plant is not adversely affected due to aging, deterioration, degradation or defects of plant structures, systems or components since commencement of operation and (ii) their functional reliability of SSCs is still comply with the requirement.

5.5. Preparation of Decommissioning Program

As stated on the License Condition a year before the license operation terminate date the operating organization of research reactor have to plan is there the reactor will continue to operate by request renewal license application or the reactor will be decommissioning. If the research reactor wants to close down the operating organization have to prepare the decommissioning program. From the 3 (three) research reactor, Kartini Reactor will be the first one which plan to decommissioning due to after performed ISI for reactor tank/liner is concluded that the Kartini reactor tank can only uses until year 2011.

Presently the Kartini Reactor operating organizing already made decommissioning team who will be preparation of decommissioning plan. Presently BAPETEN made draft Decree of Chairman BAPETEN on Requirement for Decommissioning program. On the year 2008 we will plan to make standard review plan for decommissioning program to assess is the decommissioning licensee application is complies the regulation requirement.

6. Conclusions
The research reactor in Indonesia have been performed ageing management activities by: (i) Categorization of SSCs important to safety related to ageing, (ii) In-service inspection for some components. TRIGA 2000 Reactor has experienced with ageing problems when upgraded to 2000 kW and the reactor tank was replaced with new one. Kartini Reactor has performed ISI for reactor tank/liner. RSG-GAS has performed ISI for reactor tank by visual inspection (under water camera), and the result will determine furthermore testing.

The research reactor in Indonesia have comply the requirement of Government Regulation Number 43 Year 2006 in implement ageing management.

7. REFERENCES

1. Nuclear Energy Act Number 10 Year 1997.
2. Government Regulation of The Republic of Indonesia Number 43 Year 2006 on The Licensing of Nuclear Reactor.
4. Decree Of The Bapeten Chairman “Ageing Management Of Nuclear Installation” (Draft)
5. The Licensing document of Research reactor In Indonesia, BAPETEN.