Time Limited Ageing Analysis (TLAA) as a Basis of Integrated Management Systems for Research Reactor in Implementation of Aging Management Program for critical SSC in RSG-GAS Reactor

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National Research and Innovation Agency, Indonesia

Technical Meeting on Integrated Management System for Sustainable Safe Operation and Effective Utilization of Research Reactor

Mito, Japan 16-19 June 2025

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Research Reactor In Indonesia

TRIGA MARK 2000
Located in Bandung
Maximum Output
2 MW
Operating since 1965

KARTINI REACTOR (TRIGA)
Located in Yogyakarta
Maximum Output
100 KW
Operating since 1979

MULTI PURPOSE REACTOR (RSG) G.A. SIWABESSY
Located in Tangerang Selatan
Maximum Output
30 MW
Operating since 1987

INTRODUCTION

G.A. Siwabessy Research Reactor

- Location: Serpong, Banten (West Java)
- First Criticality : March 27th, 1987
- Type: Multi Purpose Reactor
- Thermal power: 30 MW
- Fuel: Plate type, U_3Si_2Al
- First critical at 1987
- Operation mode : 45 days/cycle; 4 cycles/year
- License: valid up to 2030
- Number of Fuel : 48 element

BRIN
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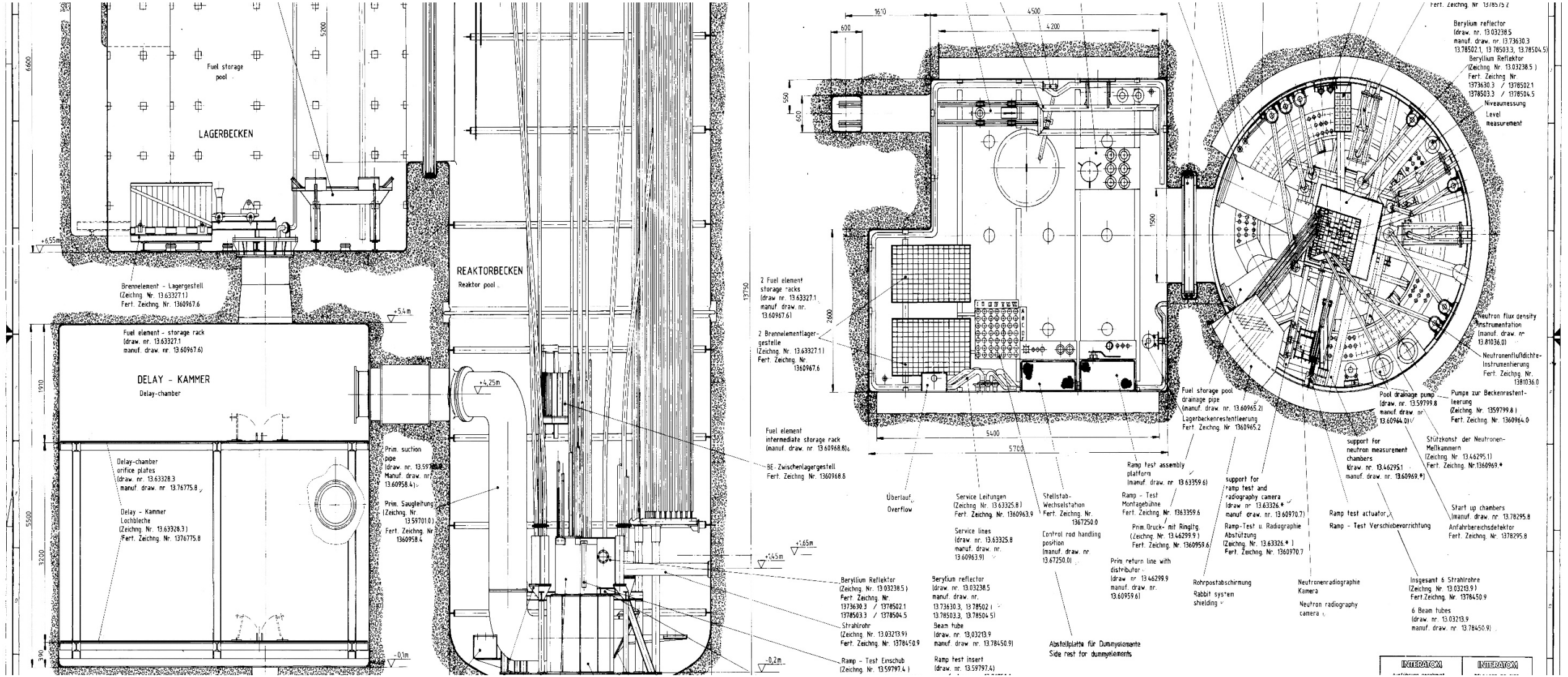
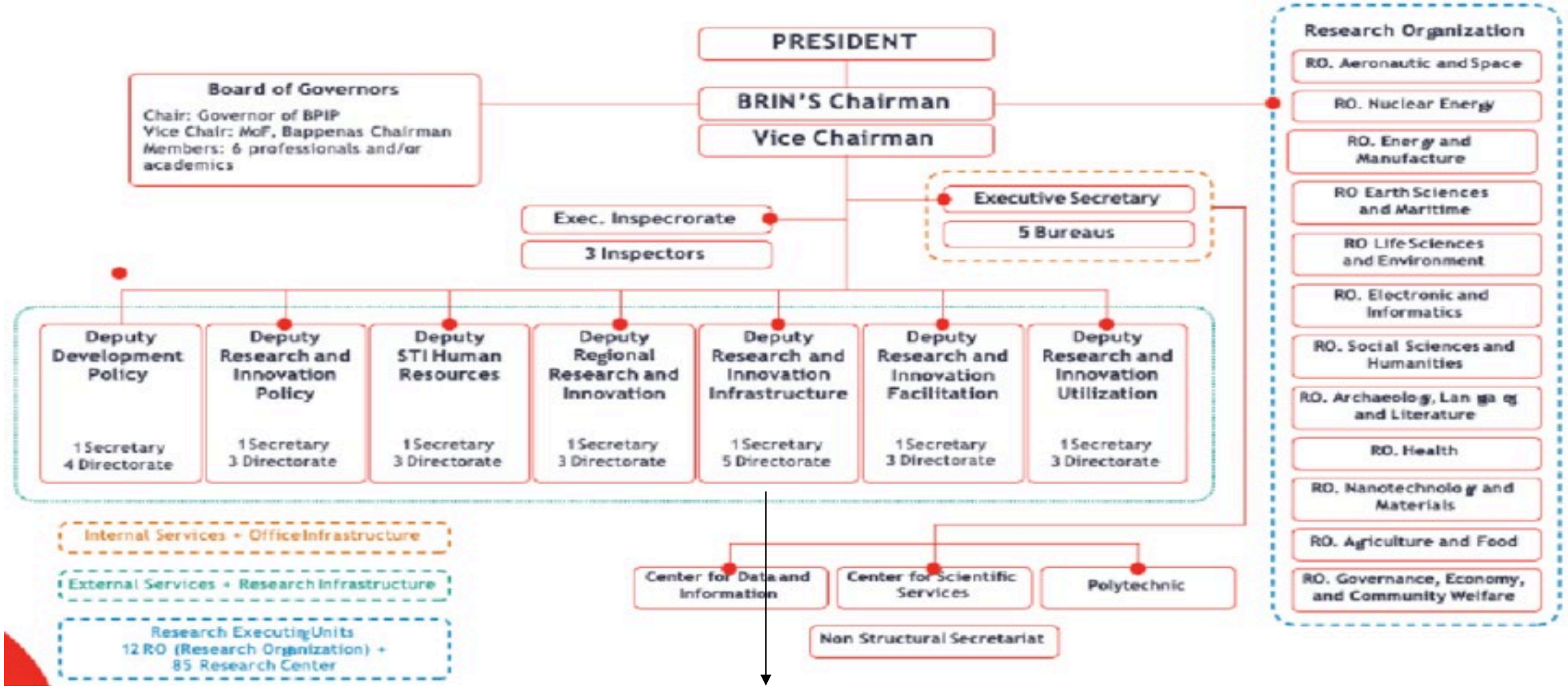
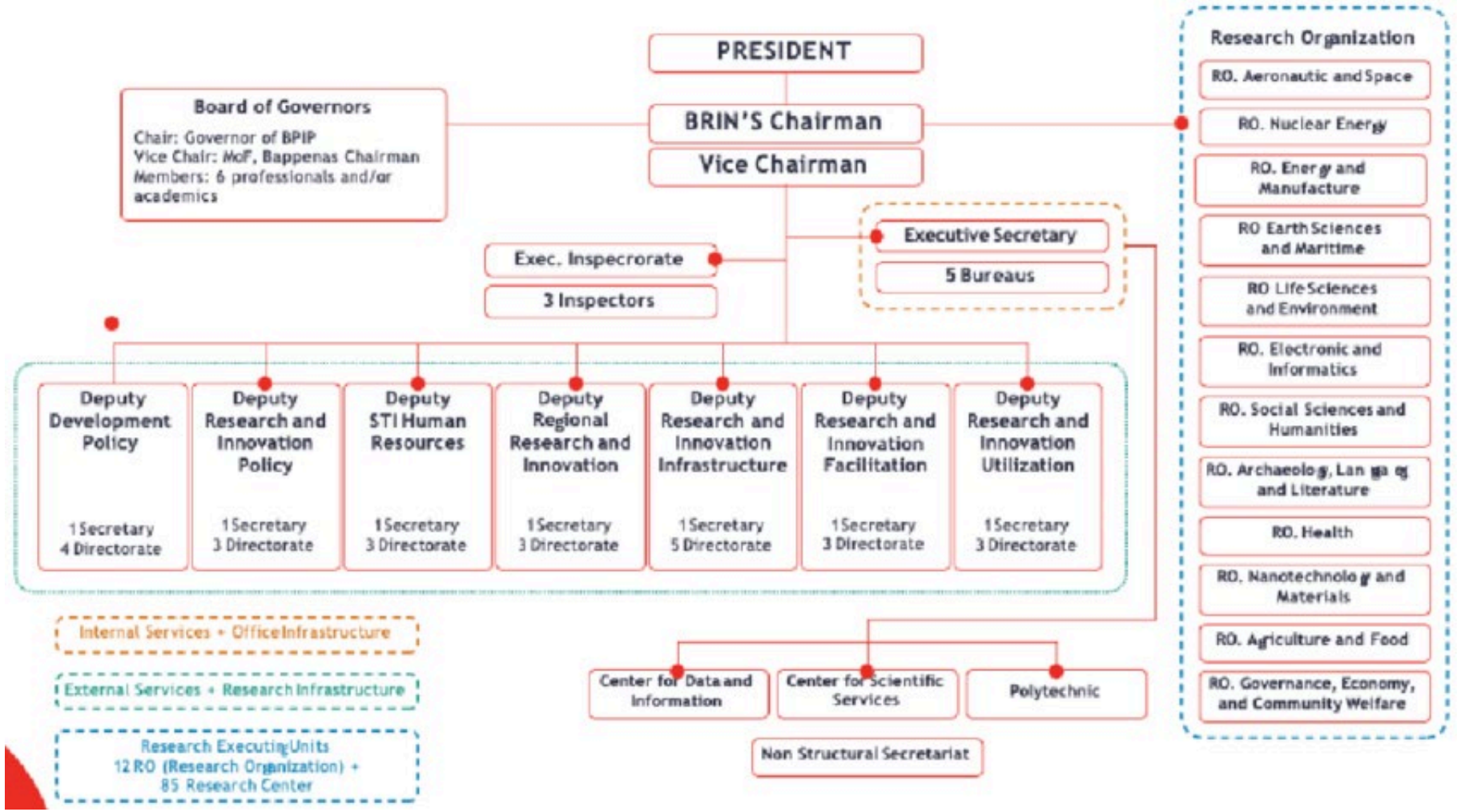
RSG-GAS Reactor Introduction



BRIN Organization Structure



Directorate of Nuclear Facility Management


PRESIDENT
Board of Governors
Chair: Governor of BPIP
Vice Chair: MoF, Bappenas Chairman
Members: 6 professionals and/or academics
BRIN'S Chairman
Vice Chairman
Exec. Inspecrorate
3 Inspectors
Executive Secretary
5 Bureaus
Deputy Development Policy
1 Secretary
4 Directorate
Deputy Research and Innovation Policy
1 Secretary
3 Directorate
Deputy STI Human Resources
1 Secretary
3 Directorate
Deputy Regional Research and Innovation
1 Secretary
3 Directorate
Deputy Research and Innovation Infrastructure
1 Secretary
5 Directorate
Deputy Research and Innovation Facilitation
1 Secretary
3 Directorate
Deputy Research and Innovation Utilization
1 Secretary
3 Directorate
Internal Services + Office Infrastructure
External Services + Research Infrastructure
Research Executing Units
12 RO (Research Organization) +
85 Research Center
Center for Data and Information
Center for Scientific Services
Polytechnic
Non Structural Secretariat
Research Organization
RO. Aeronautic and Space
RO. Nuclear Energy
RO. Energy and Manufacture
RO Earth Sciences and Maritime
RO Life Sciences and Environment
RO. Electronic and Informatics
RO. Social Sciences and Humanities
RO. Archaeology, Language and Literature
RO. Health
RO. Nanotechnology and Materials
RO. Agriculture and Food
RO. Governance, Economy, and Community Welfare

INTRODUCTION

Initiation of Ageing Management Program Activities

2003
Marcus H. Voth

2004
F. Alcala-Ruiz
DIS-Ciemat
Madrid, Spain

2005
Ageing Management Team

Ageing Management in RSG-GAS Reactor

IAEA Safety Standards Specific Safety Guide No.SSG-10 Ageing Management for Research Reactor

→

Head of National Nuclear Regulatory Agency Regulations No. 5, 2022 About Nuclear Reactor Ageing Management

→

Research Reactor Ageing Management Program

Ageing Management in RSG-GAS Reactor

Head of National Nuclear Regulatory Agency Regulations No. 8 , 2008 About Nuclear Reactor Ageing Management

Head of National Nuclear Regulatory Agency Regulations No. 5, 2022 About Nuclear Reactor Ageing Management

Change of Interpretation of Critical SSC in Research Reactor

Ageing Management in RSG-GAS Reactor

Critical SSC Interpretation on Head of BAPETEN Regulation No.8, 2008

1. Reactor Pool
2. Reactor Core Components
3. Primary Pumps
4. Reactor Building Structures

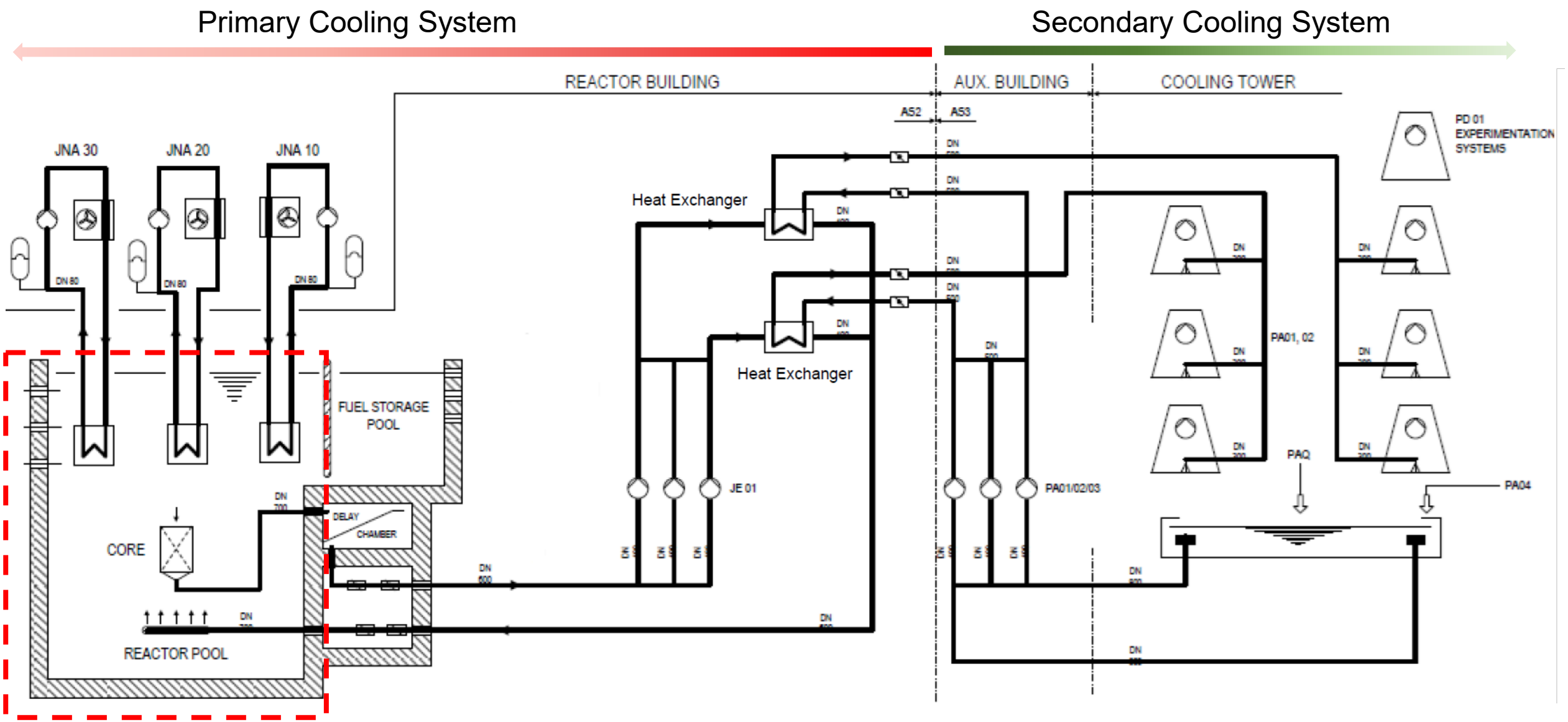
Graded Approach Method

SSG-22

Critical SSC Interpretation on Head of BAPETEN Regulation No.5, 2022

1. Reactor Pool
2. Reactor Core Components

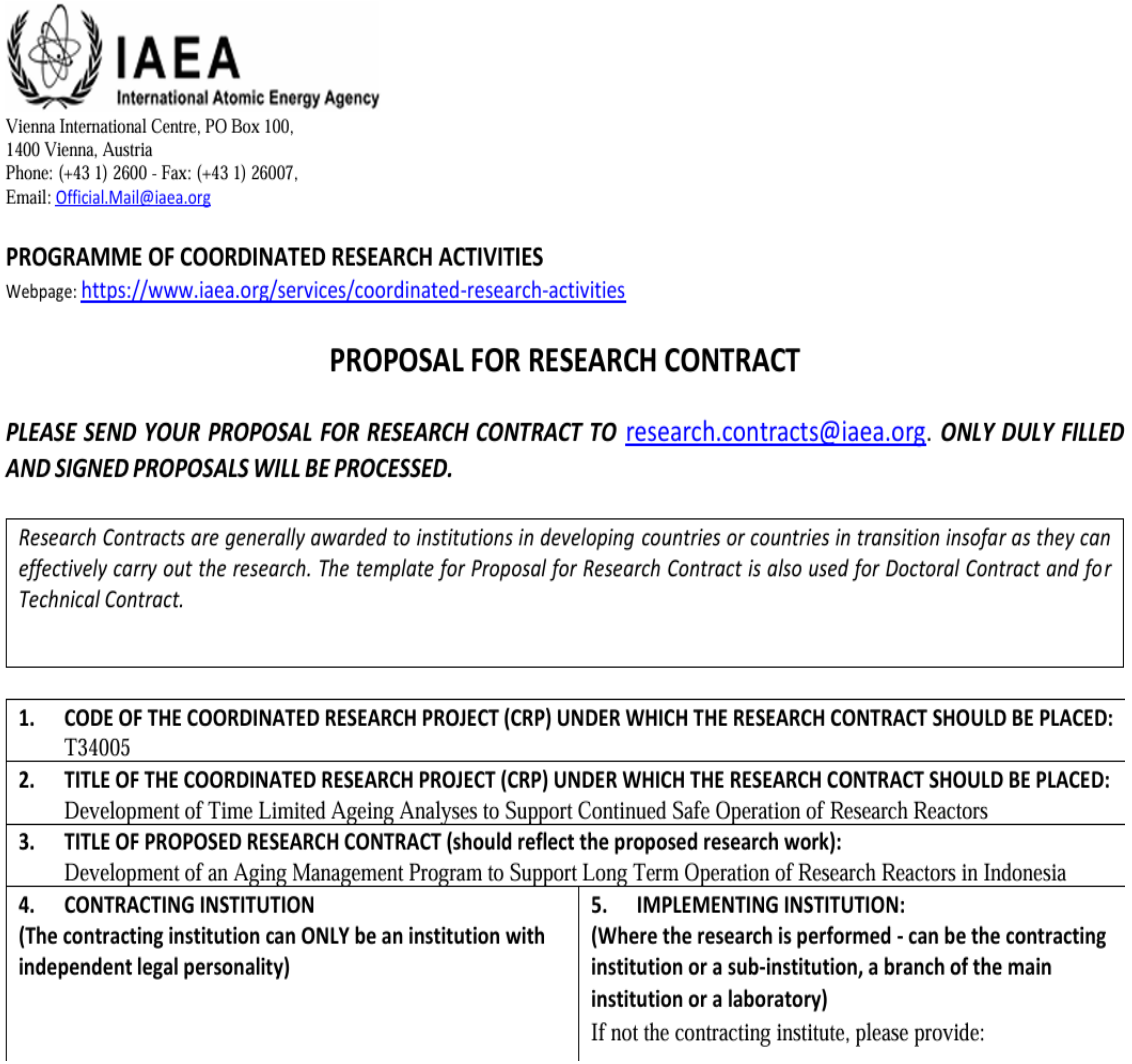
Critical SSCs



Time Limited Ageing Analysis

As a requirement from Indonesia nuclear regulatory body which requested analysis of life-time remaining for Critical SSCs in RSG-GAS, Our Agency is conducting Time limited ageing Analysis in collaboration with IAEA Coordinated Research Project

Document of Reference : IAEA SSG-48



IAEA
International Atomic Energy Agency

Vienna International Centre, PO Box 100,
1400 Vienna, Austria
Phone: (+43 1) 2600 - Fax: (+43 1) 26007,
Email: Official.Mail@iaea.org

PROGRAMME OF COORDINATED RESEARCH ACTIVITIES
Webpage: https://www.iaea.org/services/coordinated-research-activities

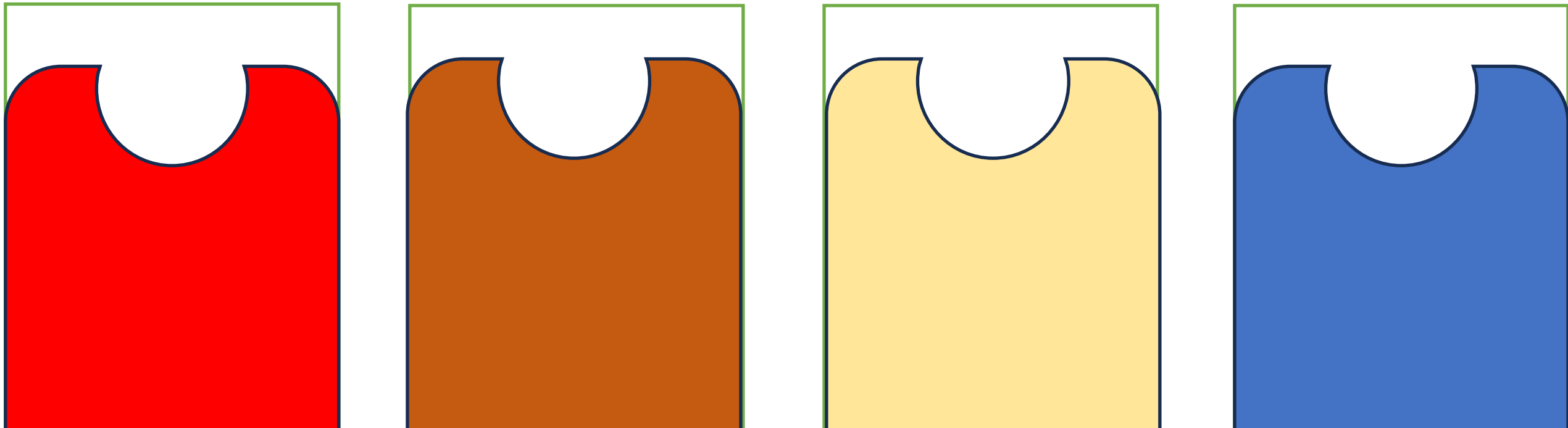
PROPOSAL FOR RESEARCH CONTRACT

PLEASE SEND YOUR PROPOSAL FOR RESEARCH CONTRACT TO research.contracts@iaea.org. ***ONLY DULY FILLED AND SIGNED PROPOSALS WILL BE PROCESSED.***

Research Contracts are generally awarded to institutions in developing countries or countries in transition insofar as they can effectively carry out the research. The template for Proposal for Research Contract is also used for Doctoral Contract and for Technical Contract.

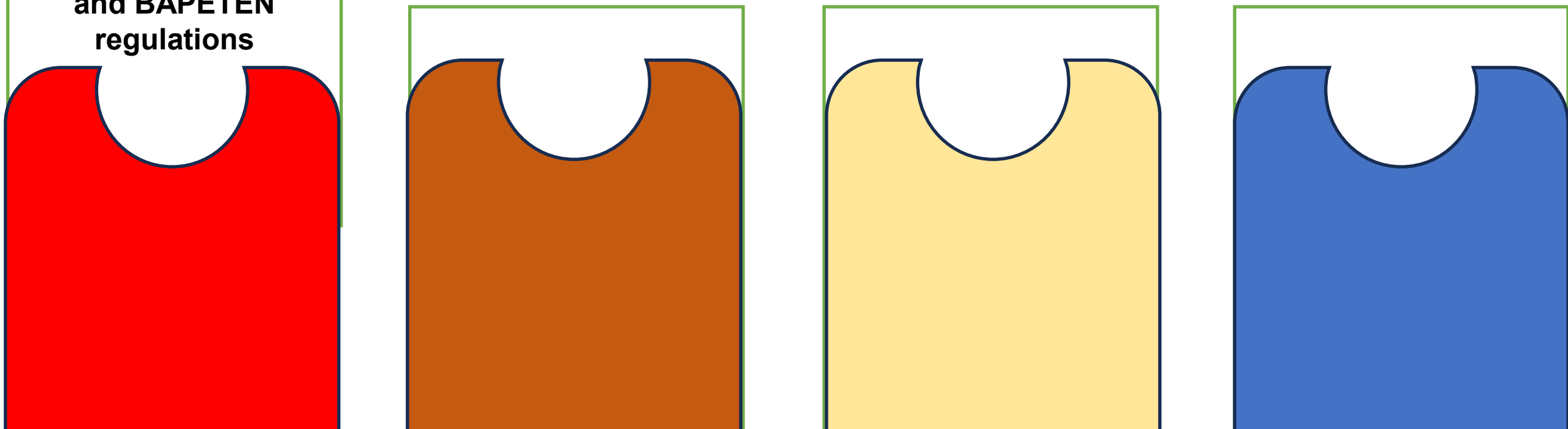
1. CODE OF THE COORDINATED RESEARCH PROJECT (CRP) UNDER WHICH THE RESEARCH CONTRACT SHOULD BE PLACED: T34005	
2. TITLE OF THE COORDINATED RESEARCH PROJECT (CRP) UNDER WHICH THE RESEARCH CONTRACT SHOULD BE PLACED: Development of Time Limited Ageing Analyses to Support Continued Safe Operation of Research Reactors	
3. TITLE OF PROPOSED RESEARCH CONTRACT (should reflect the proposed research work): Development of an Aging Management Program to Support Long Term Operation of Research Reactors in Indonesia	
4. CONTRACTING INSTITUTION **(The contracting institution can ONLY be an institution with independent legal personality)**	**5. IMPLEMENTING INSTITUTION:** **(Where the research is performed - can be the contracting institution or a sub-institution, a branch of the main institution or a laboratory)** If not the contracting institute, please provide:

Time Limited Ageing Analysis



Time Limited Ageing Analysis

Determine SSC which are referred as critical components based on IAEA guidance and BAPETEN regulations



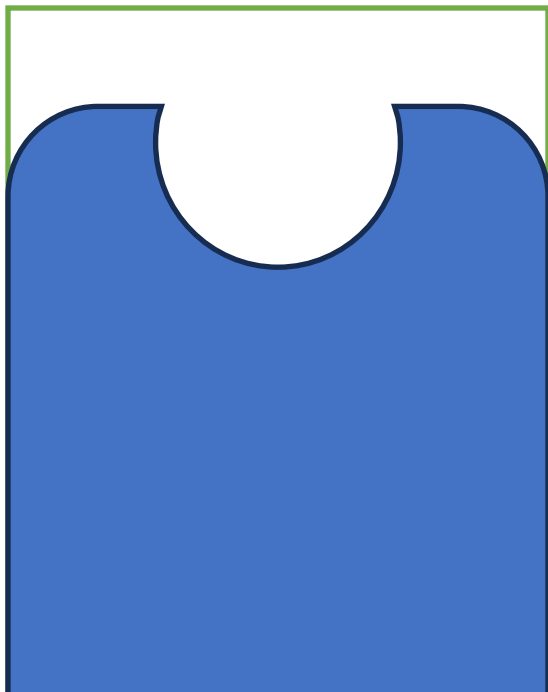
Time Limited Ageing Analysis

Time Limited Ageing Analysis

Determine SSC which are referred as critical components based on IAEA guidance and BAPETEN regulations

Compiling Data Related To Critical SSCs From Desain, Commisioning, operation and maintenance up until now

Conduct Testing and simulation analysis to critical SSC based on Degradation Factor that occurred in RSG-GAS Reactor.



Time Limited Ageing Analysis

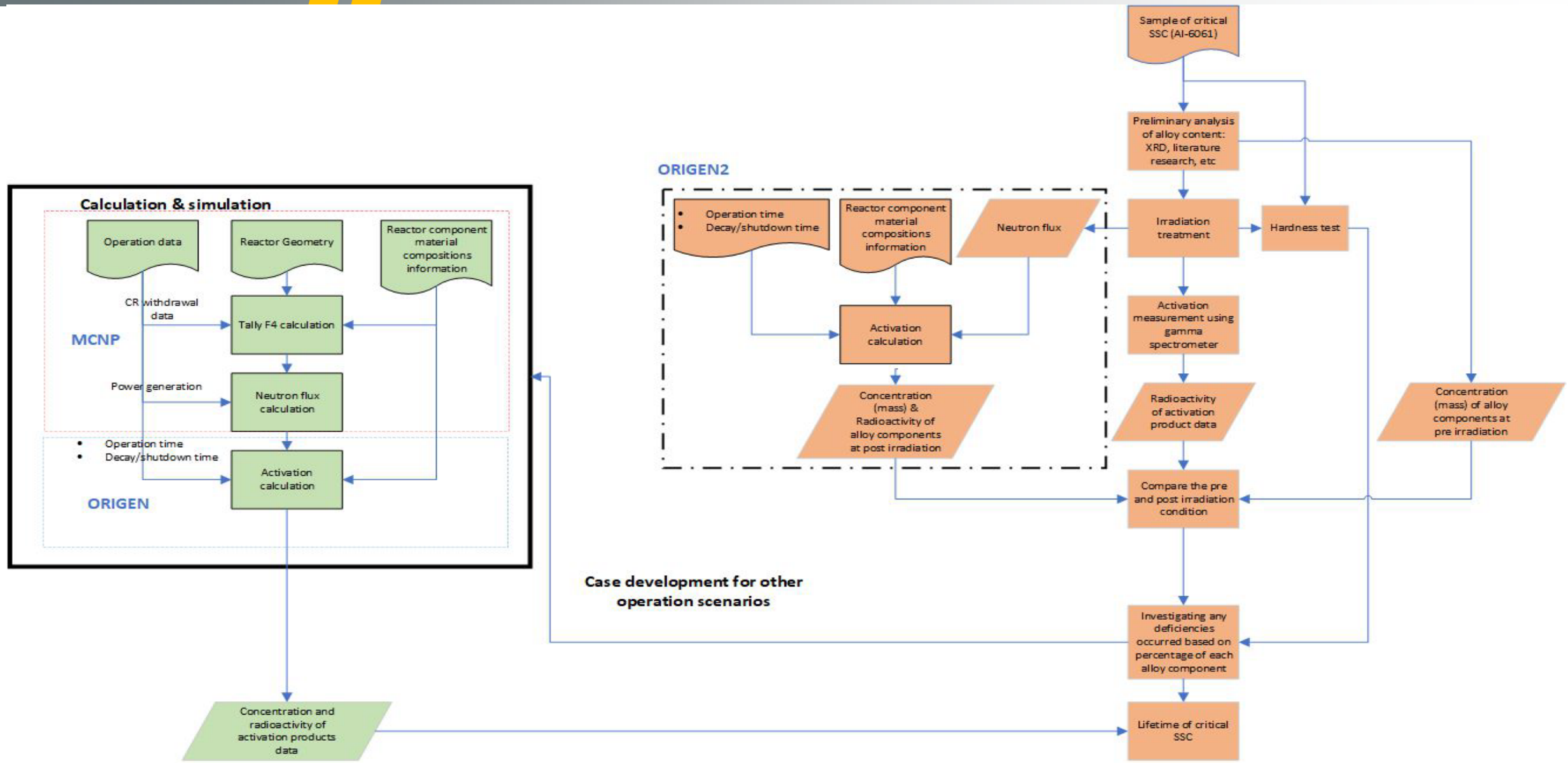
Determine SSC which are referred as critical components based on IAEA guidance and BAPETEN regulations

Compiling Data Related To Critical SSCs From Desain, Commisioning, operation and maintenance up until now

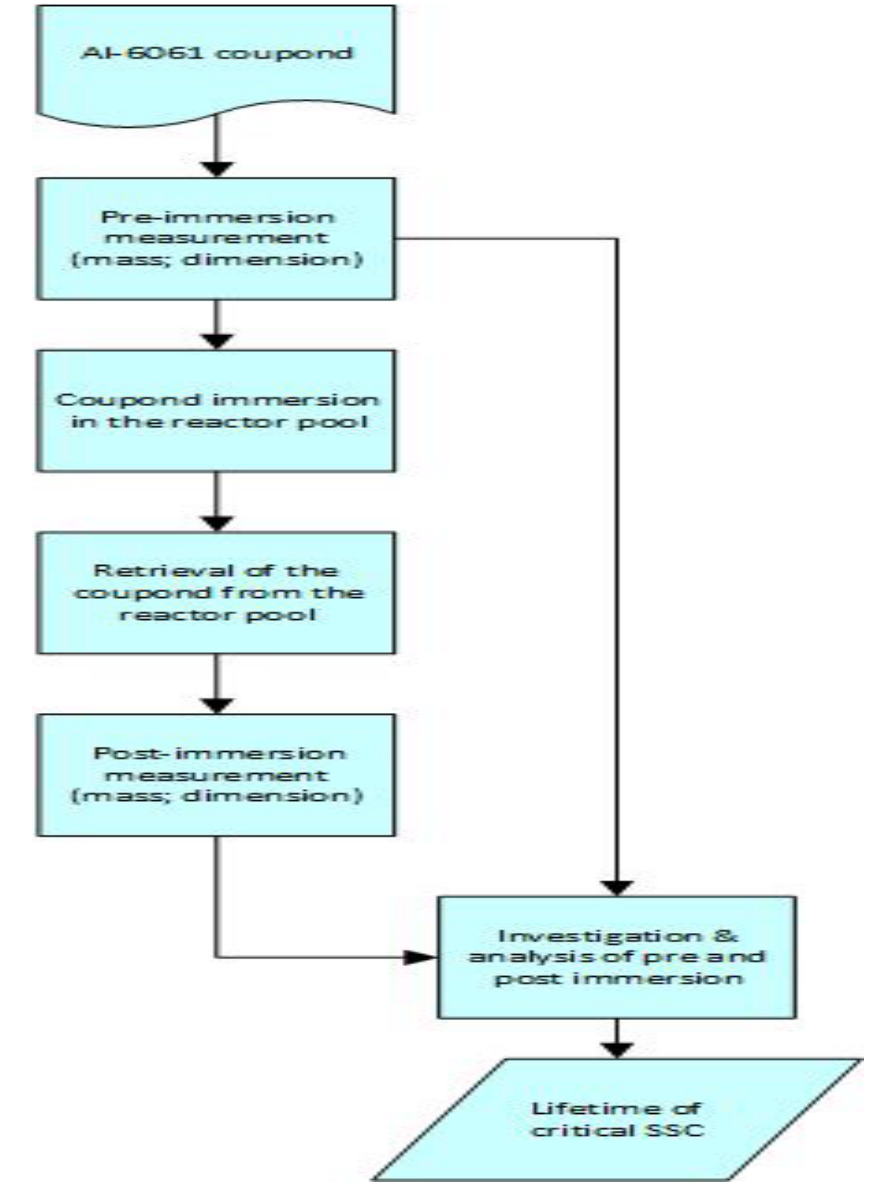
Conduct Testing and simulation analysis to critical SSC based on Degradation Factor that occurred in RSG-GAS Reactor.

Determine Remaining Life-time of SSCs based on calculation and simulation in order to prevent accident on SSCs

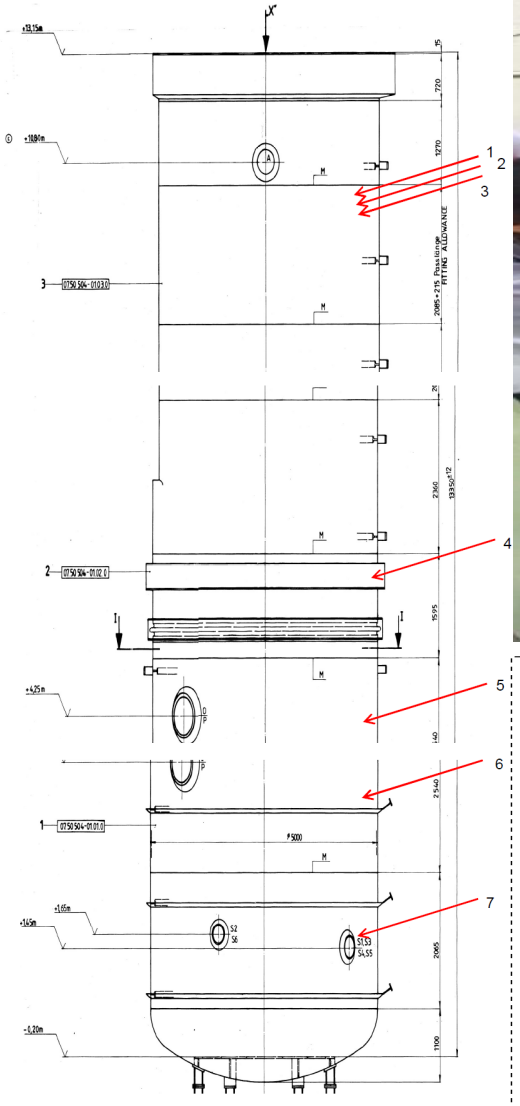
Neutron Embrittlement Based TLAA Method for RR

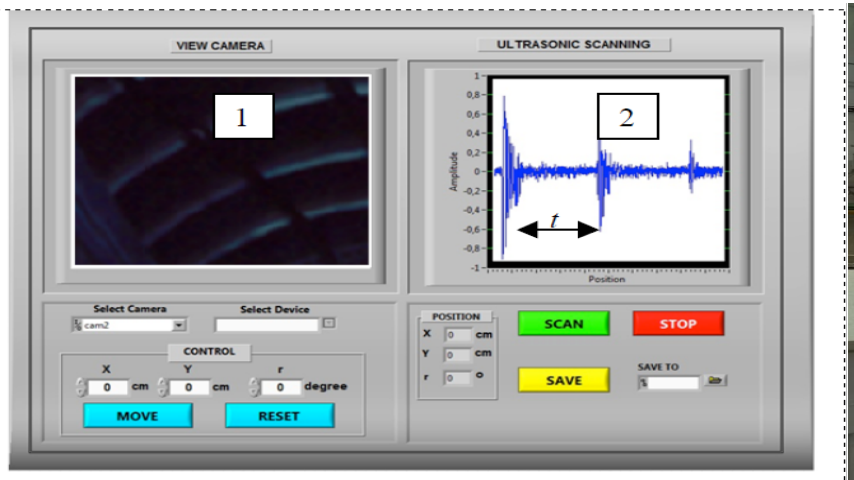


Corrosion Rate-Based TLAA Method for RR



NDT and ISI for Reactor Pool (UT Method)





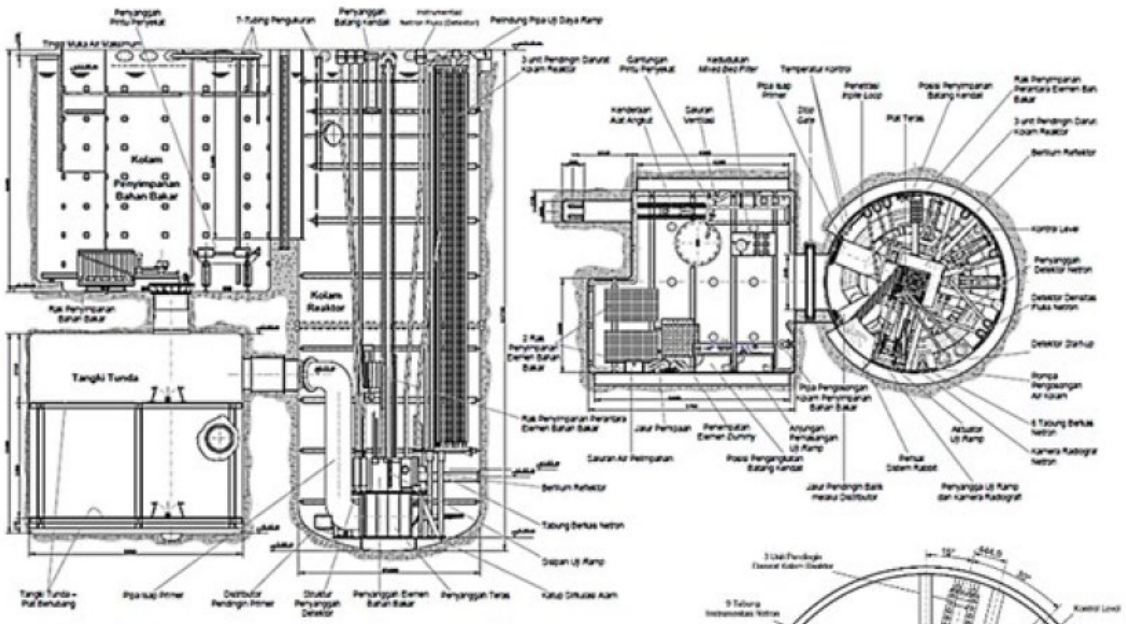
HMI Ultrasonic Scanner Design

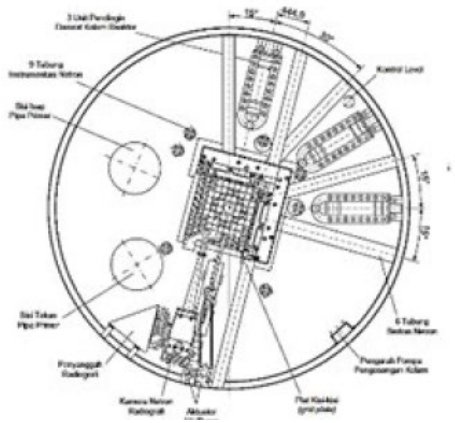
Ultrasonic Testing Results

Level (m)	RSG-GAS Wall Thickness 2013	RSG-GAS Wall Thickness 2019(mm)	RSG-GAS Reactor Wall Thickness 2023 (mm)	RSG-GAS Reactor Wall Thickness 2024 (mm)
1	10.44	10.63	10.52	10.52
2	10.45	10.21	10.23	10.23
3	10.22	10.21	10.23	10.14
4	10.15	10,63	10,14	10,14
5	10.36	10,21	10,37	10,23
6	10.43	10.63	10.37	10.37
7	10.15	10,13	10,14	10,23

NDT and ISI for Reactor Pool (VT Method)

Visual Inspection have been conducted 9 times, the latest one in 2023 through IAEA expert mission





DIAKONT

Proton 3.0 Camera

SOLUTIONS:
General Operation, Visual Inspection

- $5.5x10^5$ Rads radiation tolerance
- Full HD (1080p)
- 10x Optical zoom
- Laser measuring system
- Robust pan & tilt drive
- Portable configuration

Inspection & Monitoring Applications

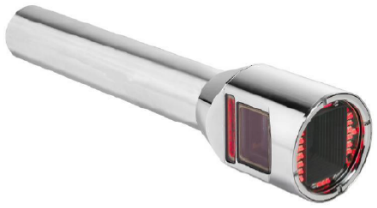
The Diakont Proton 3.0 camera system is the next evolution in refueling and decommissioning support camera systems. Simply deploy and instantly have high-resolution video to support your operations.

With its powerful 10x zoom, state-of-the-art CMOS full HD color sensor, laser measuring device, pan & tilt unit, and powerful LEDs: it is an extremely useful tool for use in the refueling cavity, reactor vessel, or elsewhere in high radiation fields.

DIAKONT

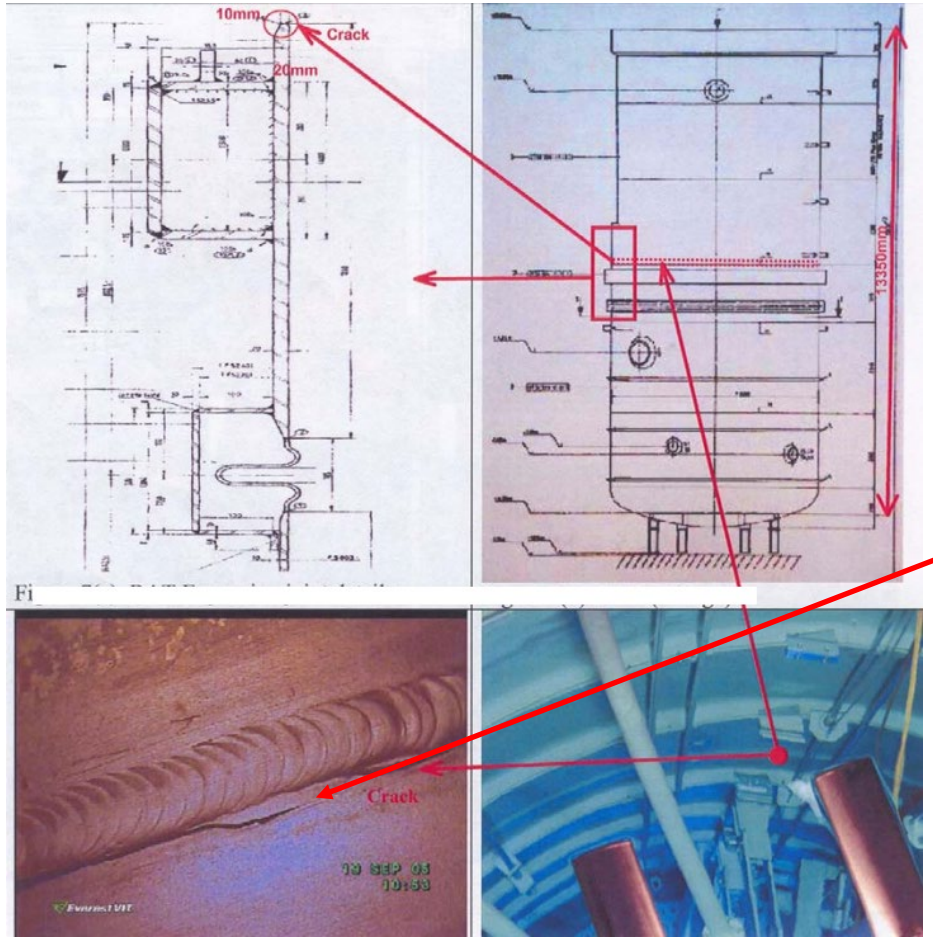
D40 DUAL AXIAL AND RADIAL HEAD

- Compact 2.56" viewing head diameter form factor
- Adjustable LED frontal/radial lights (brightness)
- Compatible with existing D40 camera systems
- Switch between frontal and radial viewing without having to change the viewing head attachment

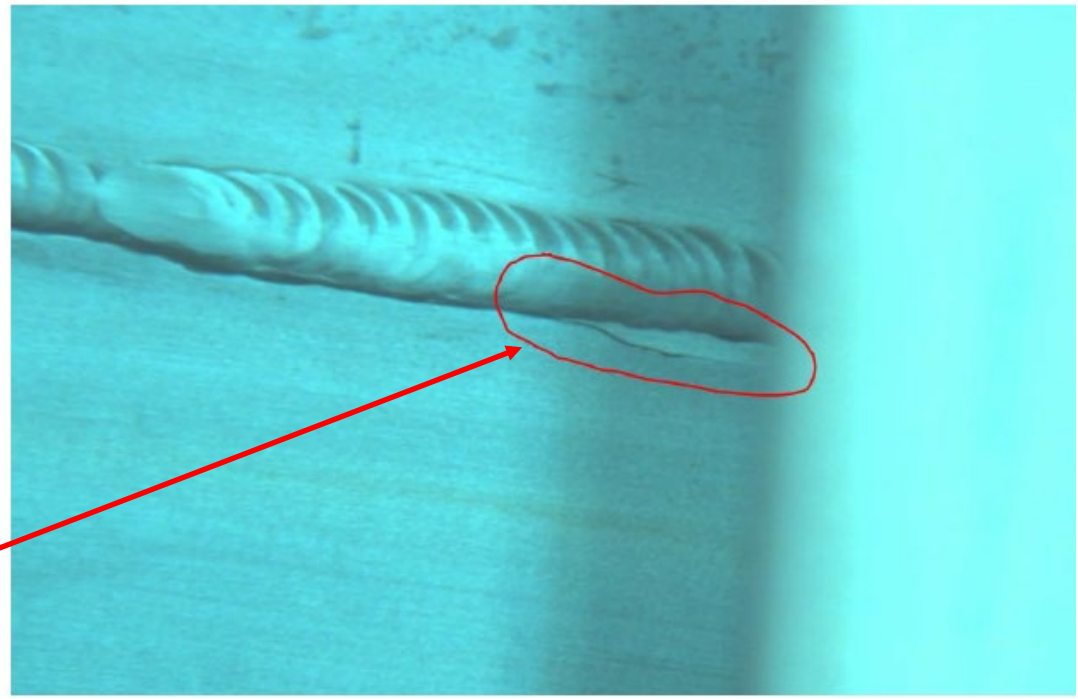


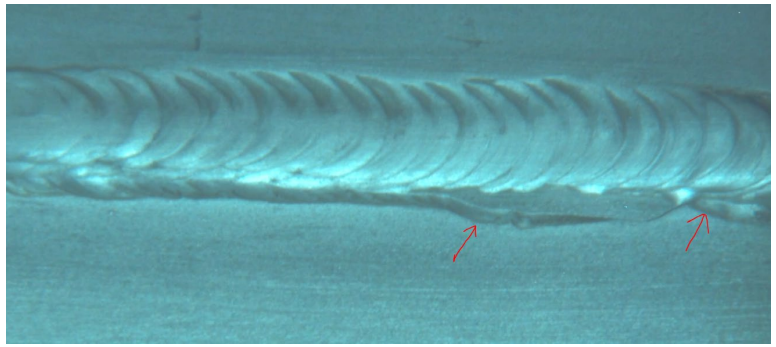
NDT and ISI for Reactor Pool (VT Method)

Previous result (2005)



Current result (2023)

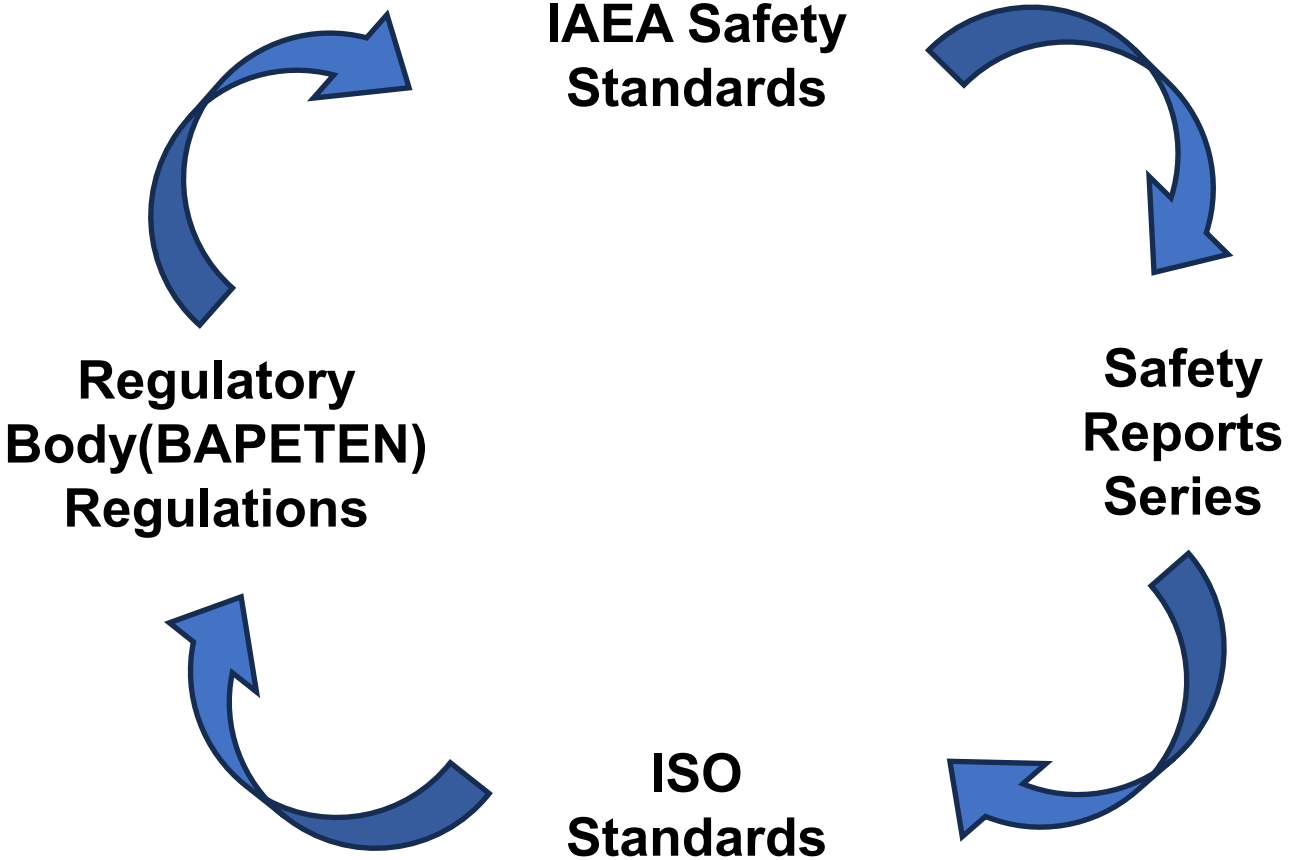


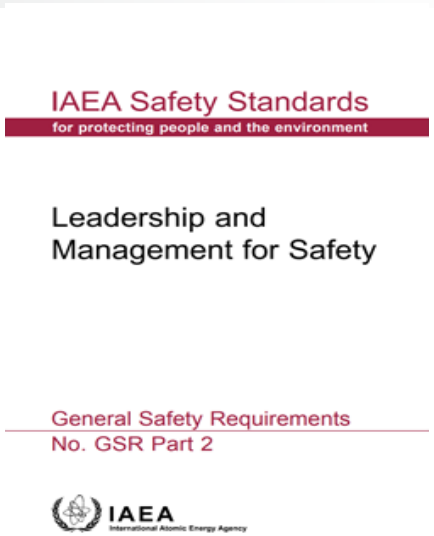


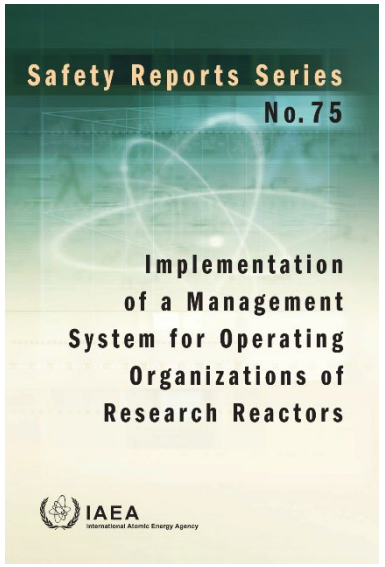
Time Table of Non DestructiveTesting on RSG-GAS SSCs

Component/ Structure	NDT Techniques	2014		2015	2017	2018		2019		2020		2021	2022	2023	2024	
		Q2	Q3	Q3	Q4	Q2	Q4	Q3	Q4	Q3	Q4	Q4	Q4	Q4	Q1	Q3
Tank Liner	Visual Testing	V			V		V		V		V	V	V	V		
	Ultrasonic Testing Thickness				V		V					V	V			
Primary Pipes	UT welding		V													
	UT thickness		V	V				V								V
Heat Exchanger	Eddy Current			V				V		V						
Core Structure	Visual Testing				V		V		V		V	V	V	V		
Concrete Structure	Ultrasonic Testing Velocity							V							V	
Primary Pumps	Acoustic Emission					V										

Integrated Management Systems







TLAA in Integrated Management System

- The implementation of TLAA in ageing management program results in more comprehensive system maintenance activities.
- Maintenance activities become more scheduled and can reduce repair activities by increasing preventive maintenance before serious damage occurs to the system.
- Maintenance management becomes more focused with scheduled maintenance activities and is focused on critical SSCs and SSCs related to safety.
- Management coordination from superiors to workers is better conveyed with targeted actions and spare parts based on TLAA analysis.
- Increased safety in maintenance activities by conducting risk assessments on critical SSCs and the impact of damage caused by failure of these systems.

Current Status of IMS in RSG-GAS

- Maintenance still using outdated Repair Manual which not include analysis for critical SSCs
- Communication for Maintenance activities is using bottom-up communication
- Database is outdated and missing many data including design and commissioning which is still in physical document form and not been digitized
- Maintenance activities is not focused on preventive maintenance

Future plans for IMS updates in RSG-GAS Reactor

1. Creating Database which contains all documents related to reactor design, commissioning, operation and maintenance
2. Creating online monitoring system for parameters related to aging management on critical SSCs
3. Using software which can predict life-time remaining of components from data obtained by online monitoring equipment
4. Scheduled periodic management and safety audits to determine the effectiveness of the management system based on safety standards
5. Creation of maintenance groups based on analysis of the remaining life of the SSCs so that research can be carried out on modifications that can be made to extend the lifetime or reduce the rate of degradation.

Conclusions

- RSG-GAS reactor currently Operating Normally and the operating license will expire in 2030
- In order to extend the operation permit, TLAA is required by the regulatory body (BAPETEN)
- Collaboration with CRP IAEA is already on going from 2024-2028 regarding TLAA
- Transition from Previous Organization to current organization provided both challenges and Opportunity for nuclear to grow in Indonesia
- TLAA will be the basis to upgrade our Managements system which will streamline our maintenance, communications, safety analysis and review.
- Revitalization of measuring equipment and methods are needed in order to minimize data error and increase accuracy for life-time analysis.

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Thank You For Your Attention