Center for Multipurpose Reactor-BATAN
Serpong, March 11, 2015

Current Status of The RSG-GAS Reactor Operation

Division of Reactor Operation

batan

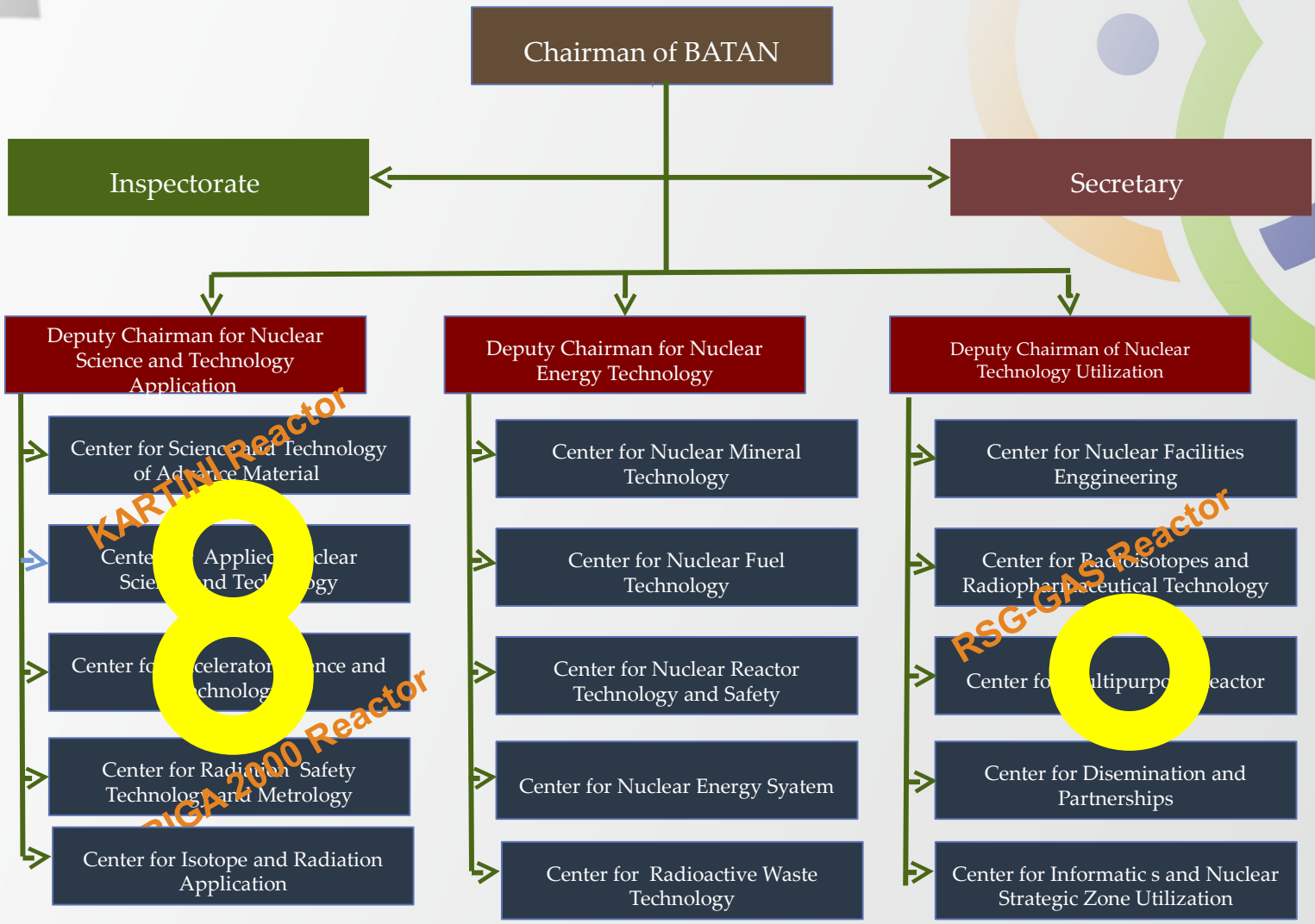
Introduction

- RSG-GAS reactor is one of three RRs operated by BATAN
- RSG-GAS reactor as a multipurpose reactor was designed and built by Interatom GmBH, Germany in 1982
- RSG-GAS reactor is utilized fulfilling the need of research and application on nuclear technology in Indonesia and regional
- Indonesia in cooperation with regional countries and International using the RSG-GAS reactor for workshop and other research purposes.
- BATAN is developing primary service satisfaction for the user and stakeholder throught the utilization of RSG-GAS reactor

BATANs Research Reactor

	TRIGA 2000	KARTINI	RSG-GAS
Operator	PTNBR, Bandung	PTAPB, Yogyakarta	PRSG, Serpong
Power, kW	2000	100	30,000
Reactor Type	TRIGA MARK II	TRIGA MARK II	MPR
Operation	On: 2 Weeks Off: 2 Weeks	On: 5 days/week	On: 45 days/cycle 4 cycles/year
Utilization	RI, NAA, NR, NS	NAA, NR	RI, NAA, NR, NS, PRT, GC
Age, Years	52	37	29

ORGANIZATIONAL STRUCTURE OF BATAN



Organization Structure of Center for Multi Purpose Reactor (Reactor Management)

Complex of Nuclear Area Serpong

- Total extents of BATAN area in Serpong is ±25 Ha
- Around 800 employees are working in BATAN-Serpong

Nuclear Waste Management

RSG-GAS Reactor

Center for Radioisotope Processing

Nuclear Fuel Element Factory

General Workshop

Management of BATAN-Area

Historical Moment of RSG-GAS Reactor

Location	Serpong, West. Of Java
Physical Construction	1982
Commissioning	1985
First Criticality	1987
Silicide Conversion	1995
Ageing Program	2000

Total Employee: 165 Peoples

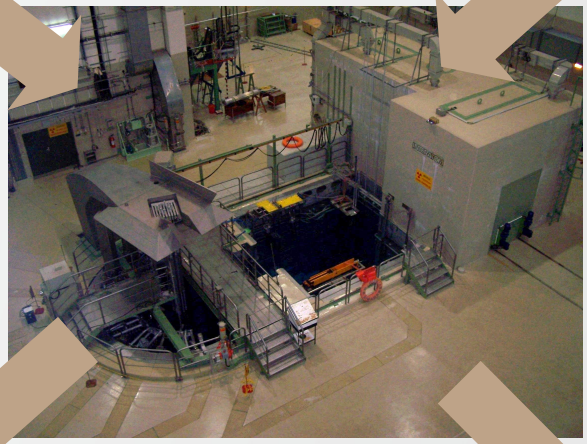
Important qualifications needed:

- Radiation Protection
- Operator
- Maintenance
- Safeguard
- Nuclear Security

The Infrastructures of RSG-GAS Reactor

Nuclear Fuel Element Fabrication

General Workshop

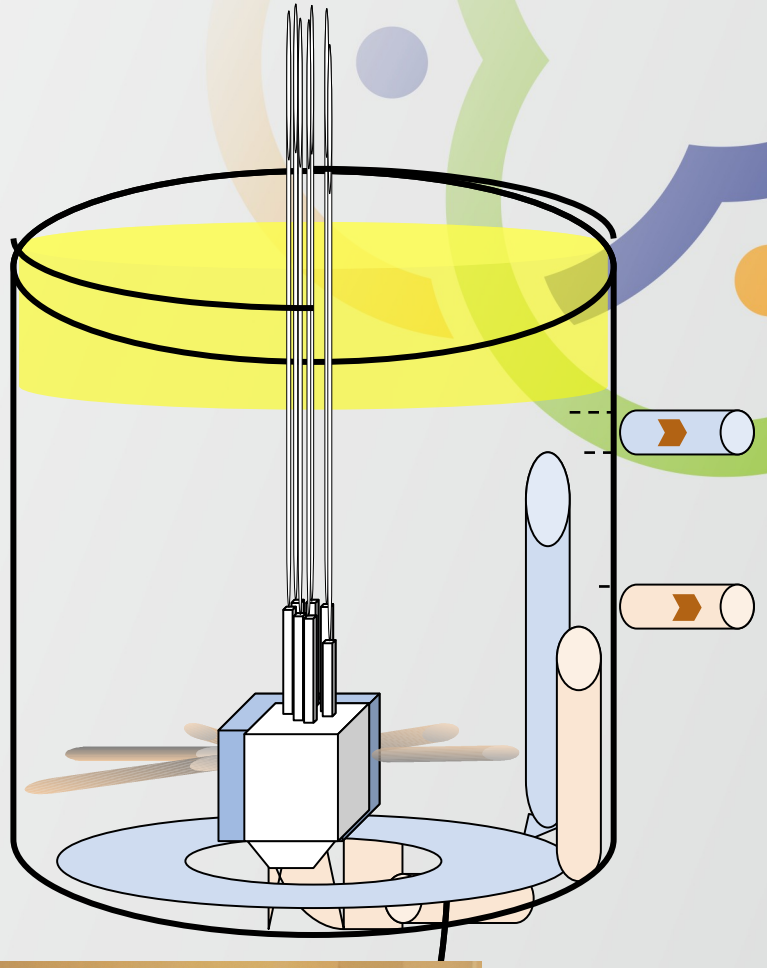


Nuclear Waste Management

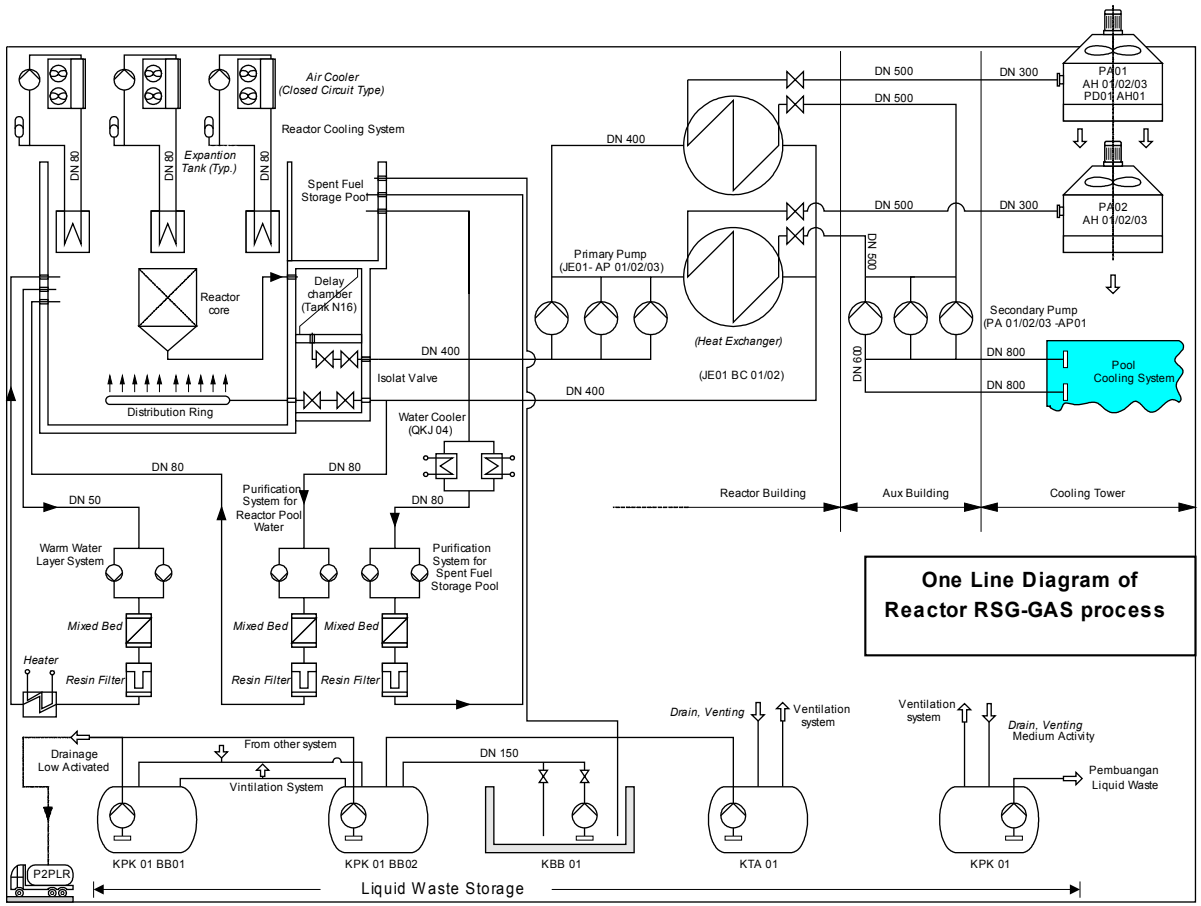
Center for Radioisotope Production

Reactor Specification

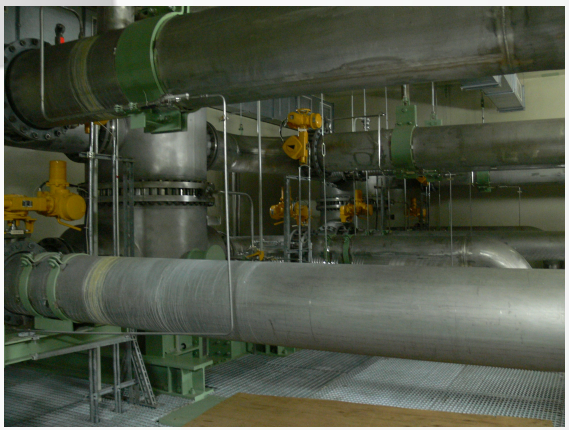
Power	30 MW
Neutron Flux	2.1014 n/cm2.s
Cooling Material	Light Water
Fuel Type	MTR
Fuel Material	U3Si2Al
235U Enrichment	19.75 %
235U Density	2.96 gr/cm3
Absorber	AgIn-Cd
Number of Control Rod	8
Reflector	Beryllium
Number of Neutron Beam	6
Radiation Protection	Warm Water



Reactor System



Primary Cooling System



Primary Cooling Pumps

Heat Exchanger

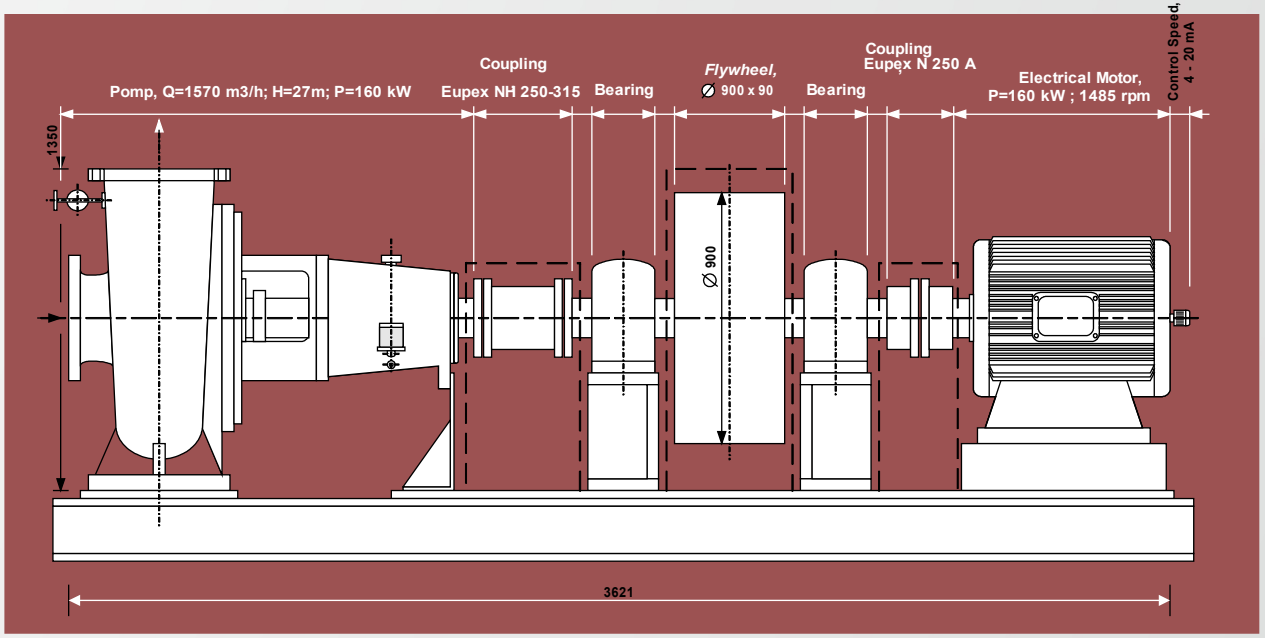
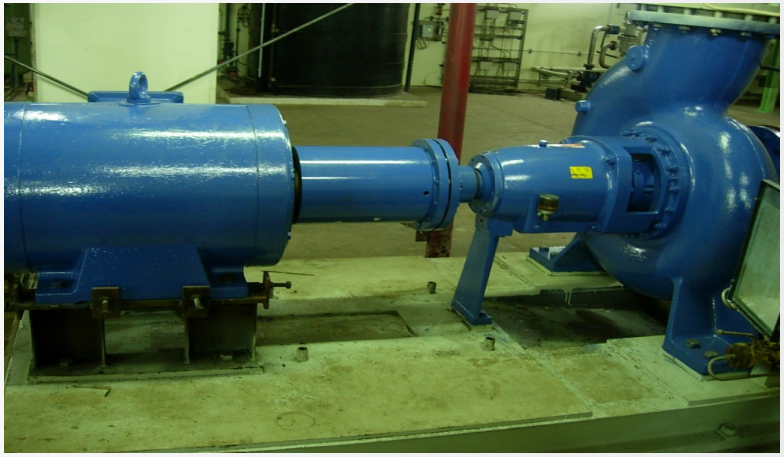


Figure : Primary Cooling Pump

Secondary Cooling System

Cooling Tower

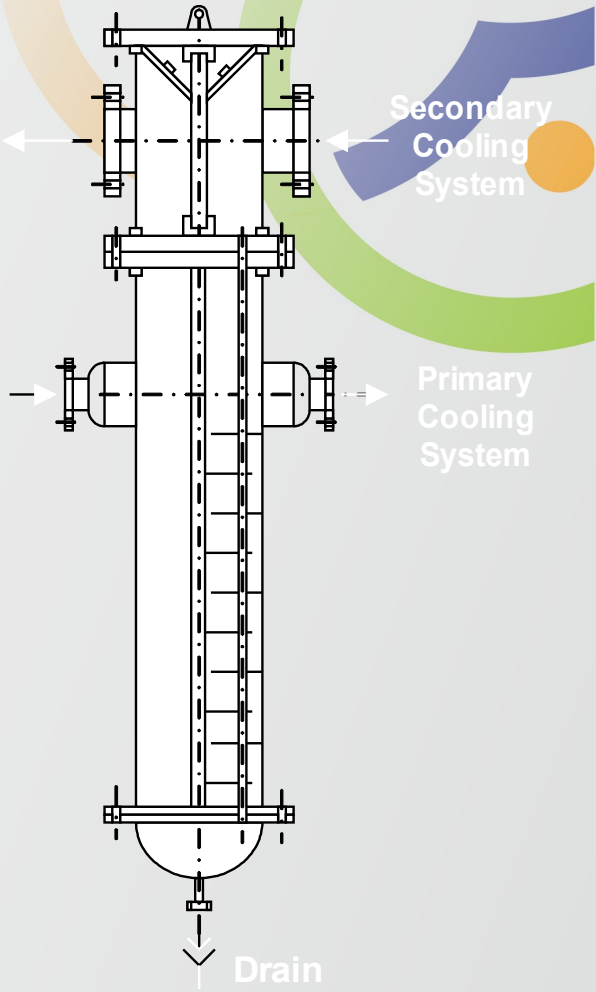
Secondary Piping System



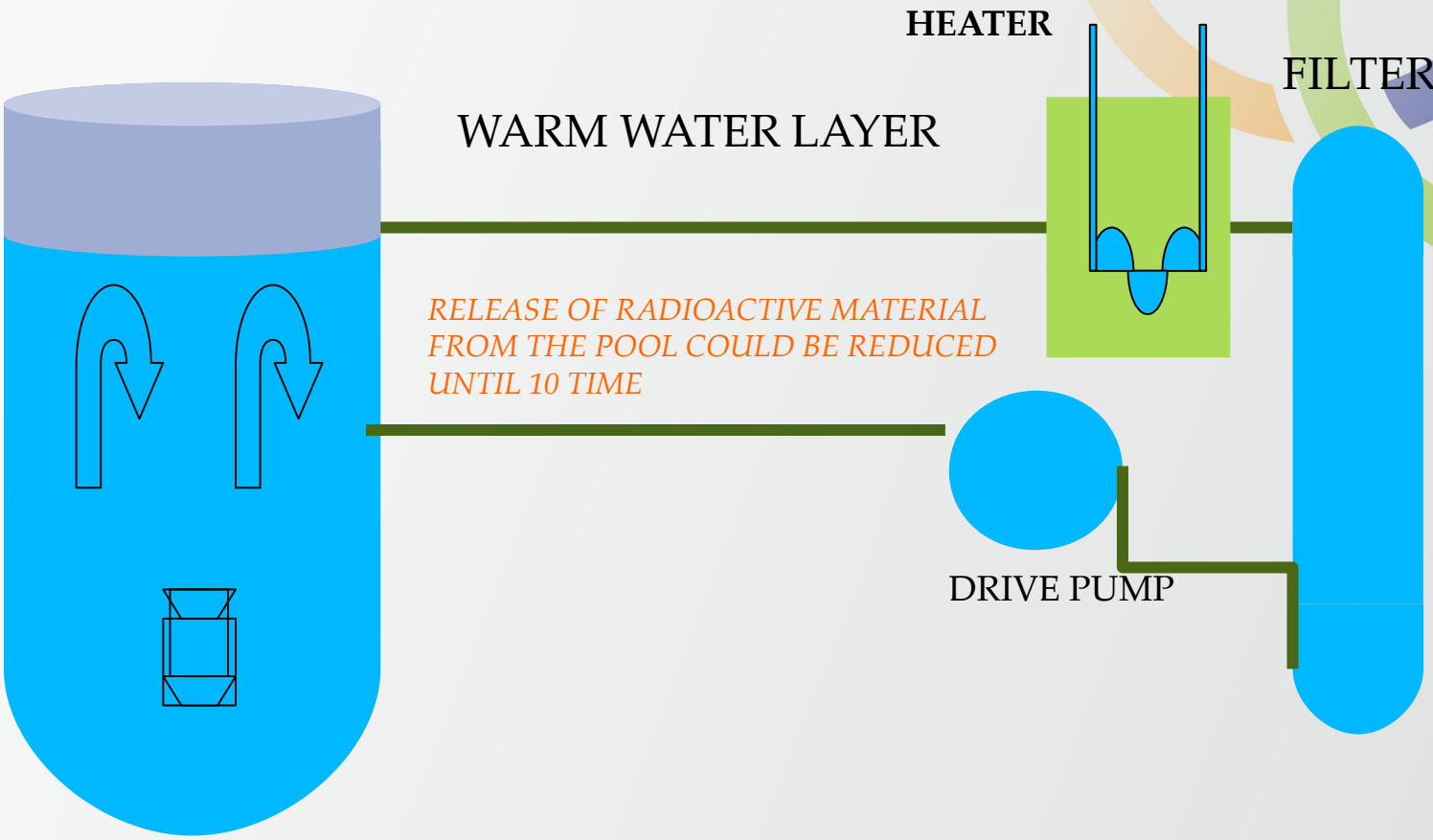
Secondary Cooling Pumps

Heat Exchanger

Type	***Shell and tube***
***shell* diameter**	**1300 mm/ 51,181 inch**
Tube diameter	**22 mm ID, 23 mm OD,0,917 ID,0,906 OD**
Amount of *tube* every phase	**816 tubes**
Tube length	**7410 mm/291,732 inch**
Tube Lay out	***Square***
Contact area	**780 m2/120900,242 inch2**
Flow rate in *shell* site	**430 kg/sec**
Flow rate in *tube* site	**485 kg/sec= (1950-2000) m3/hr, 1067 lb/sec**
Water cooling temperature	**38oC**

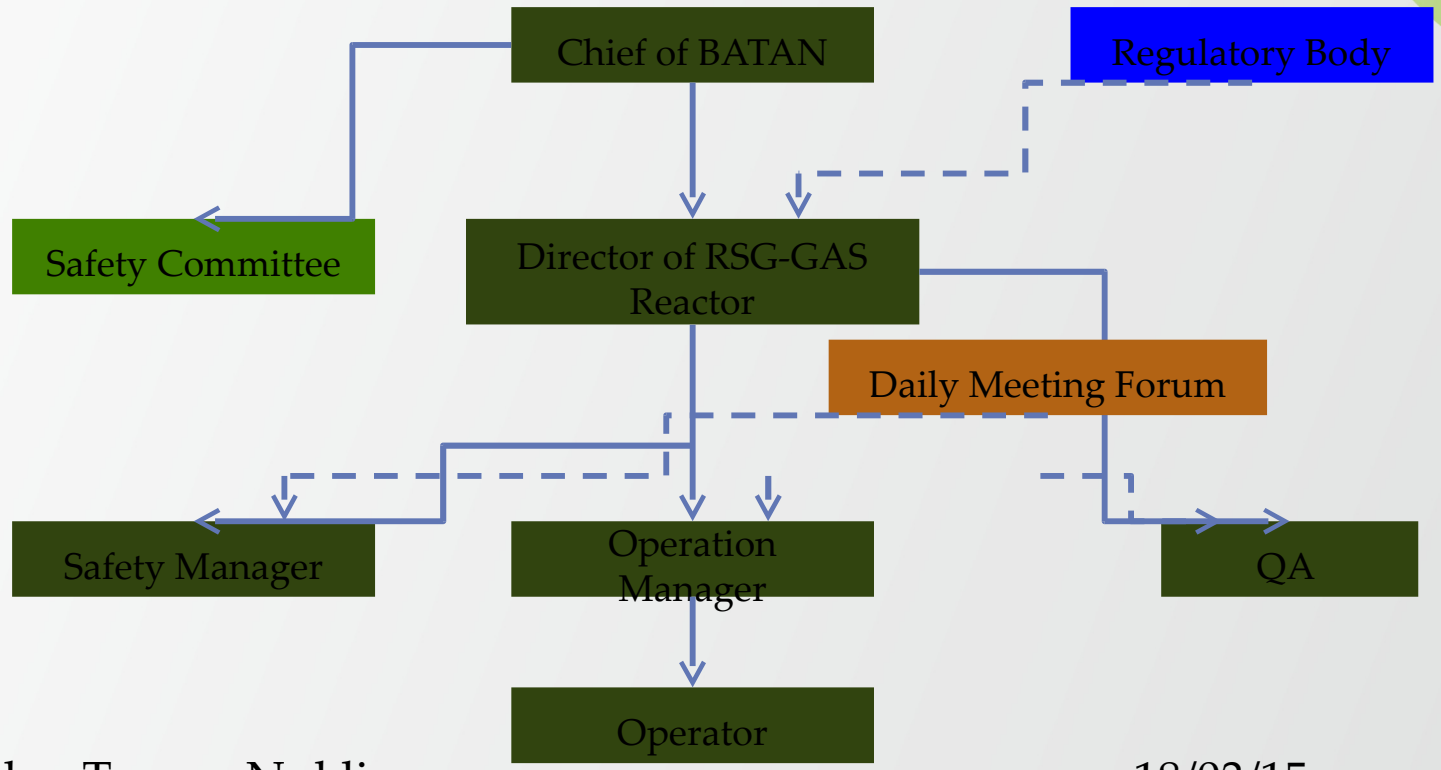


Warm Water Layer



Safety Management

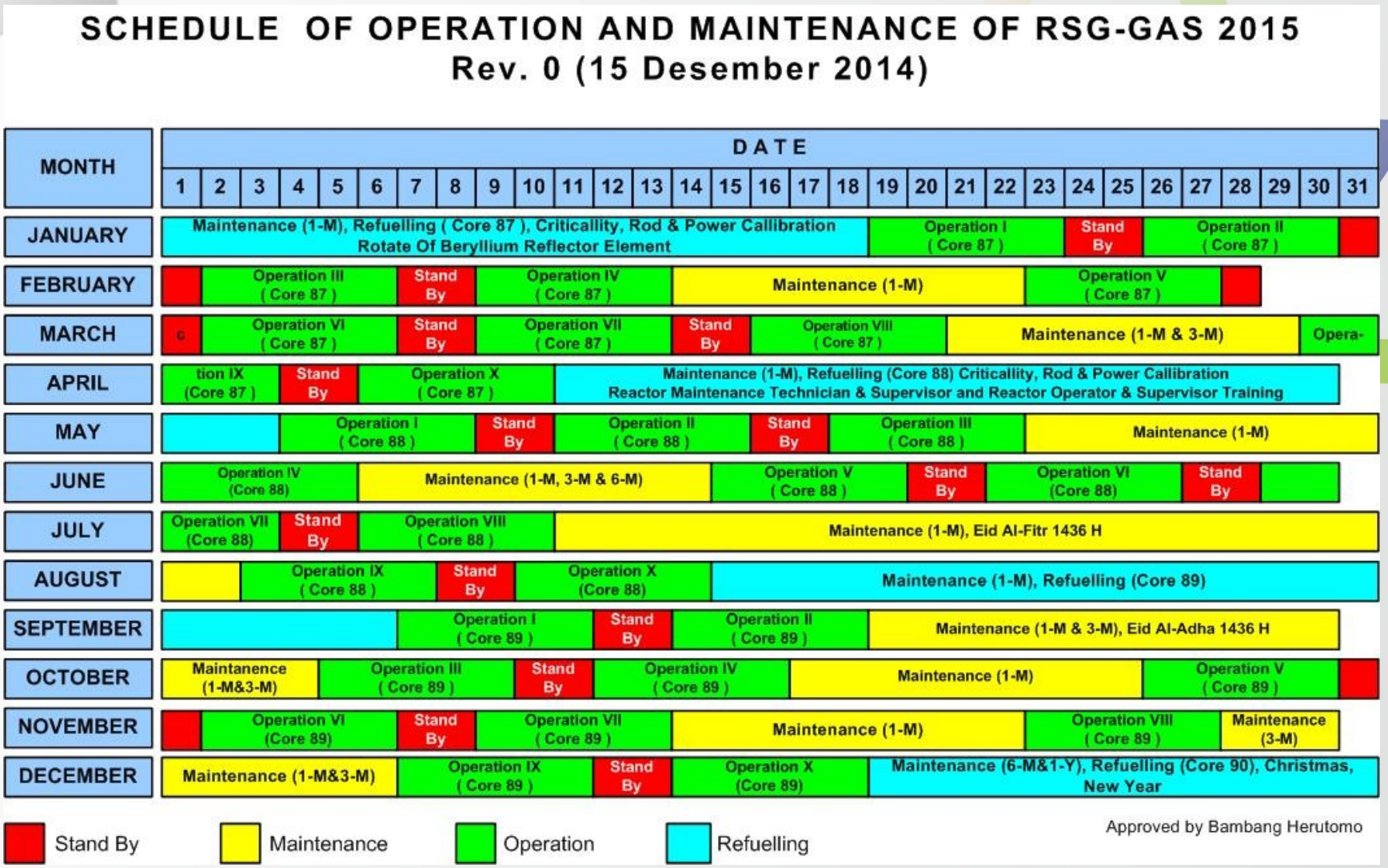
- Is organizational activities to achieve the safe operational, utilization, maintenance, research and development of the research reactor under supporting of the establishment related parties/ Institutions such as regulatory body



Safety Requirement of Reactor Utilization

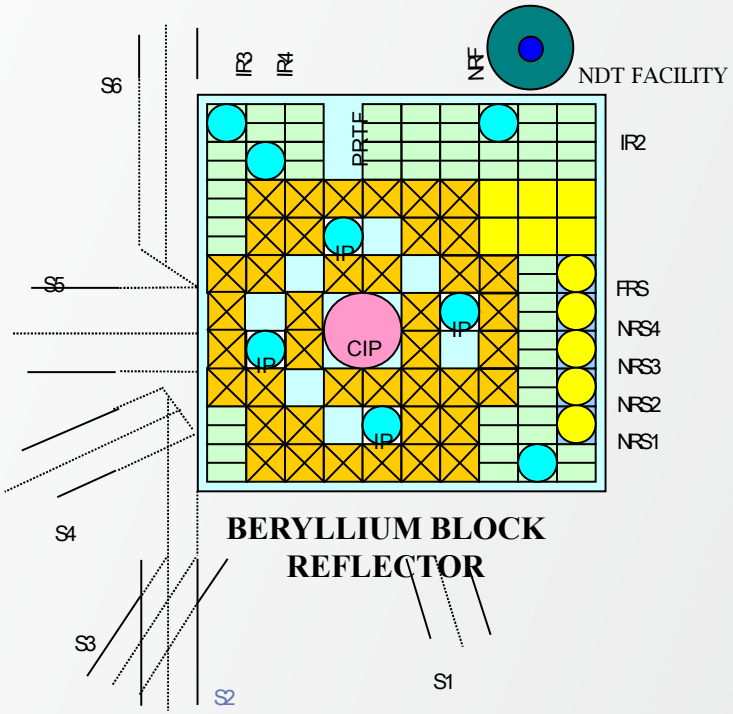
- Safety Analysis Report of irradiation facility
- Standard Operational Procedure of Facility
- Safety Analysis Report of irradiation target
- Standard Operational Procedure of material transport in facility

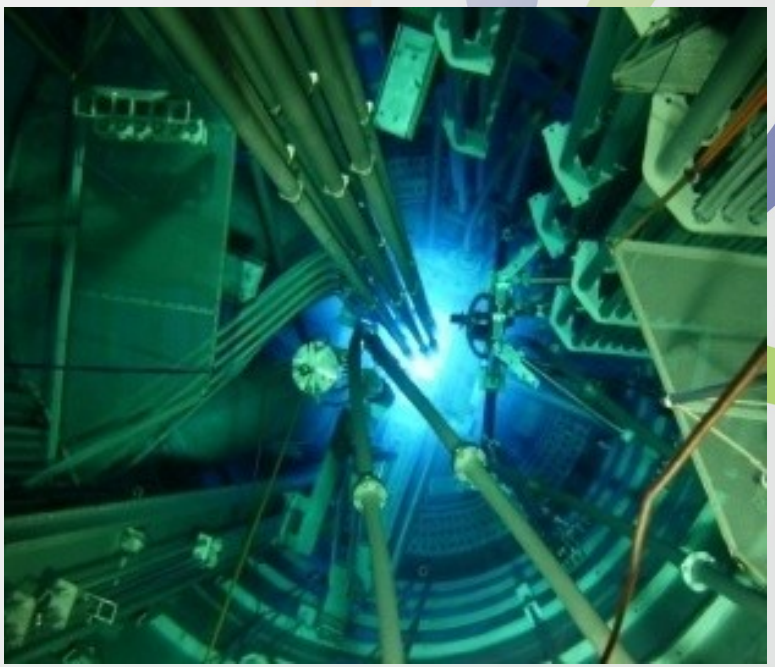
Operation Schedule 2015



Total Operation time in 2015: 150 days

Irradiation Position





Fuel Assembly

Beryllium Reflection Element

IR = Irradiation Position (reflector)

NRS = Normal Rabbit System

S = Beam Tube

NRF = Neutron Radiography Facility (out of core)

PRTF = Power Ramp Test Facility

CIP = Central Irradiation Position

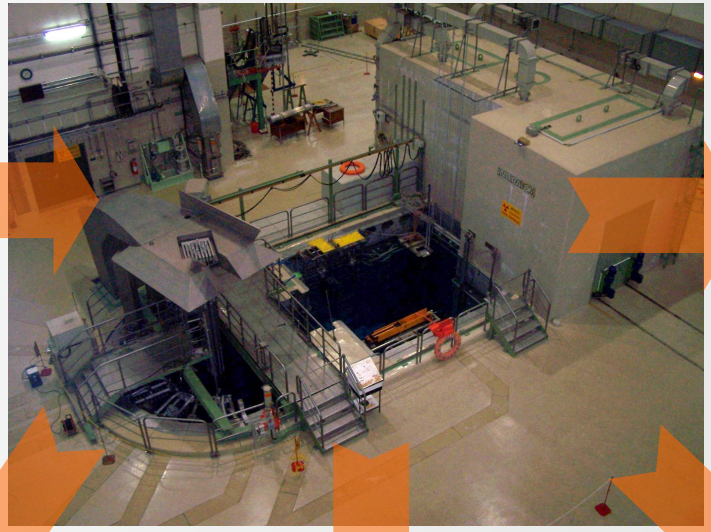
IP = Irradiation Position (core)

FRS = Fast Rabbit System

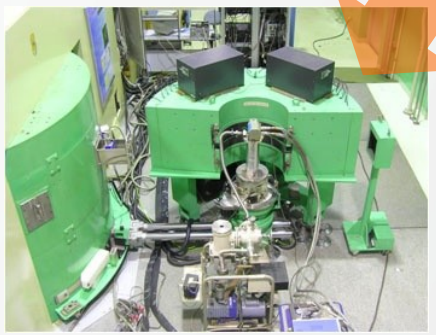
Nasional

Utilizations of RSG-GAS Reactor

RI Production

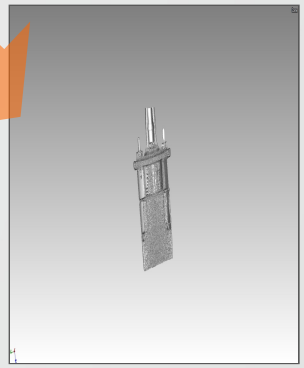


Power Ramp Test



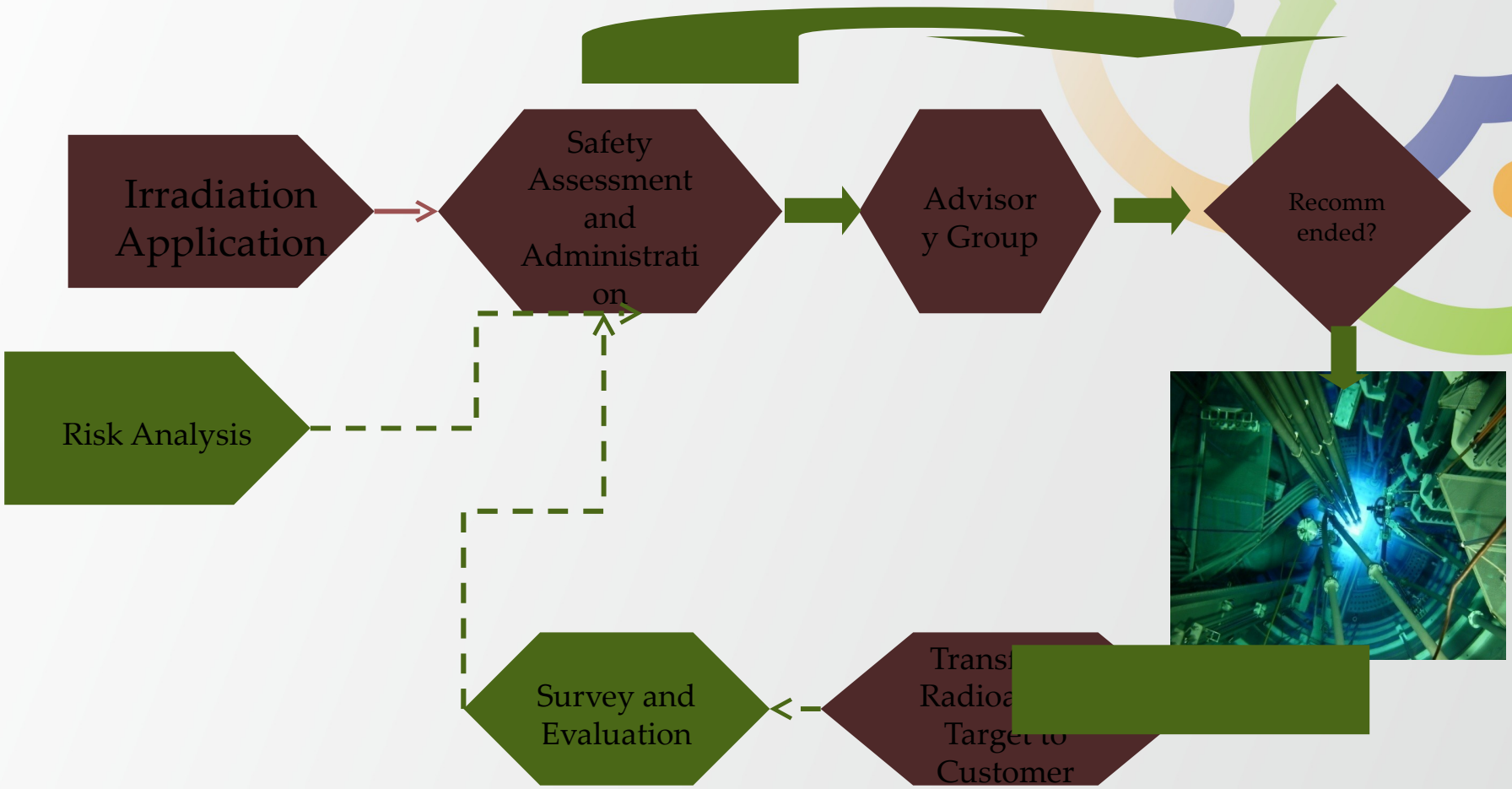
Neutron Spectrometer and Diffractometer

Neutron Activation Analysis

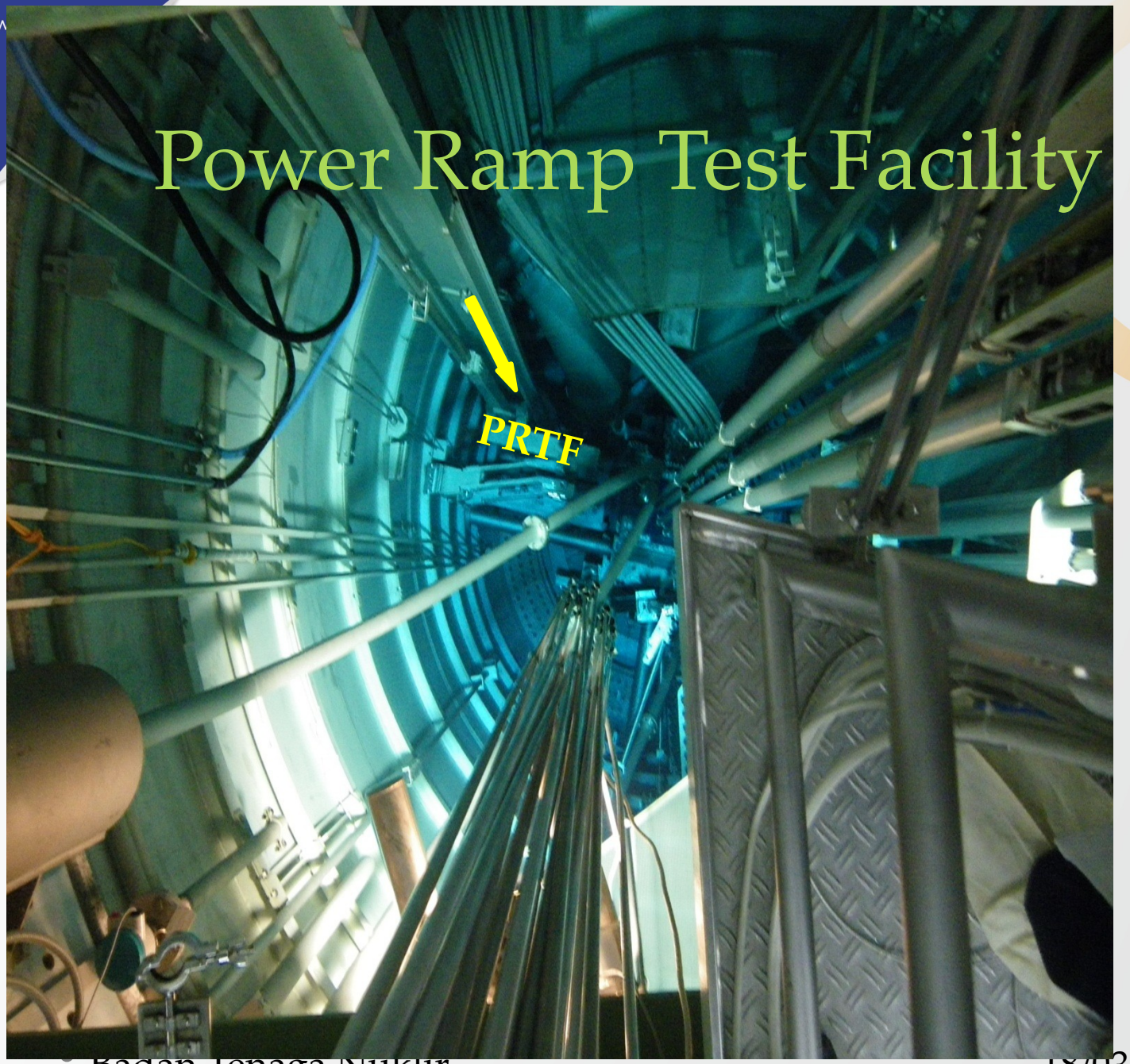


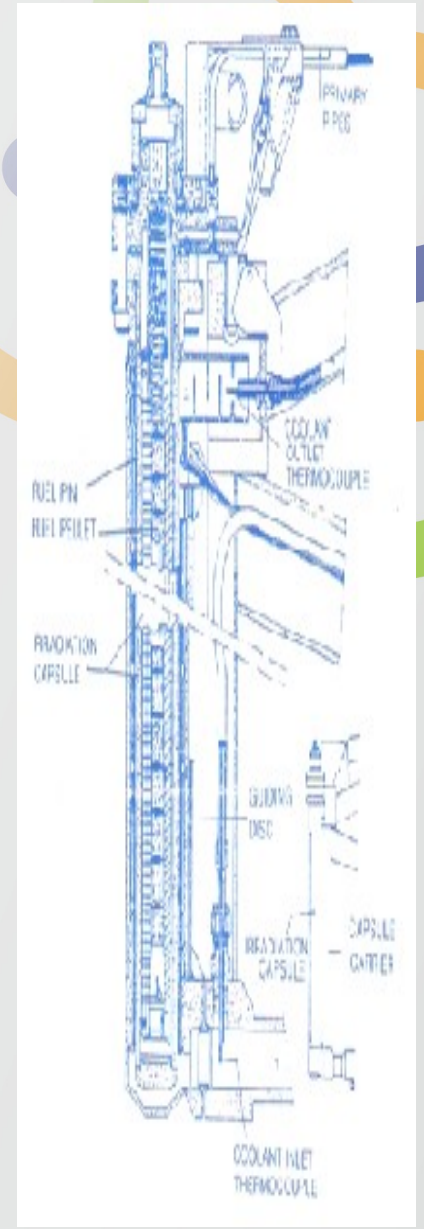
Neutron Radiography

Irradiation Services

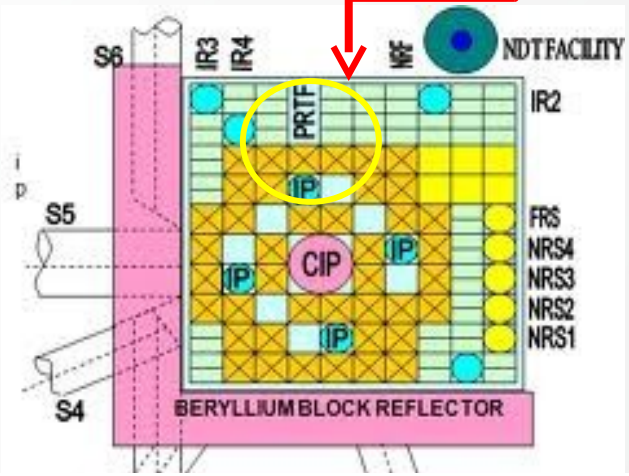


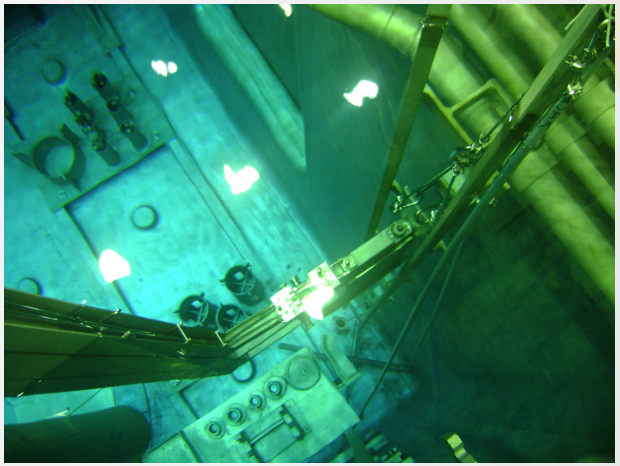
Power Ramp Test Facility

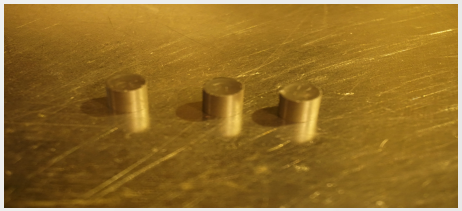


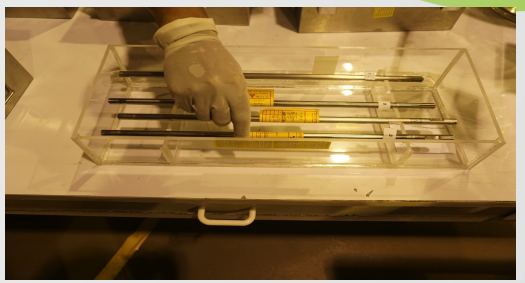


Location of Irradiation and Facility

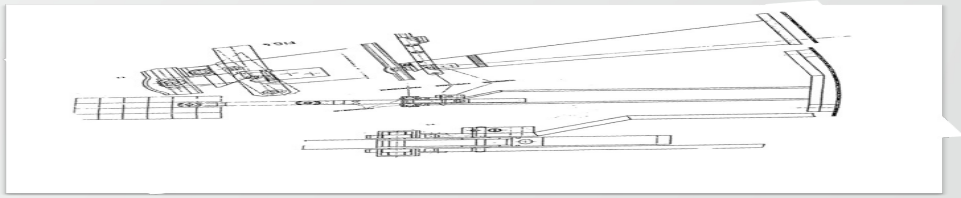




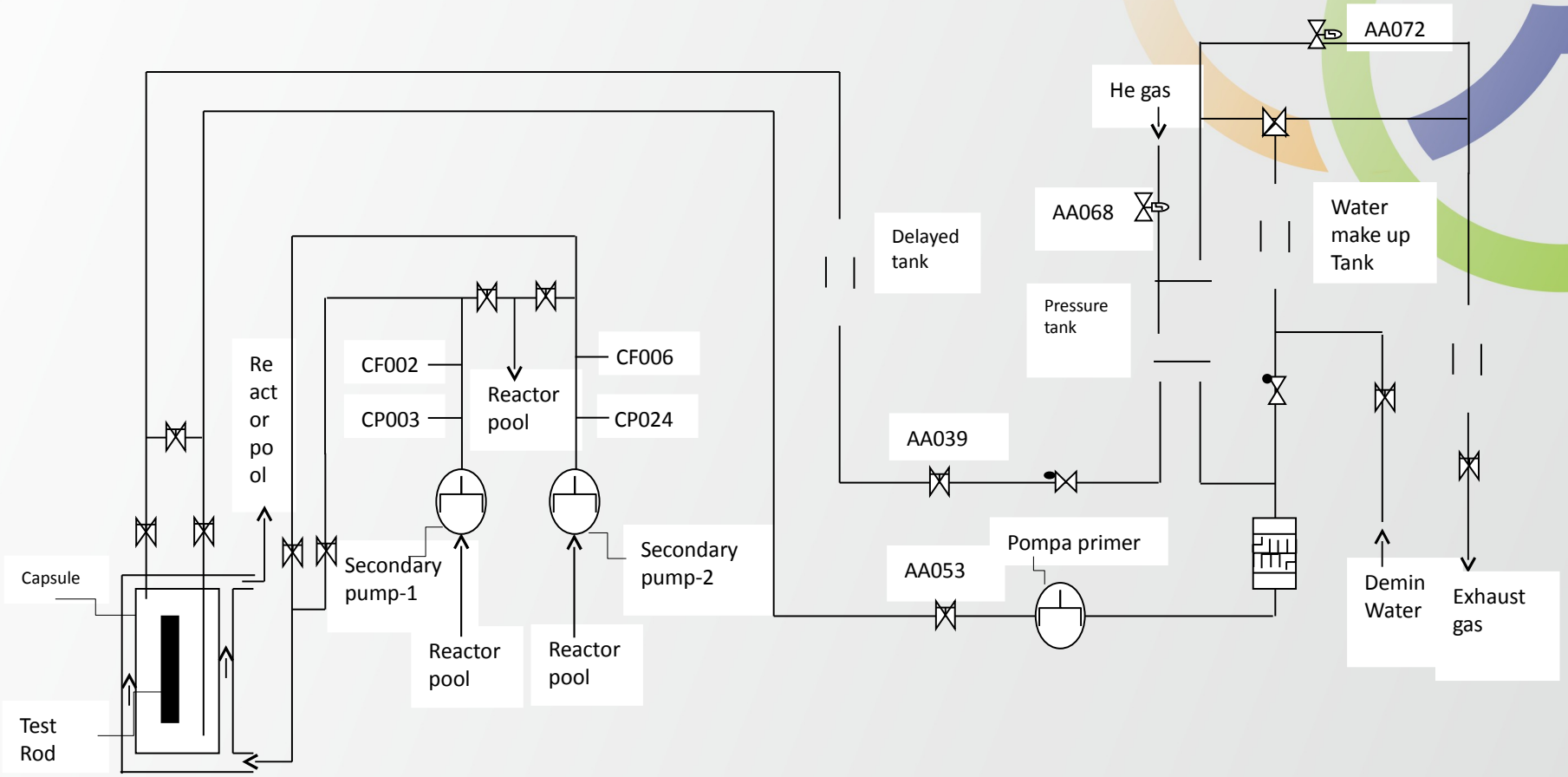




PARAMETER	LIMIT VALUE	SETTING VALUE	OLC
Minimum cooling flow	644 ℓ/h (1 pump)	600 ℓ/h (1 pump)	750 ℓ/h (1 pump)
Max cooling flow	1000 ℓ/h (1 pump)	900 ℓ/h (1 pump)	750 ℓ/h (1 pump)
ΔT Cooling (2 dari 3)	37 K	23 K	16 K
Max pressure of prim colling		162 bar	160 bar
Cooling Material Activity		2x104 cps	1000 cps



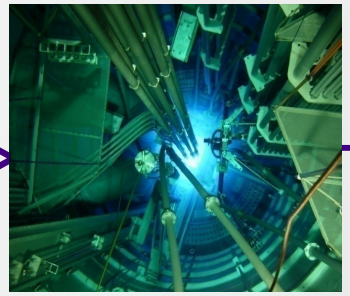
Installation of PRTF



Radioisotope Production

Material as Irradiation Target

QC



Irradiation Services

QC

Radioisotope Extraction

- 99Mo
- 131 I
- 137Cs
- 62Sm
- 90Sc

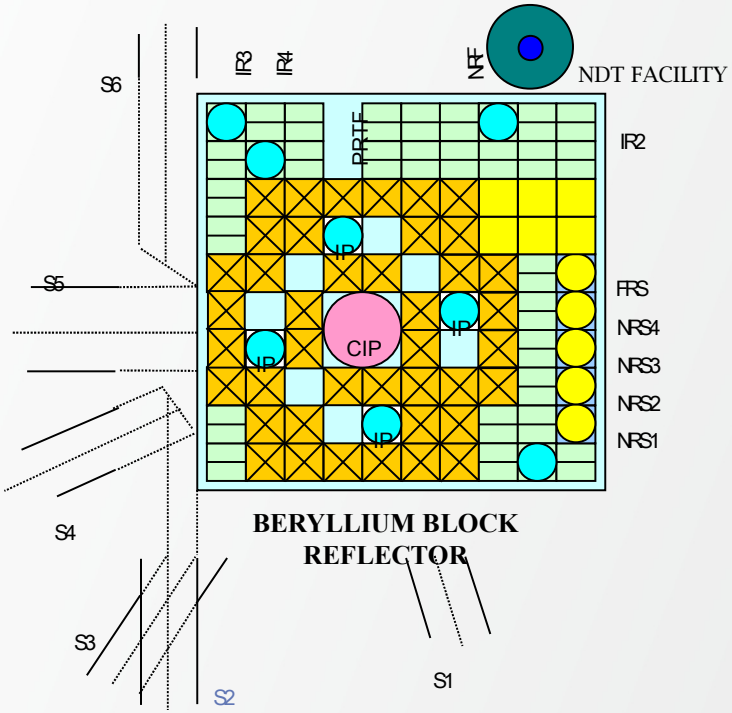
QC

Product

Radiopharmacy Production

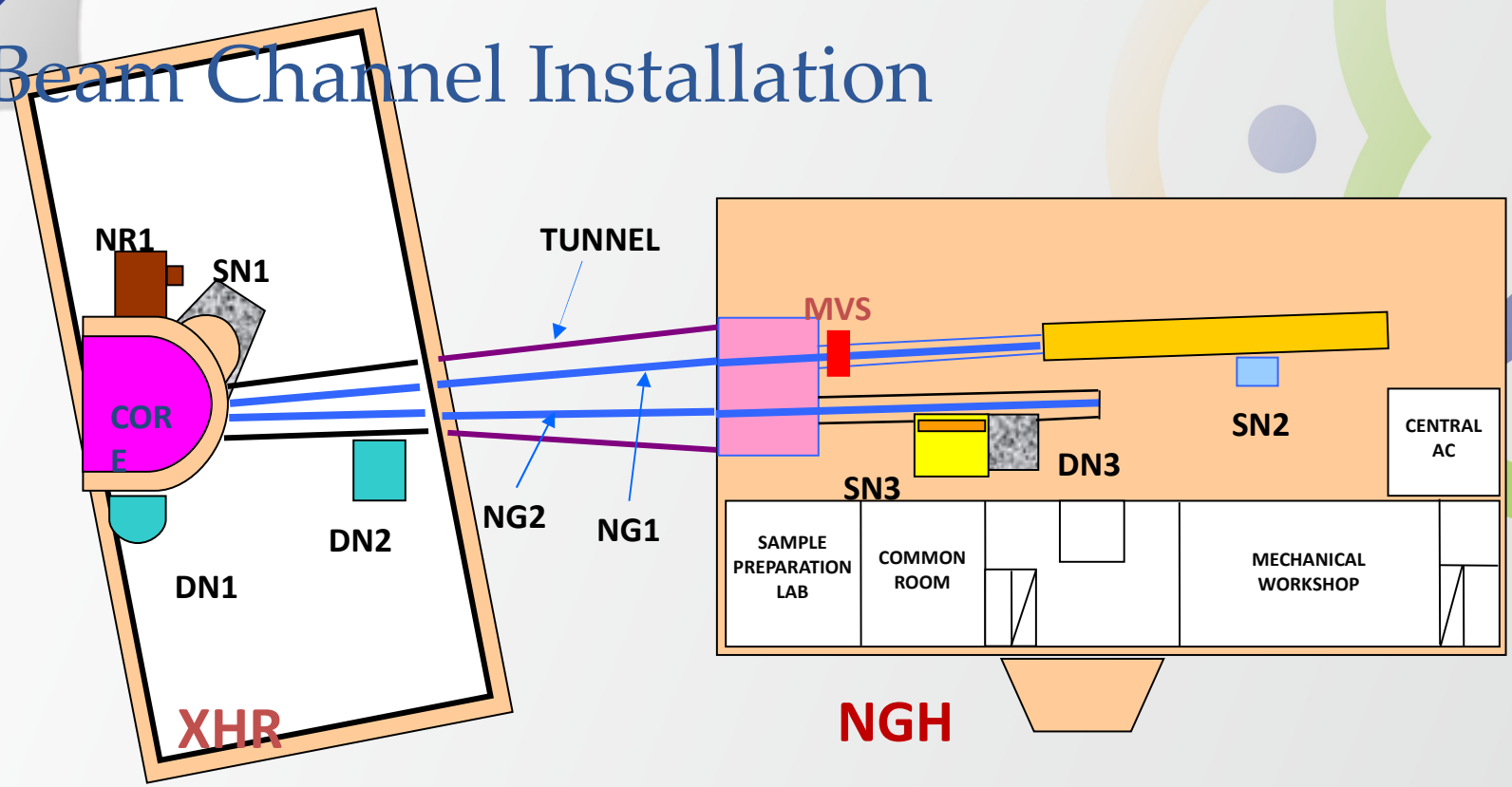
Packaging

Neutron Spectrometer and Diffractometer



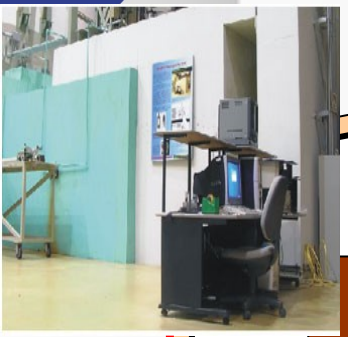
S6: DN1

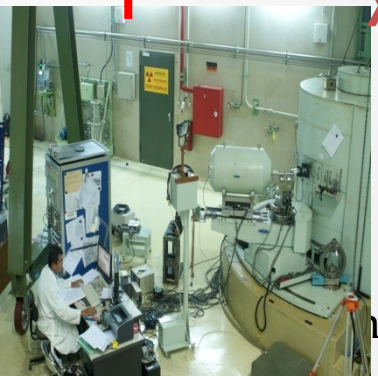
Beam Channel Installation

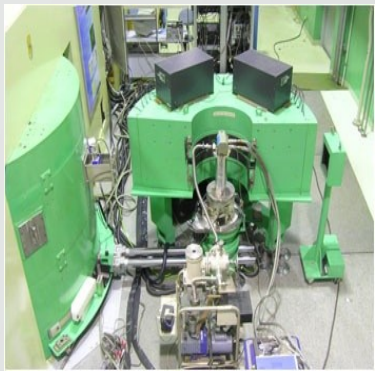


XHR	: eXperimental Hall of Reactor	DN1	: Neutron Diffractometer for Residual Stress Measurement
NGH	: Neutron Guide Hall	DN2	: Four-Circle Diffractometer/Texture Diffractometer
NG	: Neutron Guide	DN3	: High Resolution Powder Diffractometer
NG1	: First Neutron Guide	SN1	: Triple Axis Spectrometer
NG2	: Second Neutron Guide	SN2	: Small Angle Neutron Scattering Spectrometer
NR1	: Neutron Radiography Facility	SN3	: High Resolution Small Angle Neutron Scattering Spectrometer

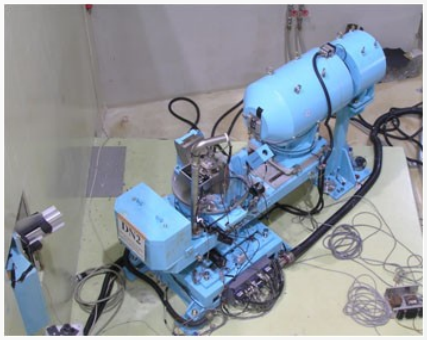
Spectrometer and Diffractometer Facilities





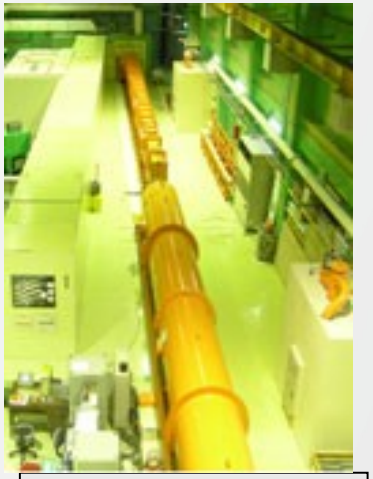


Neutron Beam Tubes Instrument Capabilities



Crystal strusture
(atomic scale: ~ Å)

Material characterizations from atomic scale to macro scale



Molecular structure
(nano scale:~ nm)

Molecular structure
(micro scale:~ µm)

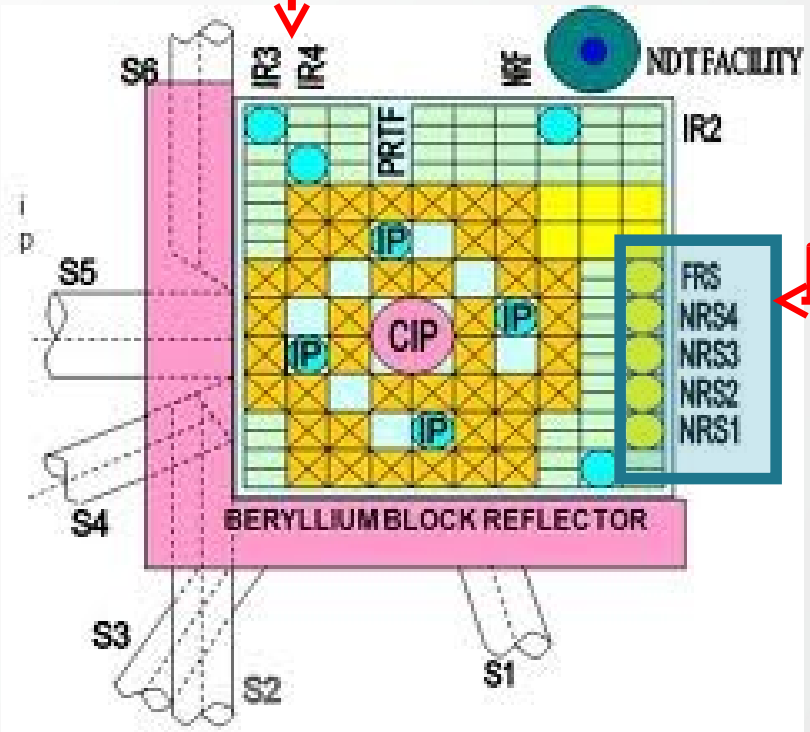
Defects
(macro scale:~ mm)

Sizes

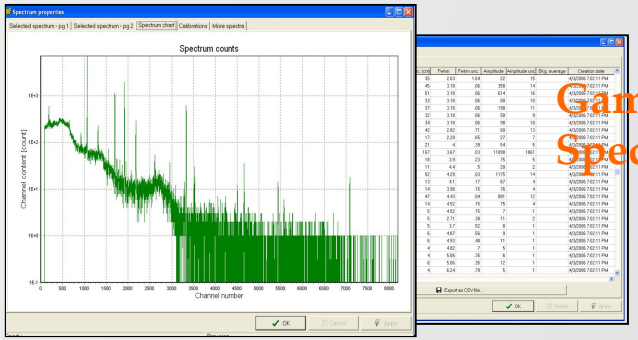
Neutron Diffractometers → **Neutron Spectrometers** → **Neutron Radiography**

Neutron Activation Analysis

NAA:
Long & Medium Irradiation



NAA:
Short Irradiation



Gamma Spectrometer

Software: Genie 2000, k0-DSM, ko-IAEA

Irradiation Facilities:
1 CIP, 4 IP, 4 HRS and 1 PRS

Analysed samples:
Food, soil, biological stof, rock, blod and Seed

Neutron Radiography

Instrument Characteristics

Neutron source :BEAM TUBE S2

Neutron flux at sample position: 106 to 107 n/cm2 sec

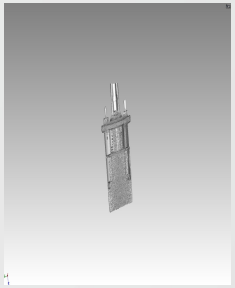
Beam size at sample position : 30 cm (dia)

Collimator L/D ratio : 83

Cadmium ratio : 6.4

Neutron/Gamma ratio : >105 n/cm2/mR

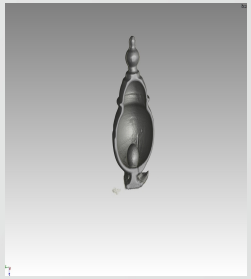
Radiography techniques : Gd converter and X-ray film, Li6-ZnS scintillator screen, CCD based electronic imaging system.



Ignition coil

Methods

- Film method
- Real time method using CCD camera
- Neutron Tomography method



Archaeological object

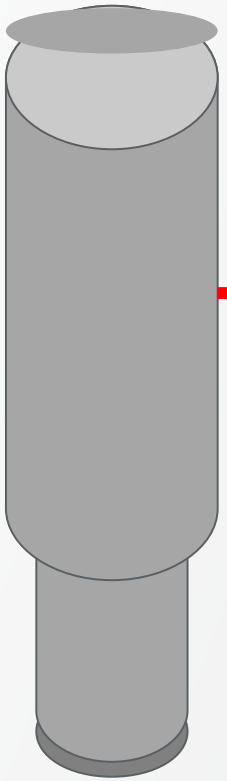
Utilization:

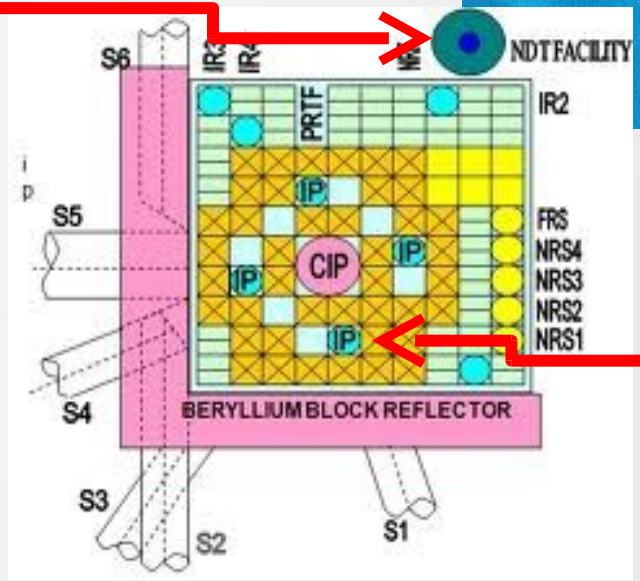
Materials inspections: industrial product, archaeological samples

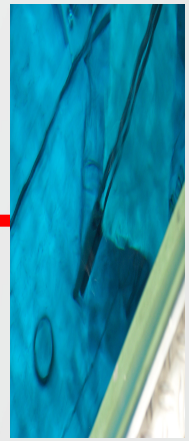
Gem Stone Coloration

1. Out Core Irradiation Facility

Produce:
17.5 kg-50 kg /month





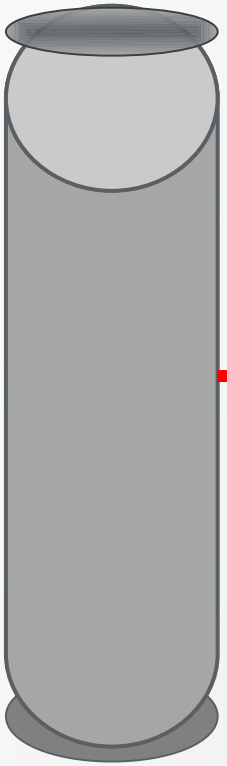


2. In Core Irradiation Facility

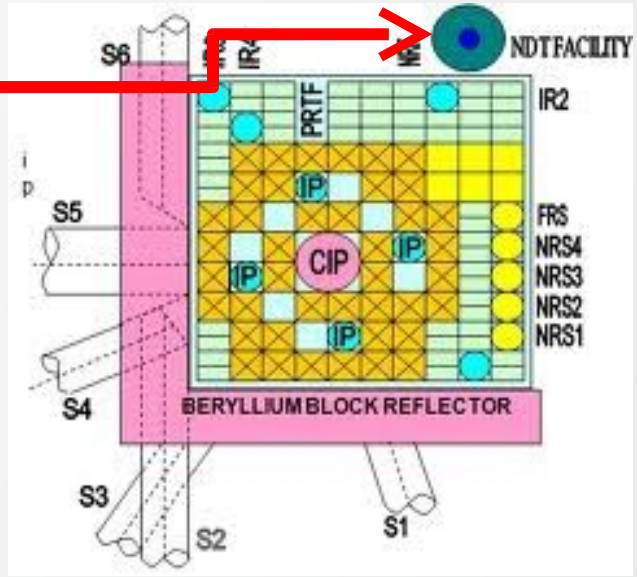
Training and Education

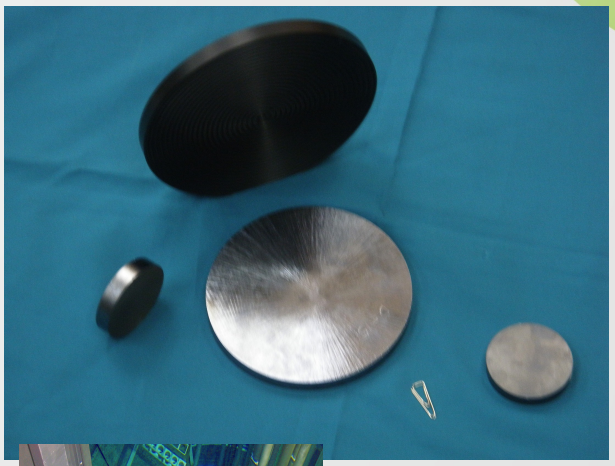
- Training for Operator and Maintenance Technicians
- Workshop on Ageing and Reactor Utilization
- Nuclear emergency preparedness drilling for local, district and national level.
- Dissemination of technology and nuclear energy to the public

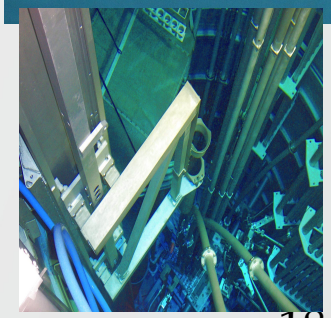
Utilization Plan: Neutron Transmutation Doping



- Design and produce special container equipped with moderator and reflector
- Irradiating various dimensions of silicon ingots





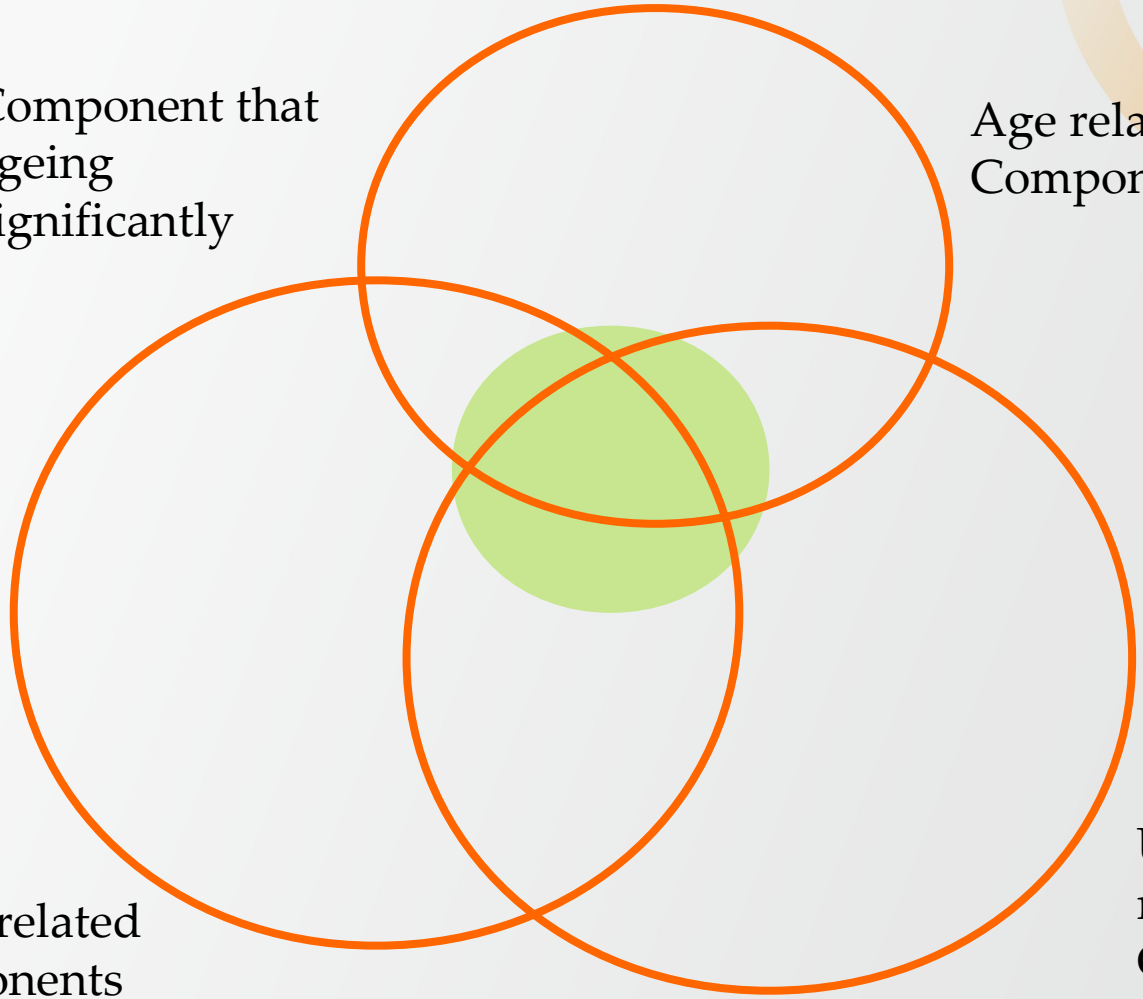


Reactor Maintenance Program

Type of Maintenance	Checking	Testing	Repairing	Inspecting	Replacing
Mechanical	✔	✔	✔	✔	✔
Electrical	✔	✔	✔	✔	✔
I&C	✔	✔	✔	✔	✔
Water Chemistry	✔			✔	
Physical Protection	✔	✔	✔	✔	✔
Rad Protection	✔	✔	✔	✔	✔
Utilization Facilities	✔	✔	✔	✔	✔

Ageing Program

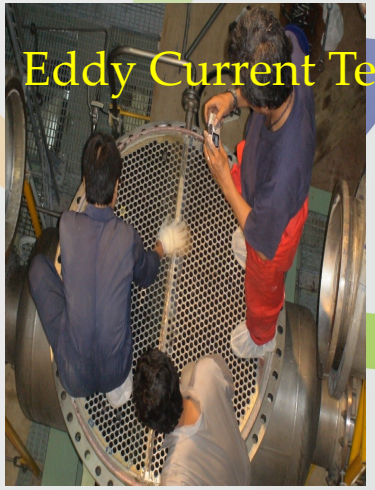
All Component

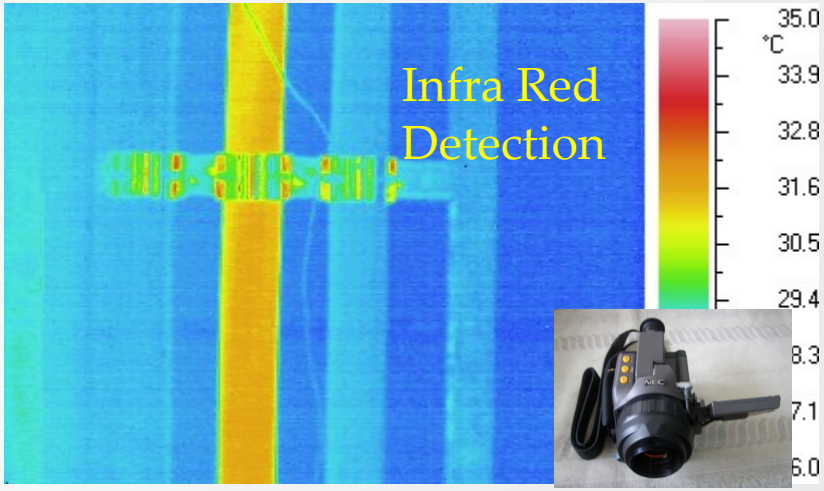


INSPECTION EQUIPMENTS AND TECHNIQUES

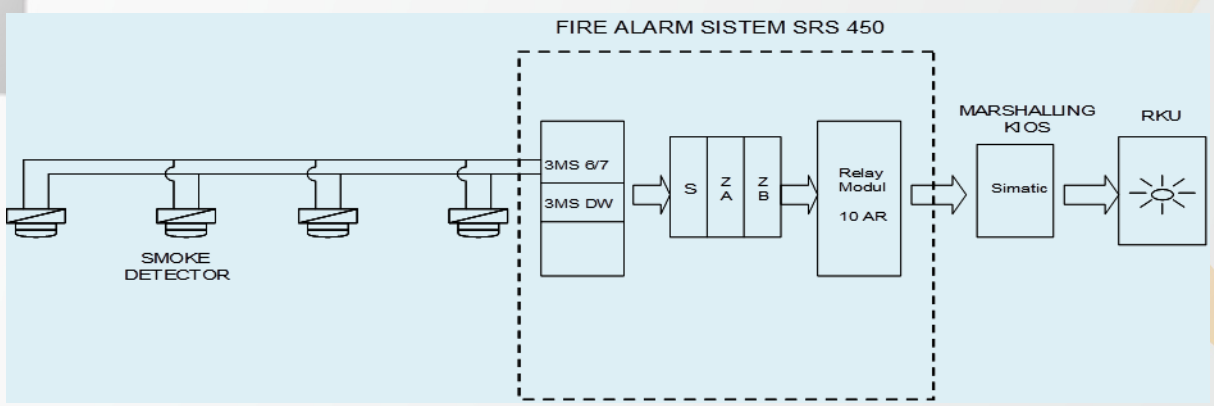
Non Visual inspection equipment	Function
Radiography	To determine the condition of the inside components, using the technique of photography, with a light source is replaced with a beam of X-ray, gamma, or neutron
Ultrasonic Test	Knowing the thickness and defects in the bottom surface of the material with the principle of ultrasonic wave propagation
Eddy Current Test	Detect any cracks, defects in the bottom surface of the material with the principle of continuity of electric current flow
In-situ Hardness Test	**Knowing the level of material toughness**
Dye Penetrant Test	To find cracks, small holes (pin holes)
Helium Leak Test	Leakage test vessel. Tubes, pipes closed at both ends
Vacuum Test	Leakage test vessel. Tubes, pipes closed at both ends
Hydrostatic Test	Leakage test vessel or piping system

Practical Activities on Ageing

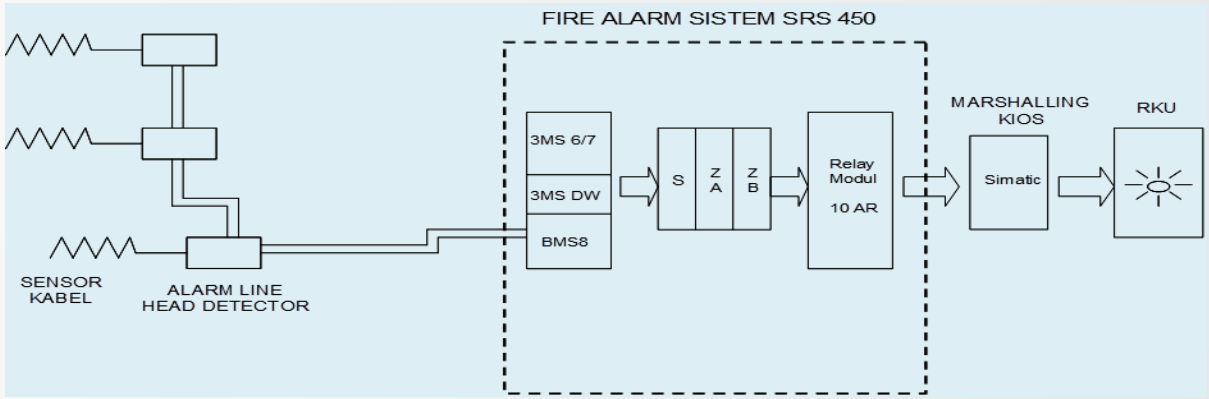




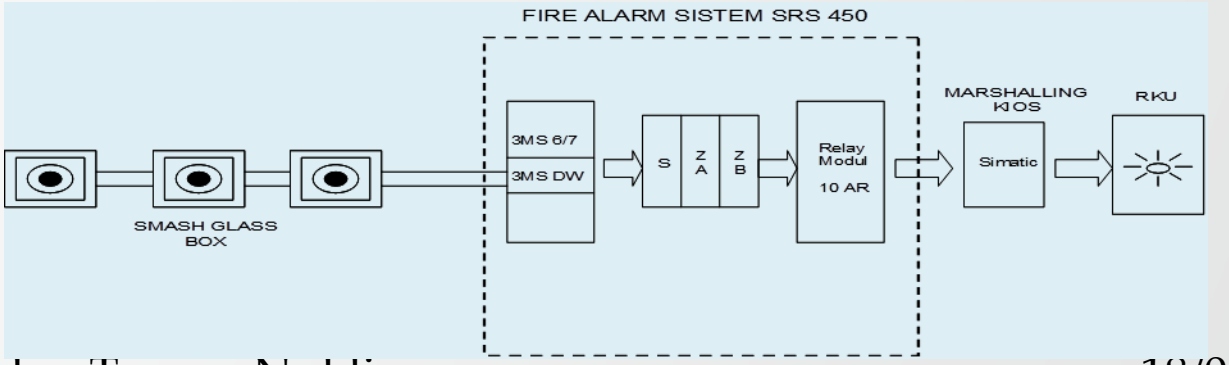
Fire Protection System



smoke detector



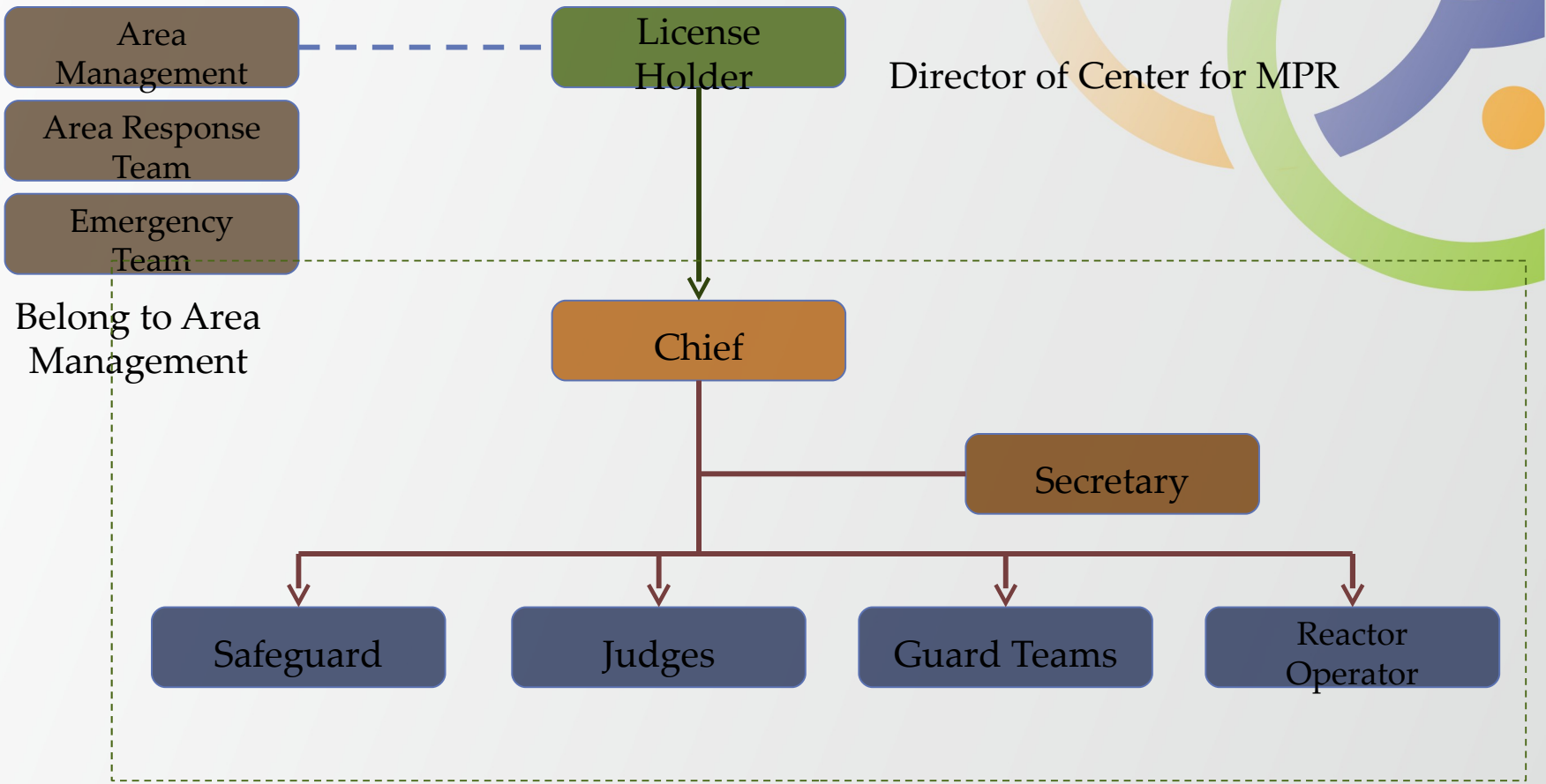
Line Alarm



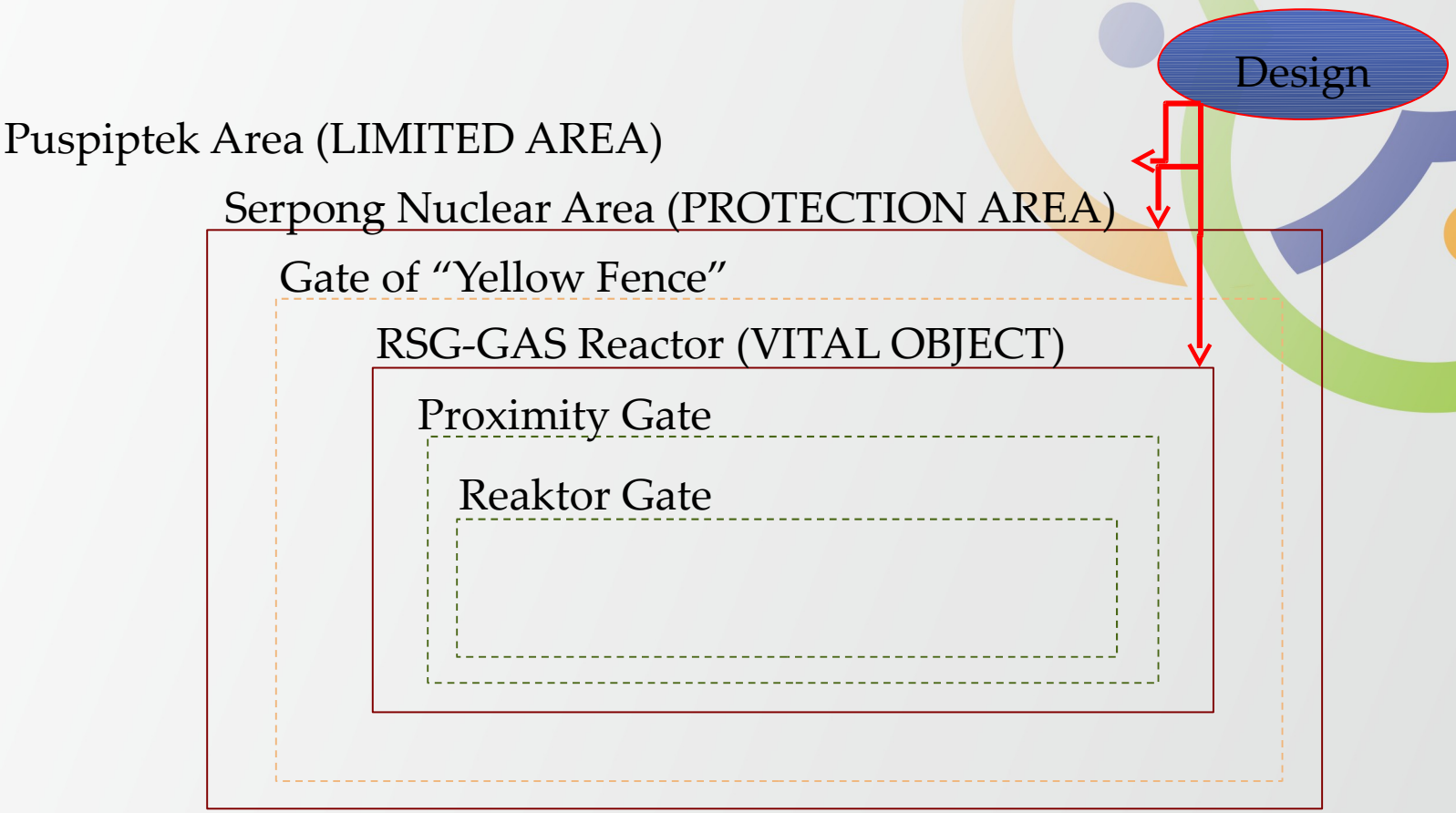
smash glass box

Organization Structure of Physical Protection in RSG-GAS Reactor

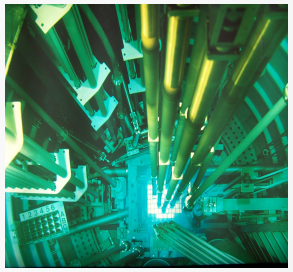
Based on BATAN Chief Decree No.1 Year 2009: #18



Physical Protection Design



Target of the Physical Protection



Reactor

Vital Building

Uranium

Vital/Important Research Instrument

Infrastructure in Security

1. *Detection System*
2. *Physical Barrier*
3. *Access System*
4. *Communication System*
5. *Surveillance Program*
6. *Contingency Planning*
7. *Documentation*

Conclusion

- RSG-GAS reactor is a multipurpose research reactor with multi utilization
- Operation of RSG-GAS has conducted safety and procedures implementing the law and other corresponded regulation.
- Management of RSG-GAS reactor plan to operate the RSG-GAS reactor for 150 days in 2015.
- Utilization of RSG-GAS reactor is going to be developed in achieve the gain of customer satisfactory.

batan

FOR YOUR ATTENTION

I THANK YOU VERY MUCH