Nuclear HRD Program

Sudi Ariyanto

Center for Education and Training
National Nuclear Energy Agency
Email: asudi@batan.go.id

WNU Short Course
Yogyakarta, October 9, 2017

Introduction

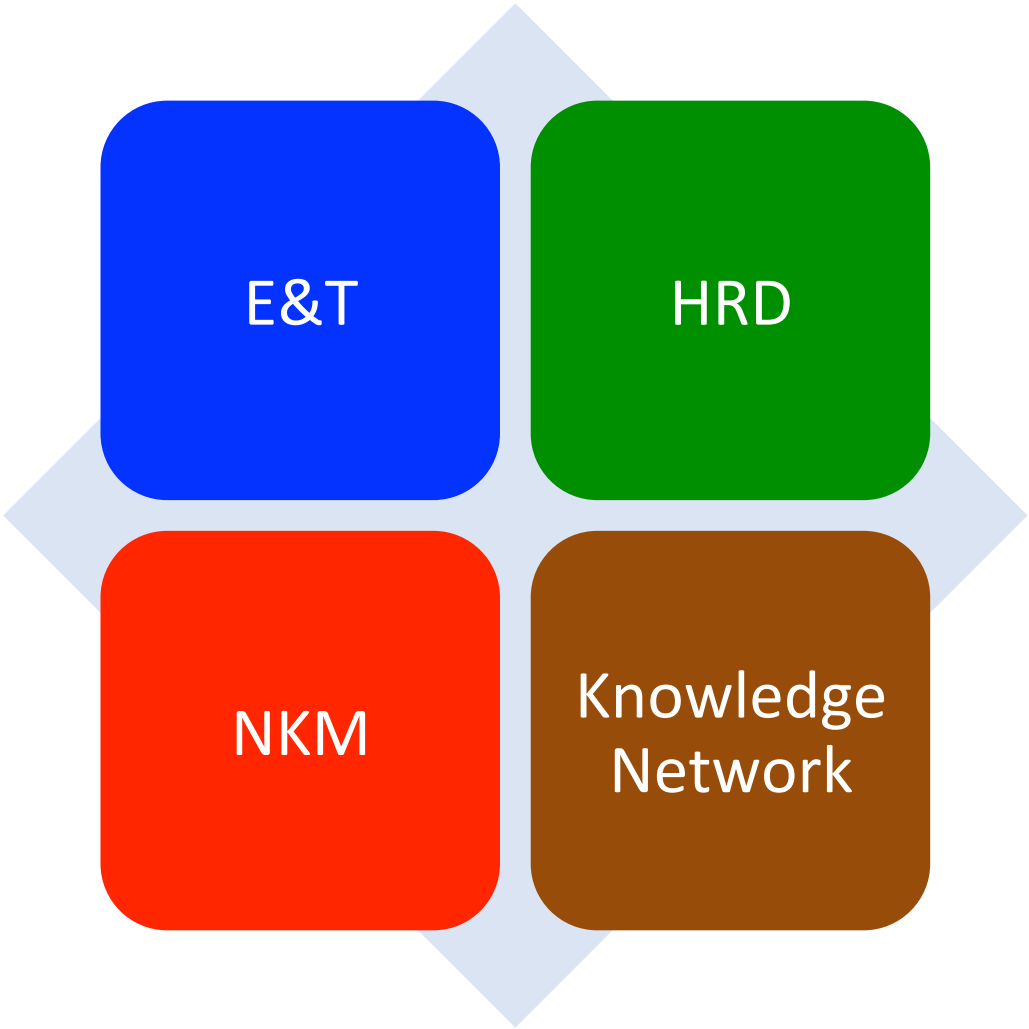
- No decision yet for utilizing NPP in the national electricity system.
- HRD is an important component, needs a long term commitment from the stake holders.
- HRD is one of 19 infrastructure has been prepared:
  - Establishment of National Team for NPP HRD in 2008
  - Bluebook/Whitebook for NPP, 2014-2015
  - Preparing documents for NPP prototype and its utilization for commercial purposes, 2017
  - CET BATAN is doing training for nuclear

HRD issues

- Manpower Requirements
- Recruitment and Training Timeframe
- Training Schemes and Certification
- Nuclear Training Center
- Standard on Personnel Competence and Competence- Based Training
- Fundamental training for NPP program

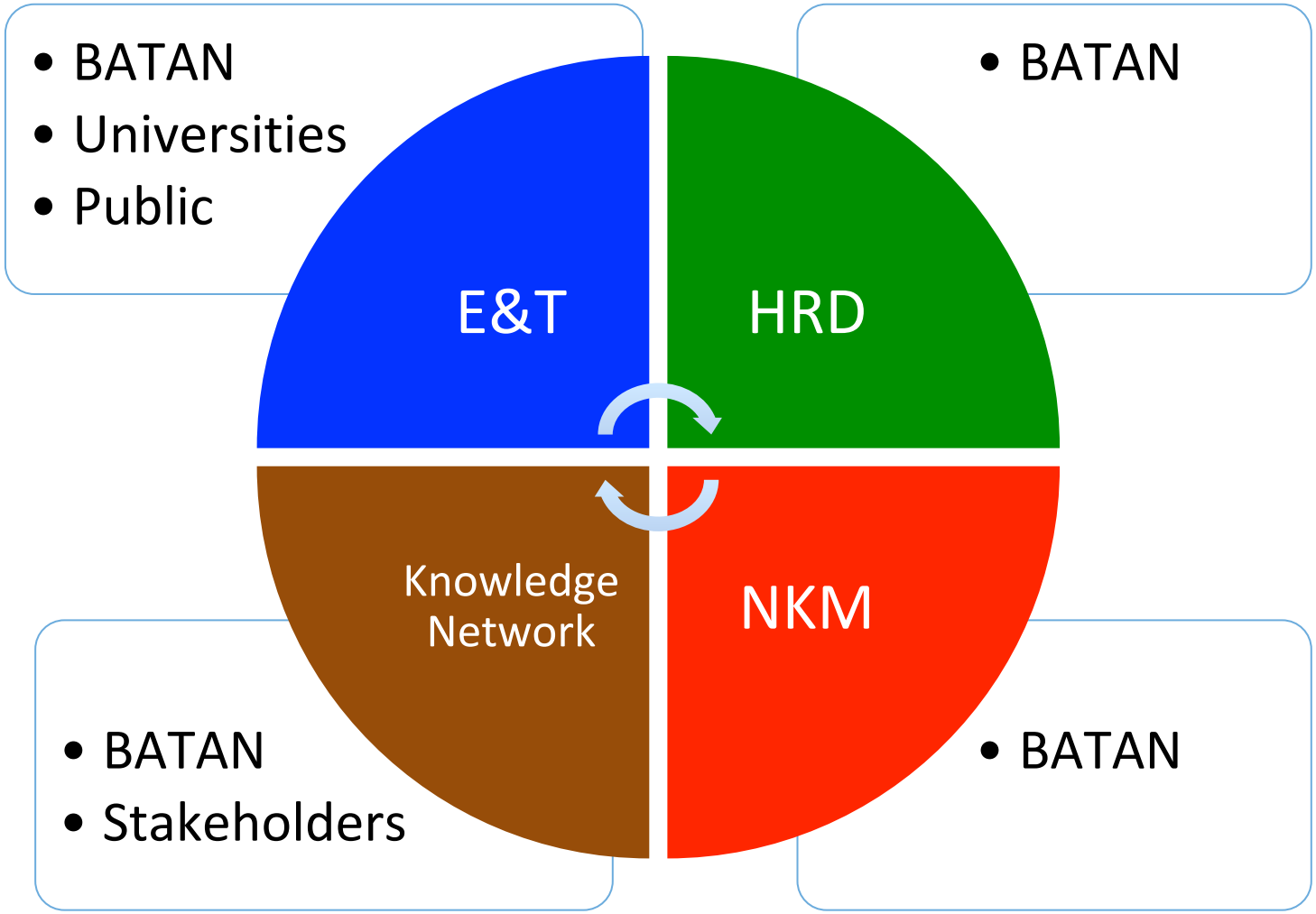
Introduction

IAEA Concept for Nuclear Capacity Building



Capacity Building of BATAN

Targets/Beneficiaries



Capacity Building of BATAN

Objectives:

E&T

- Building Competences
- Preserving nat. comp. on NST
- Public Outreach

HRD

- Effective Human Capital Management

NKM

- Preserving NK
- Preventing NK loss
- Harvesting NK

Nuclear Network

- Building competencies
- Stakeholders involvement
- Public outreach
- Increasing public support

Capacity Building

Activities:

E&T

- System Improvement
- Method diversification
- Infrastructure improvement
- External Supports

HRD

- Recruitment
- Need assessment

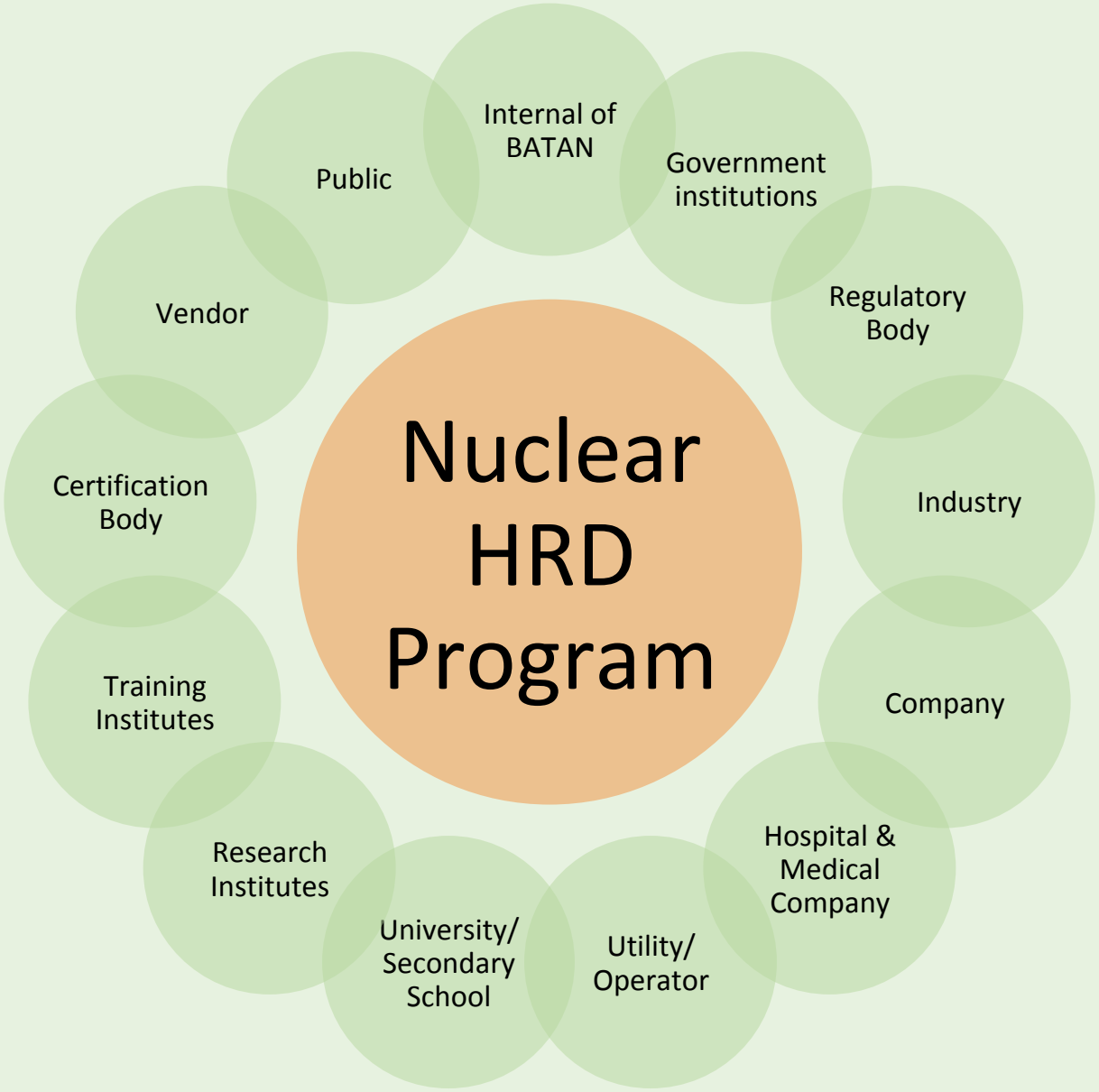
NKM

- Knowledge management strategy
- Management system

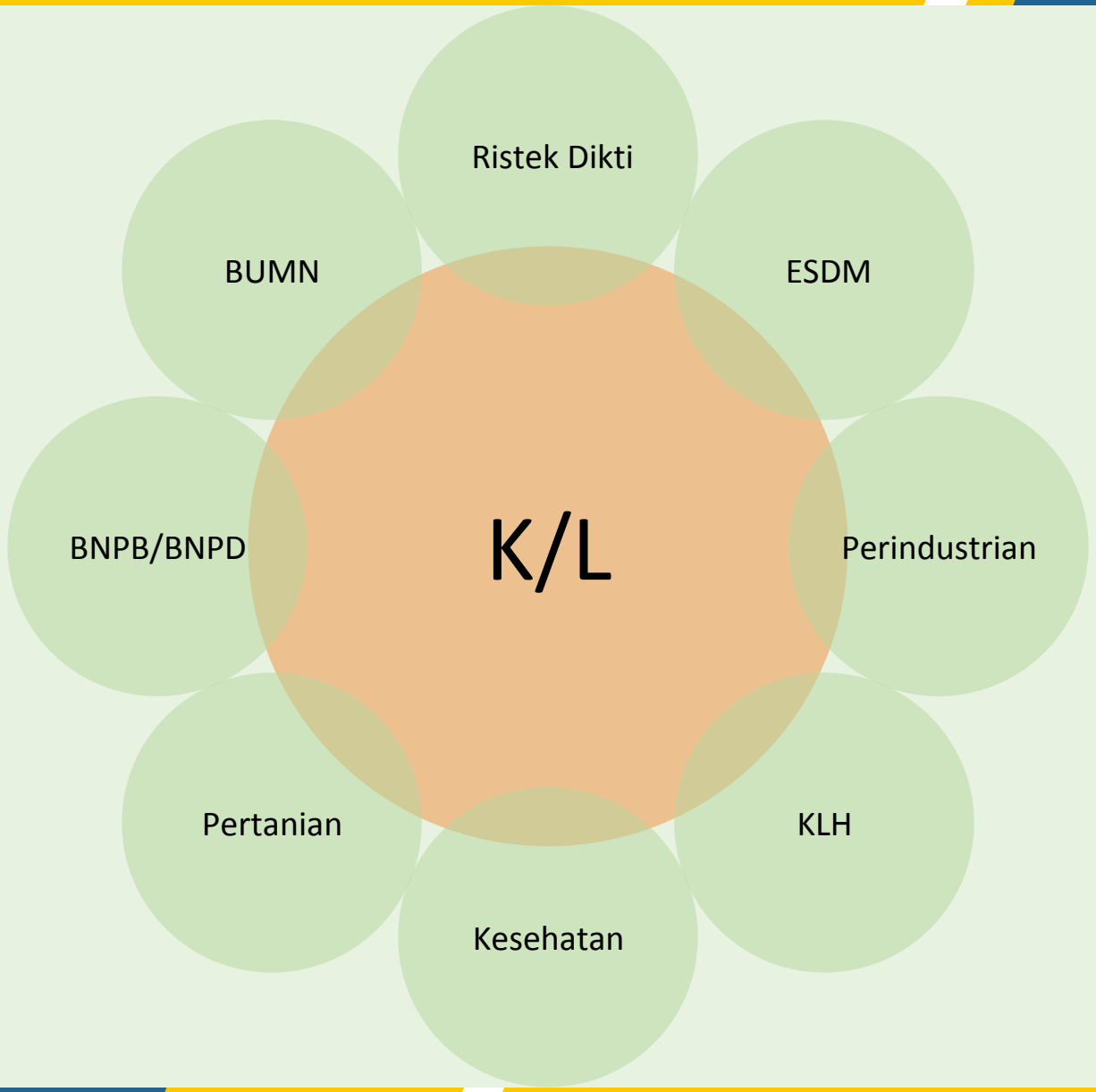
Nuclear Network

- Participation in knowledge network.

Framework for Nuclear HR



Framework for Nuclear HR



Framework for Nuclear HRD

Government

1. Infrastructure Dev.
2. Nuclear Policy
3. Nuclear Energy Planning, etc

Vendor

1. DesainDesign, Construction
2. Training, OJT

Regulatory Body

1. Regulation, License, Inspection

Training Institution

1. Training

Industry

1. Construction, Design, A/E, Fabrication

Research Institutions

1. Research & Disemination

Utiliti/Operator

1. Operation & Maintenance
2. In-house training

University

1. Higher Education
2. Research

Strategy for HR Preparation for 1st NPP

- Develop Infrastructure for HR
- Build Capacity
- Develop and Sustain Competences

Strategy for HR Preparation for 1st NPP

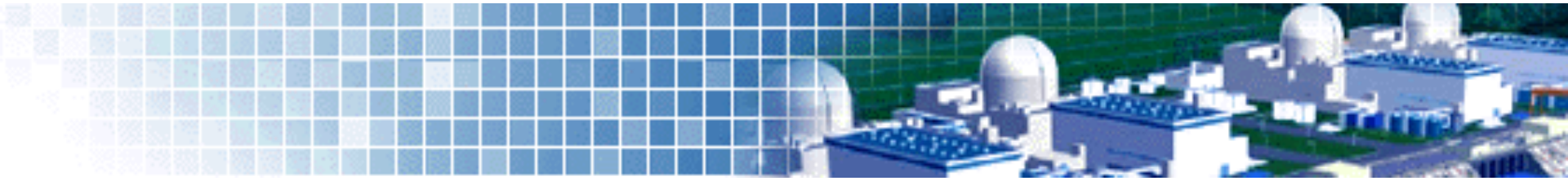
University
Nuclearization of others disciplines (Engineering, Sciences)

BATAN
• Site Preparation • Training on nuclear and NPP, etc

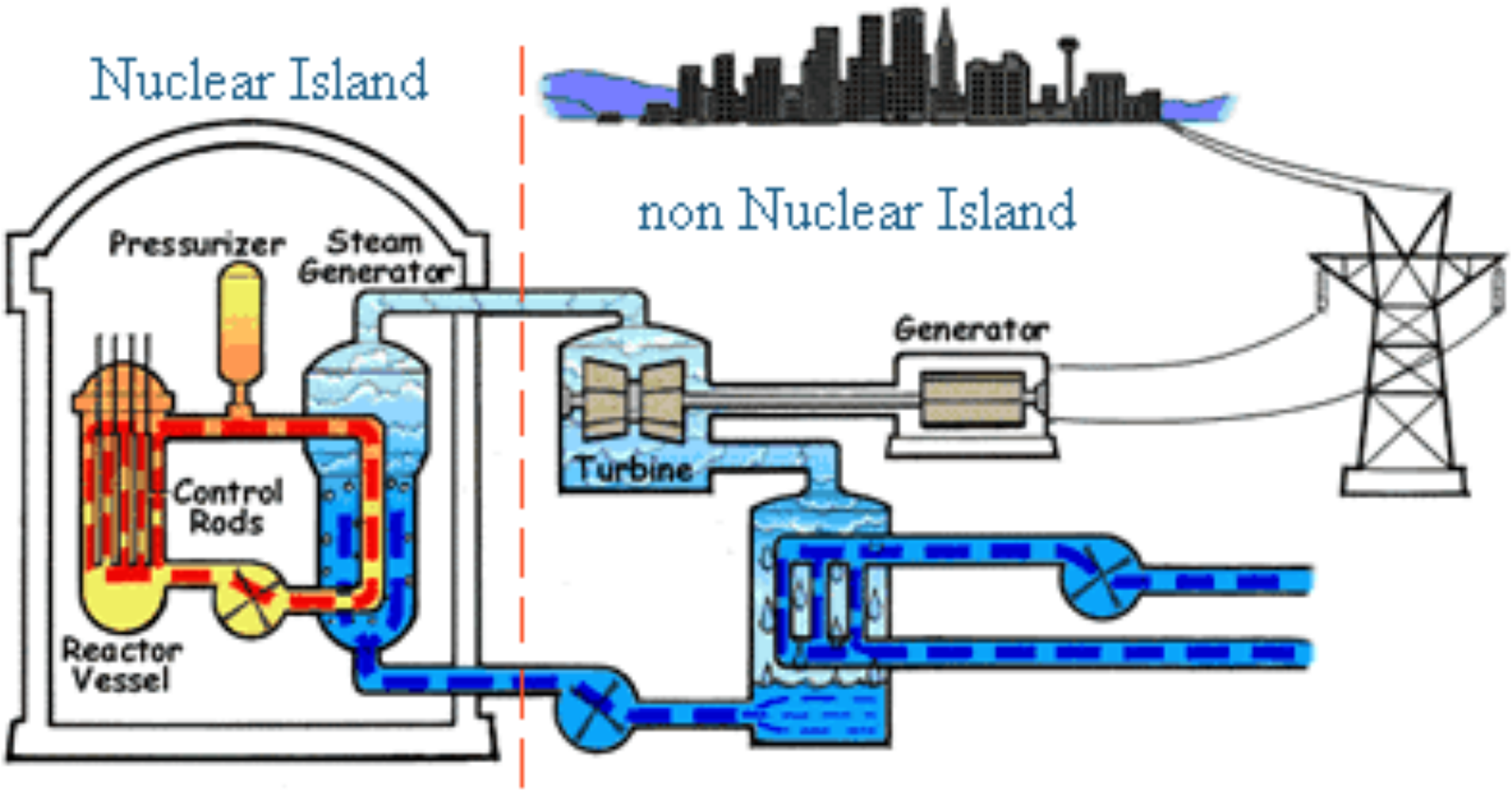
Vendor
Specific trainings

Utility/PLN
OJT on non-nuclear subjects

Readiness



Working Areas



HRD based on Areas

Experiences

Non-Nuclear

Construction and Operation of Non-Nuclear Power Plant

(Fossil-fueled Power Plant

35 MW - 600 MW)

Nuclear

Construction and Operation of Nuclear Research Reactor :

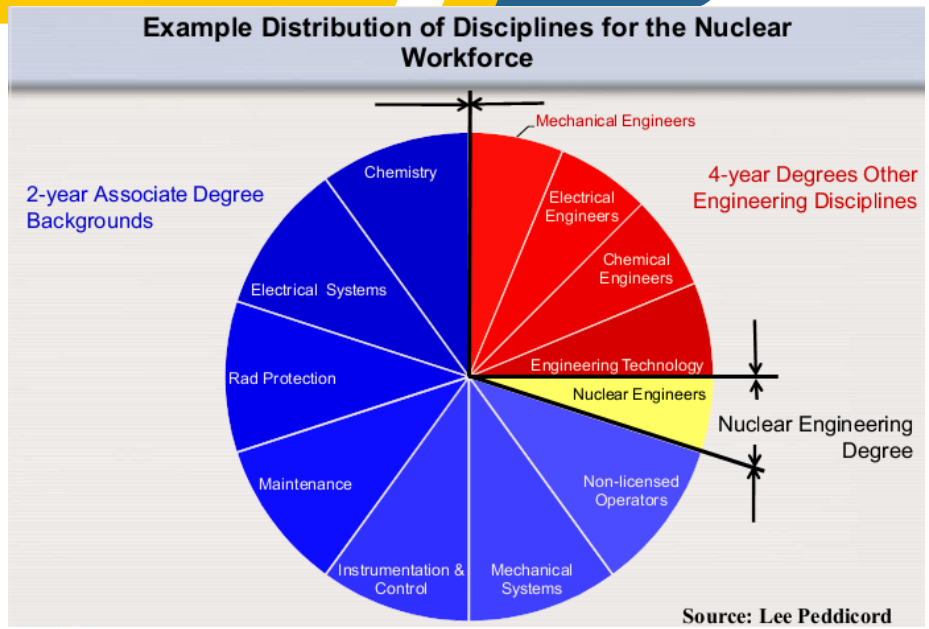
- Kartini, Yogyakarta (100 kW),
- Triga-2000, Bandung (2 MW)
- GA. Siwabessy, Serpong (30 MW).

HRD for NPP

- Majority of permanent workforce is needed for the Operating Organization, once NPP is commissioned; typical workforce for a 2-Unit NPP is 600-1200 personnel
- Around 65 - 80% of workforce are required at non-graduate level i.e. 'Technicians'
- Of the graduate workforce (20 – 35%) only around 20% (or ~ 5% of total workforce) need a Nuclear engineering background
- Training/experience requirements for very specialist roles can be 5-10 years
- In Regulatory Body, % of Graduates is much higher (> 50%) but specialist Technicians still needed

IAEA

Brenda Paganone, IAEA



Operation and Maintenance of NPP needsi 170-270 personnels:
9-14 personnels of Nuclear Engineering (5%)

Stakeholders

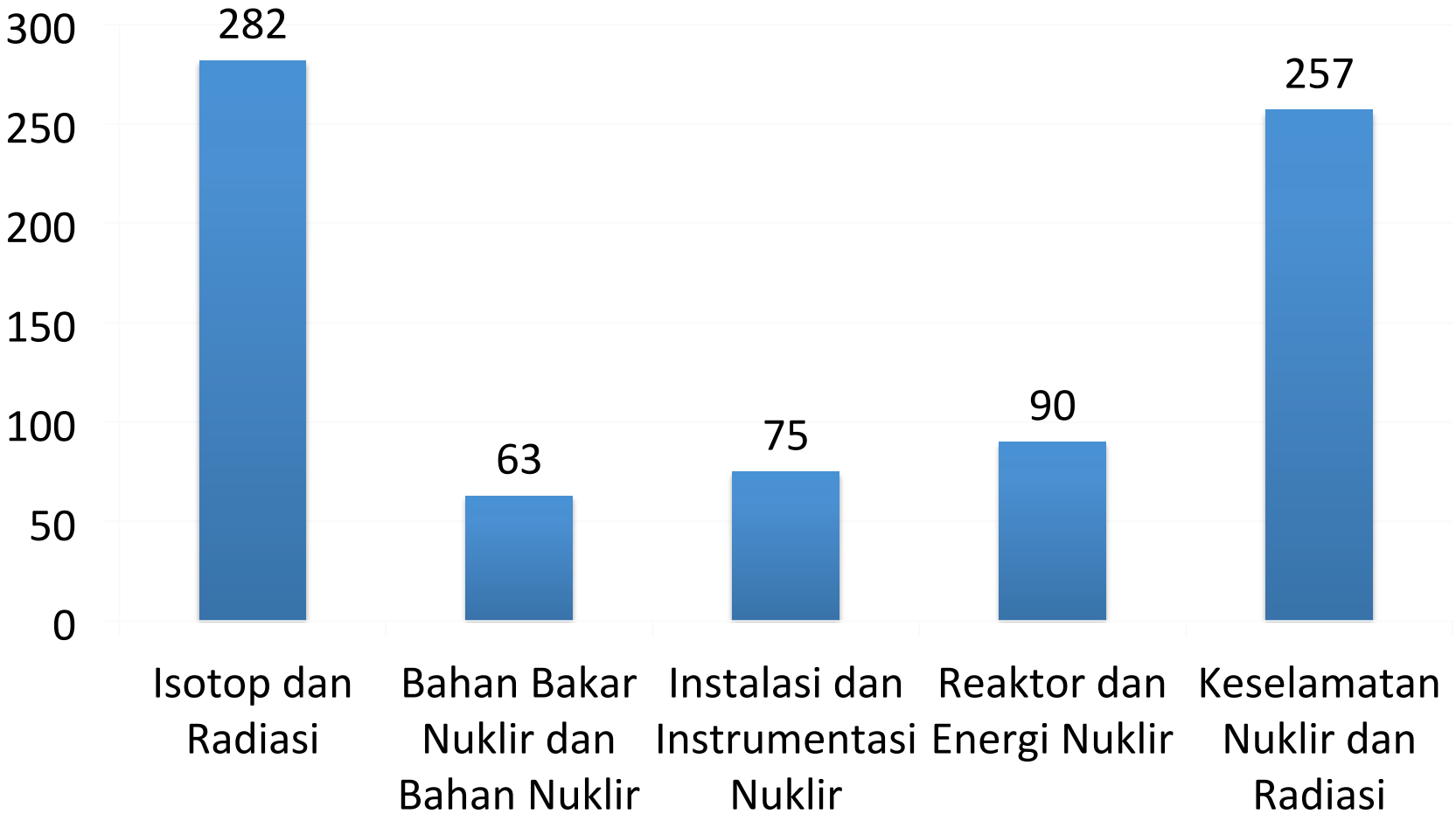
Non Nuclear

- MEMR
- PLN
- University
- Secondary/Vocational Schools

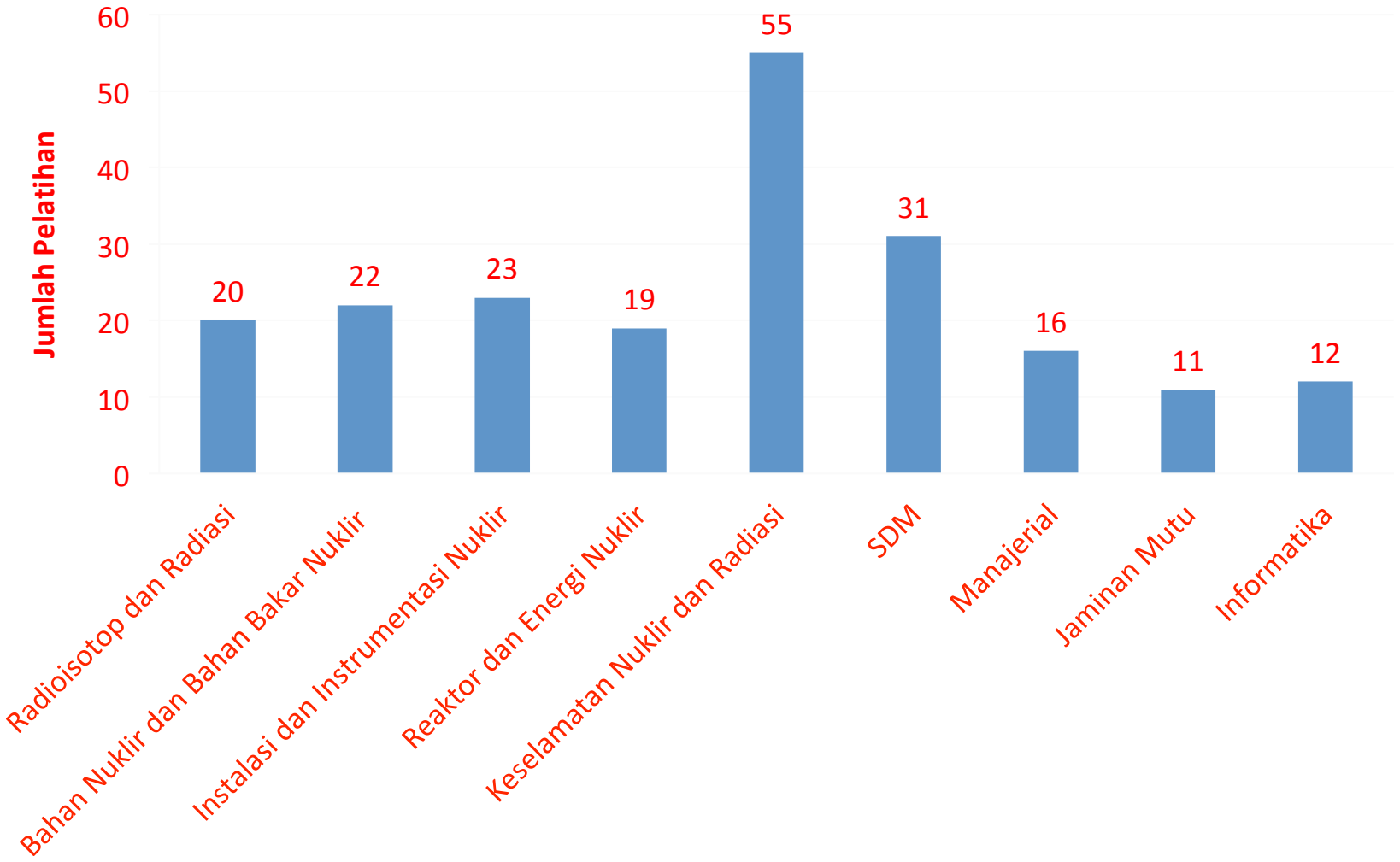
Nuclear

- BATAN
  - CET
  - STTN
- BAPETEN
- University

Training by CET, BATAN 1980-2009



Training by CET, BATAN 2010-2015



Reactor Engineering and safety I

Nuclear Physics

Reactor Physics

NPP Technology

Fuel Engineering

Core Inherent Characteristic

Reactivity Control

Characteristic of BWR

Characteristic of PWR

Reactor Structural Mechanics

Reactor Material Engineering

Waste Management

Decommissioning

SRAC Code: Neutronic

Reactor Operation
Startup, Power Manuver, Shutdown

NPP Simulator
Startup, Power Manuver, Shutdown

Reactor Engineering and safety II

- Thermal Engineering
- Reactor Heat Transfer and Thermodynamic
- Intro. Reactor Safety
- Basic Concept of Reactor Plant Safety

- Reactor Thermo Hydroulic
- Thermal Hydraulic Design
- Core Thermo Hydraulic
- Fuel Element Thermal Performance
- Deterministic Safety Analysis
- Probabilistic Safety Analysis
- Severe Accident
- Exposure Evaluation at Accident

- Boiling Heat Transfer
- Cobra
- RELAP 5
- Origen

Universities

Faculty	Subject	UGM (S1)	UI (S1)	ITB (S1)	STTN (D4)
Engineering	Nuclear Eng.	40	0	0	0
	Physic Eng.	93	0	100	0
	Electrical Eng.	103	80	150	0
	Chemical Eng.	115	80	271	0
	Mechanical Eng.	119	80	155	0
	Electronic & Mechanics	0	0	0	34
	Elektronic and Instrumentation	0	0	0	31
	Nuclear and Tecnochemical	0	0	0	37
Natural Science	Physic	75	90	227	0
	Chemistry	179	70		0
Specialization		Nuclear Eng: Teknology, safety, and Medical Physic	Nuclear Physic and Particle	Nuclear Physic	Reactor Technology

National Team of HRD for NPP 2008

Members from various institutes:

- Ministry of Energy and Mineral Resources (ESDM)
- Ministry of Research and Technology
- National Nuclear Energy Agency (BATAN)
- National Nuclear Regulatory Body (BAPETEN)
- State Owned Electricity Company (PLN)
- others

National Team of HRD for NPP

Task and Program (start from 2008)

- Development of Academic Paper on "Preparation of Human Resource Development for the First Nuclear Power Plant in Indonesia".
- Development of Blue Print on "Human Resource Development for Nuclear Power Plant".
- Establishment of Nuclear Training Center for NPP: standard of personnel competences; standard for competences training.

National Team of HRD for NPP

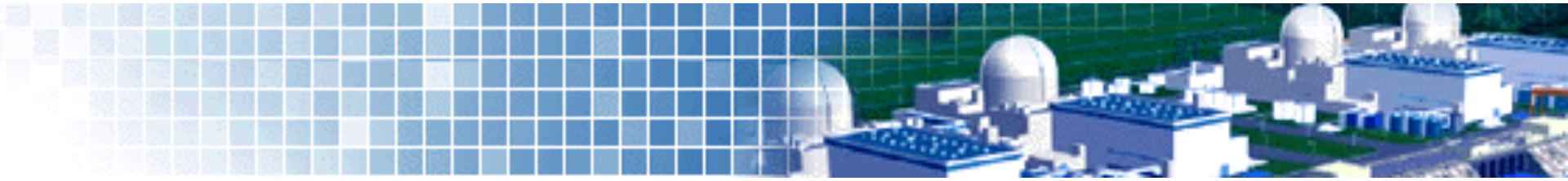
- Development of Academic Paper (2008 ~ 2009)
- **Personnel requirements**: quantitative and qualification (education, training, and experience)
- **Existing infrastructure of HRD:** education, training, and licensing system.
- **Action Plans**

Standards for Personnels Available

Standard of Personel Competences

Standar of Competences Training (SLK)

NPP Operator and Maintenance



Strategy for HR Training

Personnel Competence Standard

Training Competency Based Standard

Standard Curriculum

Training Material

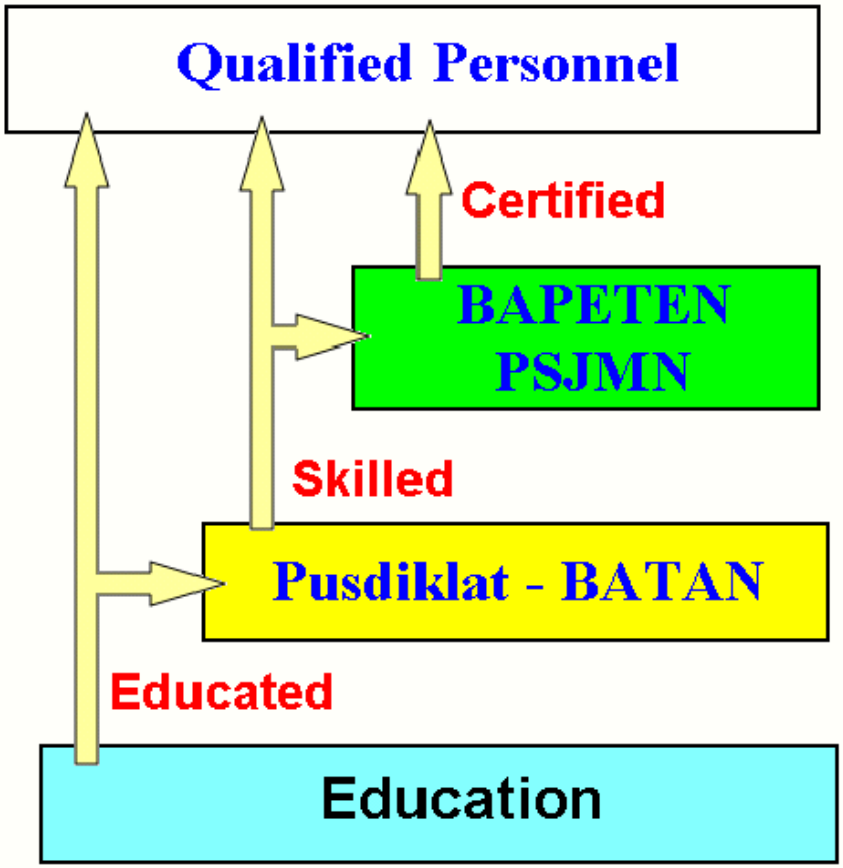
Instructor

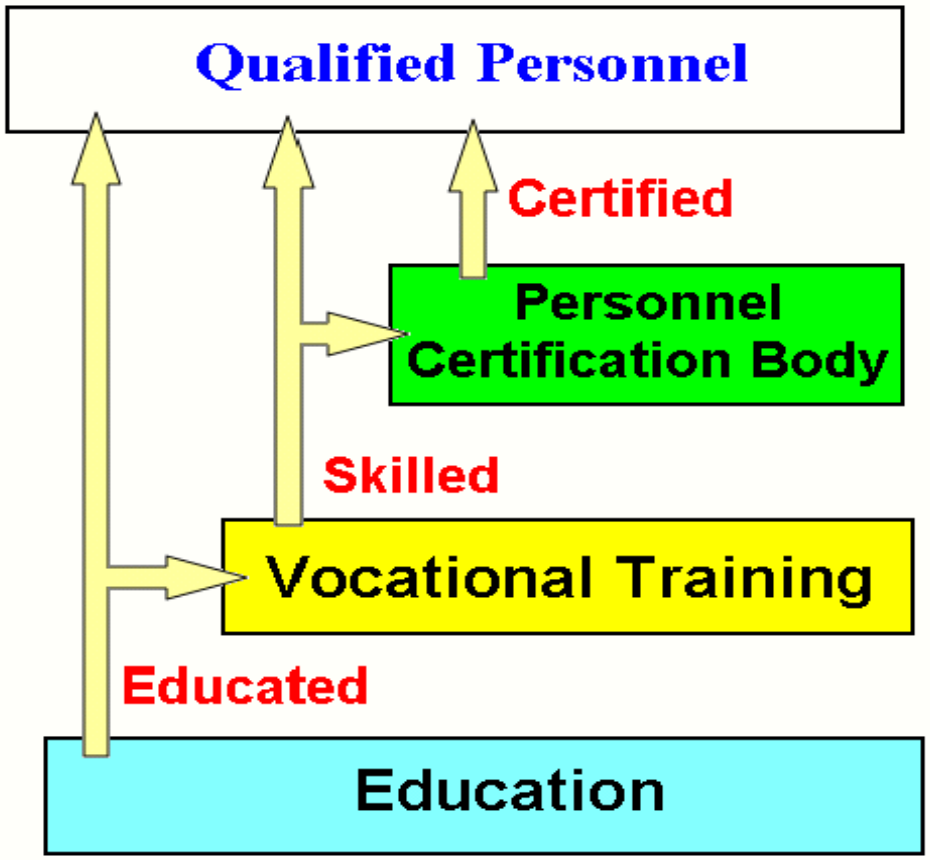
Laboratory

Training Implementation

Utilization of Systematic approach to Training

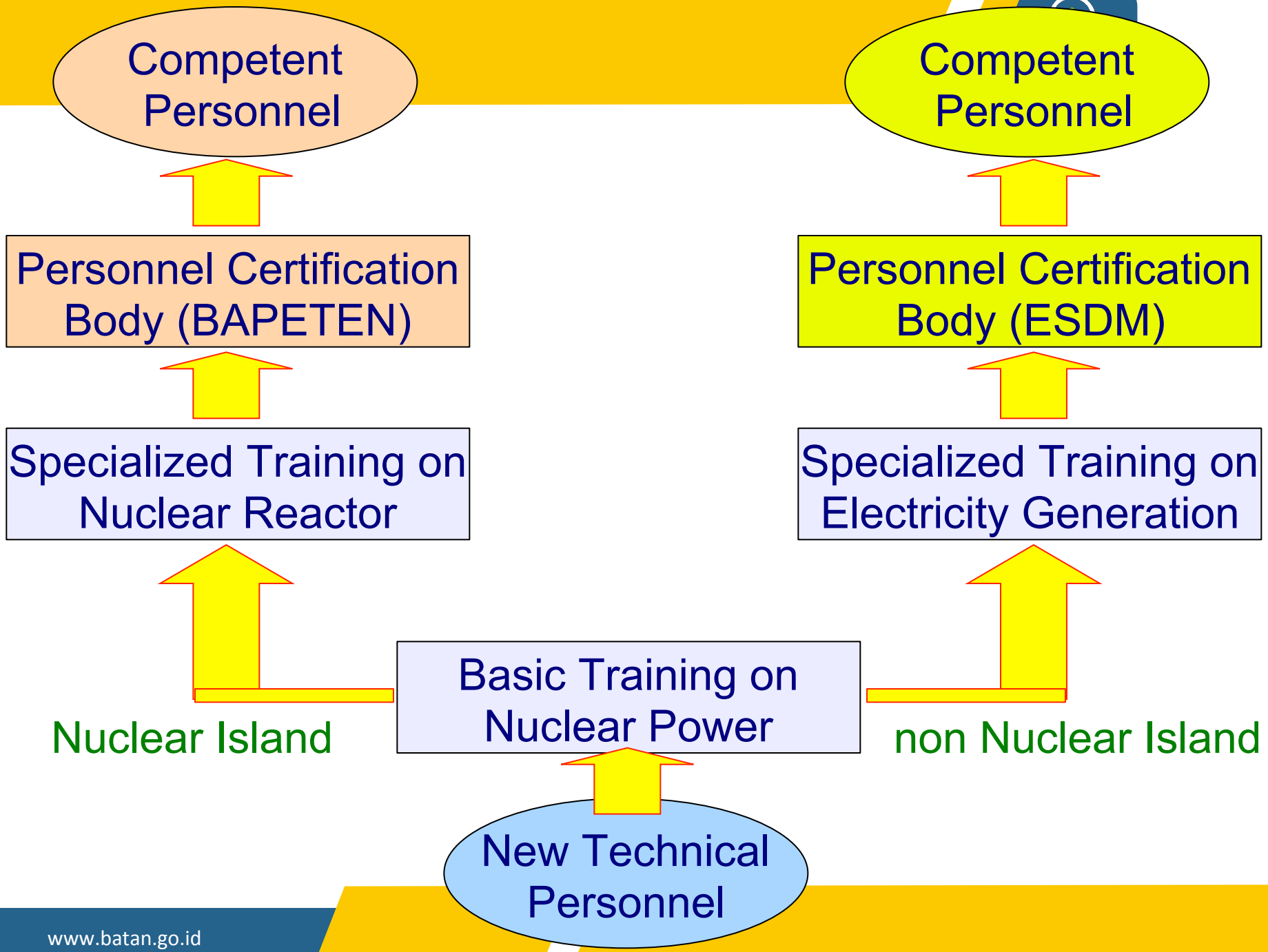
Personnel Competencies Development





Infrastructures:

- National Education System
- Institutional Training Facilities


Competent Personnel
Competent Personnel
Personnel Certification Body (BAPETEN)
Personnel Certification Body (ESDM)
Specialized Training on Nuclear Reactor
Specialized Training on Electricity Generation
Basic Training on Nuclear Power
Nuclear Island
non Nuclear Island
New Technical Personnel

Training Scheme for BATAN Staff

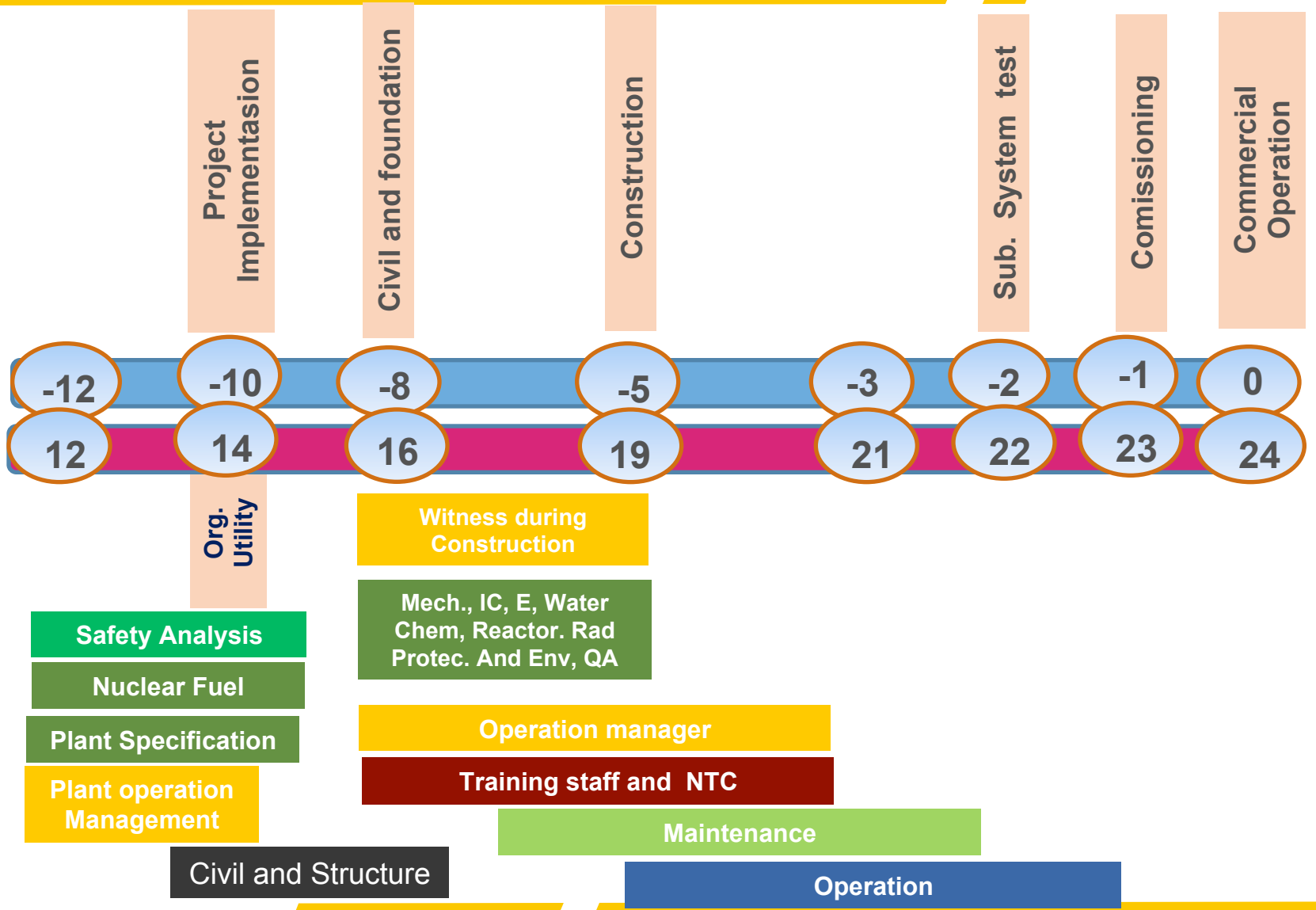
Basic (< 3 years)			Junior (3 ~ 8 years)	Senior (> 8 years)
Radiation Protection for New Employee	Radiation Measurement and Spectroscopy	Basic Professional Training Course on Nuclear Safety (level I and II)	Radiation Protection Officer	Radiation Protection Supervisor
			Reactor Operator	Reactor Supervisor
			Reactor Maintenance Officer	Reactor Maintenance Supervisor
			Nuclear Material Inventory Officer	Nuclear Material InventorySupervisor
			Nuclear Emergency preparedness	
			Nuclear Fuel Fabrication Officer	
			Nuclear Waste Management Officer	
		Application of Nuclear Technique in Industry and Environment	Radiation Protection Officer	Radiation Protection Supervisor
			Operator Radiography	Supervisor Radiography
			Irradiator/Accelerator Operator	
			Irradiator/Accelerator Maintenance Officer	
			Radiological Emergency preparedness	
			Radioisotope Production Officer	
	Not Safety Related Competency (Administrative, Quality Assurance, Informatics, instrumentation, etc.)			

Timeframe of Personnel Recruitment

Position	201X-10	201X-9	201X-8	201X-7	201X-6	201X-5	201X-4	201X-3	201X-2	201X-0.8	201X-0.5	201X	
	Specification of plant facilities	Plant suply contract	Start of earth work and civil contruction			Start of plant construction		In-service of house transformer	Functional tests of subsystems	Fuel loading beginning of comissioning	Tentative hand over of unit 1	Hand Over Unit 1	Commercial operation of twin units
General Manager, Nuolear Power Departemen	1	1	1	1	1	1	1	1	1	1	1	1	
Deputies													
Budget management during construction	1	1	1	1	1	1	1	1	1	1	1	1	
Site condition and environment assessment	2	2	2	2	2	2	2	2	0	0	0	0	
Construction management (Cont. Sche. And local govt affair etc)	2	2	2	2	2	2	2	2	2	2	2	2	
Planning of strategy for nuclear fuel cycle and waste disposal	1	1	1	1	1	1	1	1	1	1	1	1	
Procurement of nuclear fuel	2	2	2	4	4	4	4	4	3	3	3	3	
Plant facility specification(preparation of plant facility and specification.)	10	10	10	10	10	10	0	0	0	0	0	0	
Safety analysis and evaluation (preparation of SAR)	2	2	2	2	2	2	2	2	2	2	2	2	
Licensing affairs to the regulatory bodies	2	2	2	2	2	2	2	2	2	2	2	2	
Operation provision (planning of the plant op. prov. and built-up plant op)	2	2	2	2	4	4	4	1	1	1	1	1	
Quality assurance program strategy	2	2	1	1	1	1	1	1	1	1	1	1	
Total in the headquarters	**27**	**27**	**26**	**28**	**30**	**30**	**20**	**17**	**14**	**14**	**14**	**14**	
Plant Manager	0	0	0	1	1	1	1	1	1	1	1	1	1
Deputy Plant Manager for Engineering Management													1
Reactor Safety Staff										2	2	2	2
Training & Educations Staff								2	2	2	2	2	2
Quality Assurance Staff			2	2	2	2	2	2	2	2	2	2	3
Engineering & Technical Support Section												1	1
General Technical Affairs & Technical Support												3	9
(Technical consultant)													8
Configuration Control & Document Room												1	2
(Document room)												3	6
Nuclear Fuel & Reactor Core Section							0.33	0.33	1	1	1	1	1
Reactor Core Management & Fuel Handling							2	2	2	4	7	7	7
Radiation Control Section							0.33	0.33	1	1	1	1	1
Radiation Protection							2	2	6	17	17	17	17
(Radiation monitor maintenance)												2	2
(Radiation survey meter maintenance												5	5
(Access control to radiation area ang other supplementa work)										10	18	18	18
(Radioactive Waste Facilities Operation & Handling)											18	18	18
(Laundry work)										4	20	20	20
(Housekkeeping in the control area)											12	12	12
Environment Monitoring							2	2	2	2	7	7	7
(Environment research of sea area)													0
(Supplemental works of environment monitoring)												4	4

Position	201X-10 Specification of plant facilities	201X-9 Plant suply contract	201X-8 Start of earth work and civil contruction	201X-7	201X-6	201X-5 Start of plant construction	201X-4	201X-3 In-service of house transformer	201X-2 Functional tests of subsystems	201X-0.8 Fuel loading beginning of comissioning	201X-0.5 Tentative hand over of unit 1	201X Hand Over Unit 1	Commercial operation of twin units
Water Chemistry Control Section							0.33	0.33	1	1	1	1	1
Water Chemistry Control							2	2	3	8	8	8	8
(Supplemental works of chemical analisys)												9	9
(Water Proccessing Facilities Operation)										5	5	5	5
Deputy Plant Manager for Faolity Management and Operation													1
Facility Management Section											1	1	1
Facility Modification Planning													6
Steam Generator Cleanup Taskforce													5
Maintenance Budget & Account											4	4	4
Work Planning for Refueling Outage											4	4	4
Plant Operation Section								1	1	1	1	1	1
Expenditure & Operation Section Management											2	3	4
Plant Operation Management								2	4	4	6	6	8
(Supplementary work for plant facility operation)													1
Isolation Planning for Refueling Outage											5	5	5
Operation Shift													
Shift supervisor									6	6	6	6	6
Unit Supervisor									6	6	6	6	12
Operator								5	12	12	12	12	24
Patroller								5	18	18	18	18	30
Deputy Plant Manager for Plant Maintenanoe													1
(Daily maintenance work of plant facilities, outsorching)													212
Electrical Maintenance Section							0.5	0.5	1	1	1	1	1
Instrumentasion & Control System – Primary system							2	2	5	5	5	16	16
Instrumentasion & Control System – Turbine Island							2	2	4	4	4	13	13
(Control valve maintenance)												7	7
Electrical Equipment							2	2	4	4	4	13	13
(Maintenance tool room)											2	2	2
Mechanical Maintenance Section							0.5	0.5	1	1	1	1	1
Reactor System							2	2	4	4	4	13	13
Balance of Plant							2	2	5	5	5	16	16
Turbine Island							2	2	3	3	3	11	11
(Spare-parts storage and machine shop)											2	2	2
Architectural Maintenance Section			1	1	1	1	1	1	1	1	1	1	1
Building			1	1	2	2	2	2	2	2	2	3	3
Civil Facility & Earthwork			2	2	2	2	2	2	2	2	2	3	3
Total in the power plant	0	0	6	7	8	8	29.99	44.99	100	139	223	318	597

Training timeline for NPP key personnel



Training for Key-person of NPP Personnel

Job Area	Topic of Training	Duration	-12	-11	-10	-9	-8	-7	X
Safety analysis	Sistems of nuclear power plant	1Y							
	Basic of sgery analysis	3 M							
	Plant system and safety analysis	2 Y							
Nuclear Fuel	Sistems of nuclear power plant	3 M							
	Nuclear core characteristics	1 Y							
Specification on plant facilities and equipment									
	Systems of nuclear power plant	1 Y							
Mechanical equipment on the primary island	Function and specifications of equipment in the primary island	2 Y							
Mechanical equipment on the seconday island	Systems of nuclear power plant	1 Y							
	Function and specifications in the secondary island	1 Y							
Water purification facility and other facility in secondary island	Systems of nuclear power plant	1 Y							
	Function and specification of facitities	2 Y							
Instrumentation and control system	Systems of nuclear power plant	1 Y							
	Function and specification of I and C in the primary island	1 Y							
	Function and specification of I and C in the secondary island	1 Y							
Electrical equipment	Systems of nuclear power plant	1 Y							
	Function and specification of electric equipment	1 Y							
System for monitoring and protecting radiation exposure	Systems of nuclear power plant	1 Y							
	Function and specification of radiation control systems	2 Y							
Water chemistry and bio assessment	Systems of nuclear power plant	1 Y							
	Equipment for water chemistry and bio assessment	2 Y							
Reactor core and nuclear fuel	Systems of nuclear power plant	1 Y							
	Function and specification of equipment for fuel handing	2 Y							
Archiecture and civil work	Systems of nuclear power plant	3 M							
Planning of operator build up and operation									
Operation-related system	Systems of nuclear power plant	1 Y							
	Plant operation and operation management	1 Y							

Training for Key-person of NPP Personnel

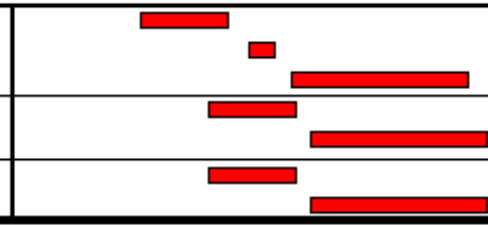
(continued)

Job Area	Topic of Training	Duration	-8	-7	-6	-5	-4	-3	-2
Witness during plant construction									
Mechanical equipment in reactor facility	Systems of nuclear power plant	1 Y							
	Function and specifications of equipment in the primary island	2 Y							
Mechanical equipment in balance of plant of primary island	Systems of nuclear power plant	1 Y							
	Function and specifications of equipment in the primary island	2 Y							
Mechanical equipment in turbine and other seconday island	Systems of nuclear power plant	1 Y							
	Function and specifications of equipment in the primary island	2 Y							
I&C system in the primary island	Systems of nuclear power plant	1 Y							
	Function and specifications of I & C in the primary island	2 Y							
I&C system in the seconday island	Systems of nuclear power plant	1 Y							
	Function and specifications of I & C in the secondary island	1 Y							
Electrical equipment	Systems of nuclear power plant	1 Y							
	Function and specifications of electric equipment	2 Y							
Equipment for managing the reactor core and nuclear fuel assembly	Systems of nuclear power plant	1 Y							
	Function and specifications of equipment for fuel handling	2 Y							
Radiation monitoring and protection environment monitoring	Systems of nuclear power plant	1 Y							
	Function and specifications of radiation control system	2 Y							
Equipment for water chemistry and bio assessment	Systems of nuclear power plant	1 Y							
	Equipment for water chemistry and bio assessment	2 Y							
In-service of transformer and function test of sub system									
Training of education staff	Systems of nuclear power plant	1 Y							
	Requered qualifications of plant personel	1 Y							
Manager and staff of plant operation section	Systems of nuclear power plant	1 y							
	Plant operation and operation management	1 Y							
Shift supervisor	Systems of nuclear power plant	1 Y							(including simulato
	Plant operation	2 Y							
Unit supervisor	Systems of nuclear power plant	1 Y							
	Skill-up in the plant operation	1 Y							(including simulato
	Plant operation	2 Y							
Plant operator	Systems of nuclear power plant	1 Y							
	Skill-up in the plant operation	1 Y							(including simulato
	Plant operation	2 Y							

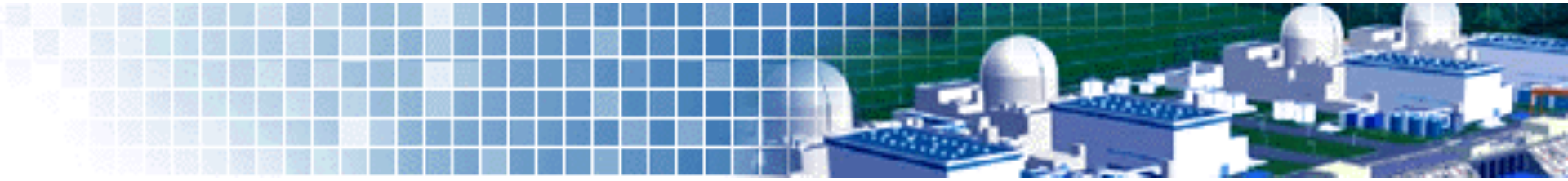
Training for Key-person of NPP Personnel

(continued)

Job Area	Topic of Training	Duration	-6	-5	-4	-3	-2	-1	X
Deliver of nuclear fuel and tentative hand over of system									
Nuclear safety staff	Sistems of nuclear power plant	1 Y							
	Basic of sgery analysis	3 M							
	Plant system and safety analysis	2 Y							
Work Planning for refueling outage	Sistems of nuclear power plant	1 Y							
	How to plan the work schedule of refueling outage	2 Y							
Isolation planning for refueling outage	Sistems of nuclear power plant	1 Y							
	How to prepare the isolation for refueling outage	2 Y							

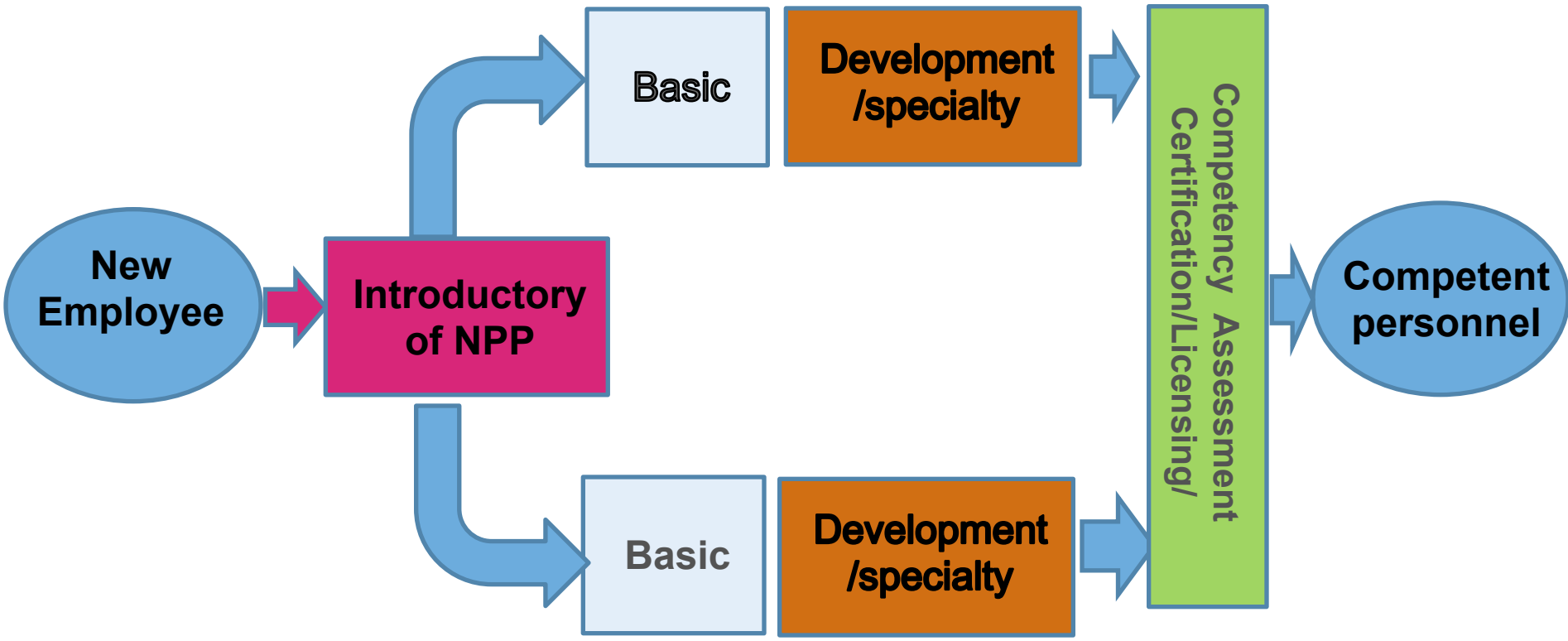


Training Schema and Certification



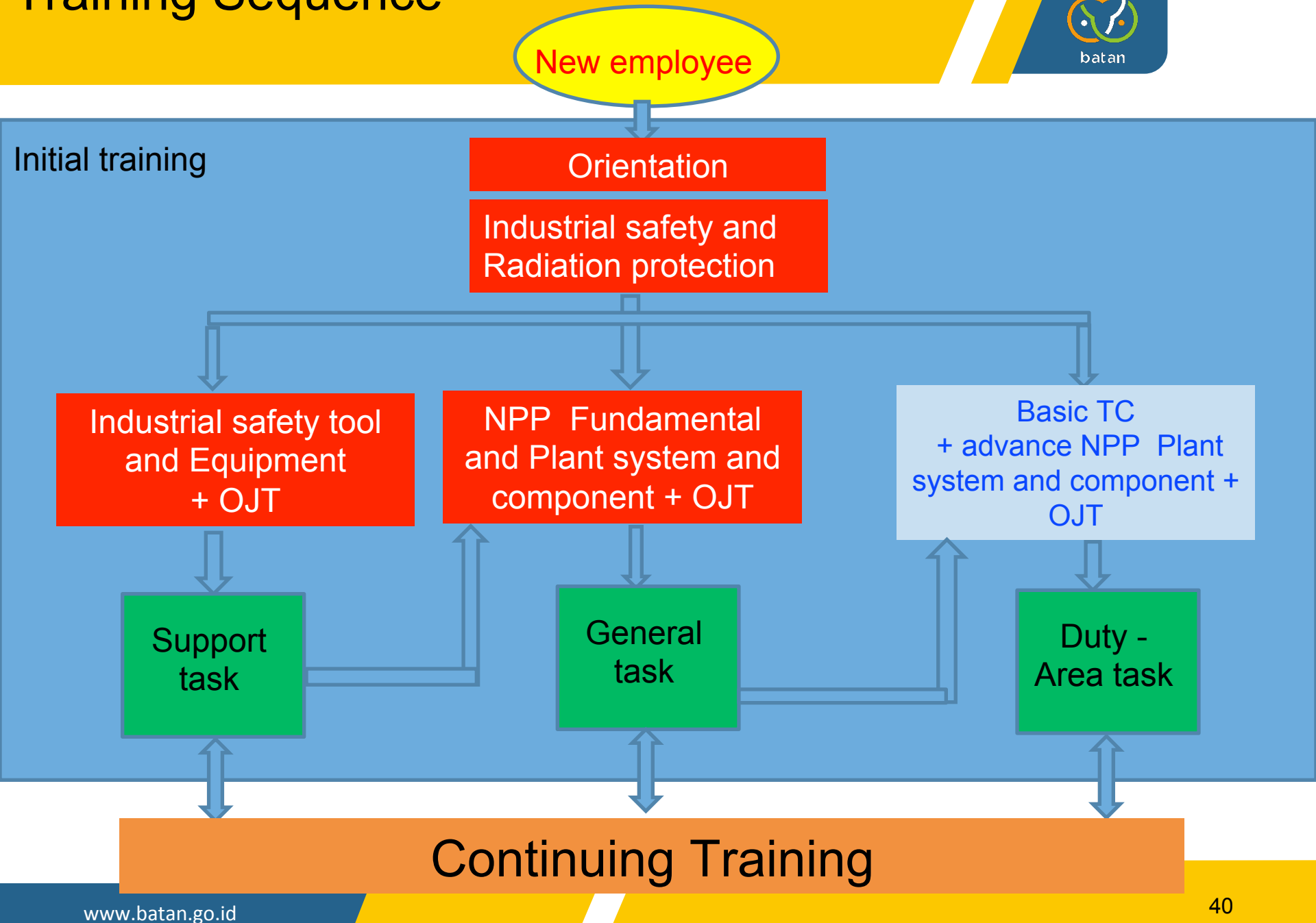
Training and Certification

Technician (nuclear Island /BOP)

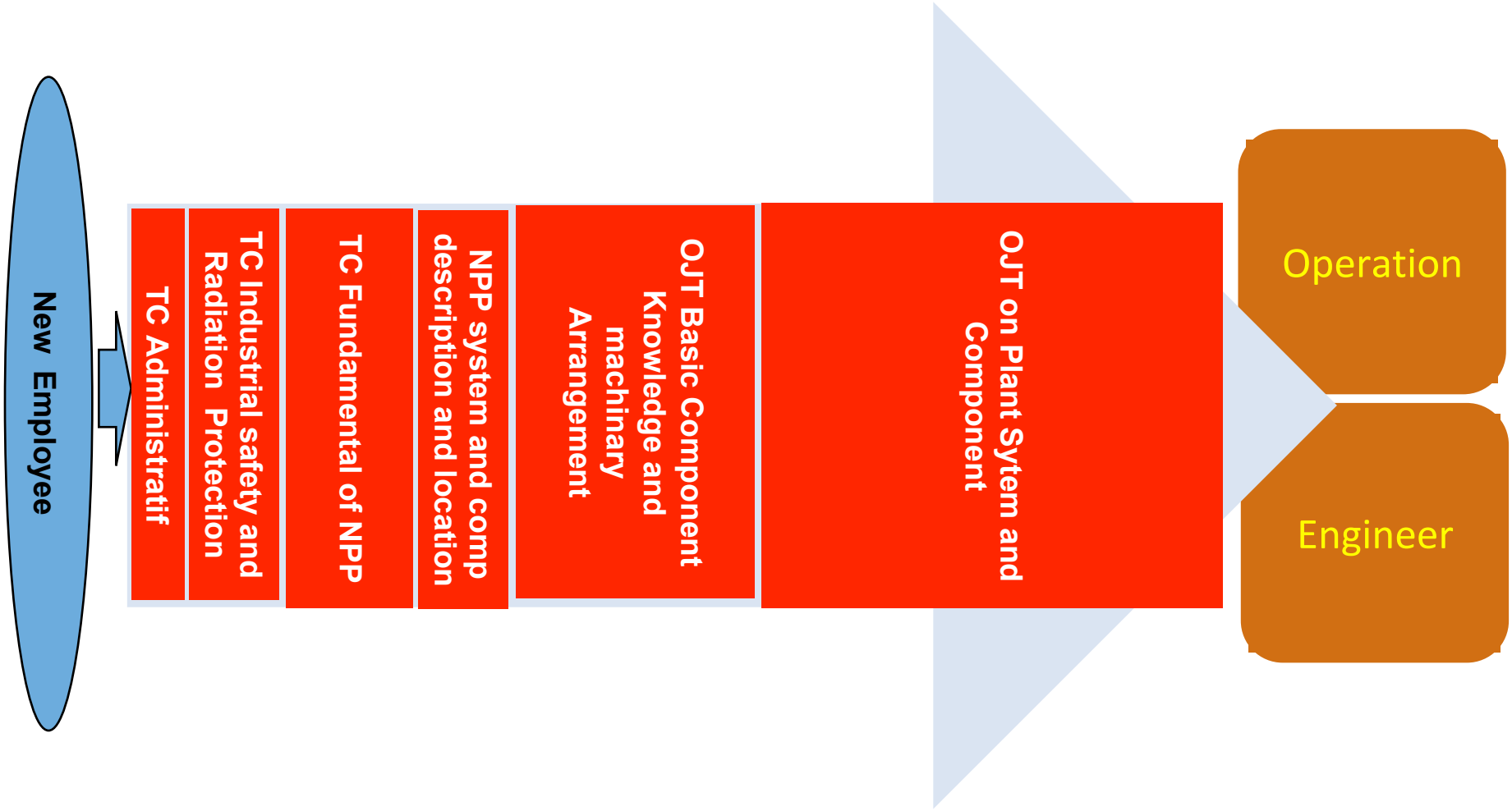


Engineer (Nuclear Island/BOP)

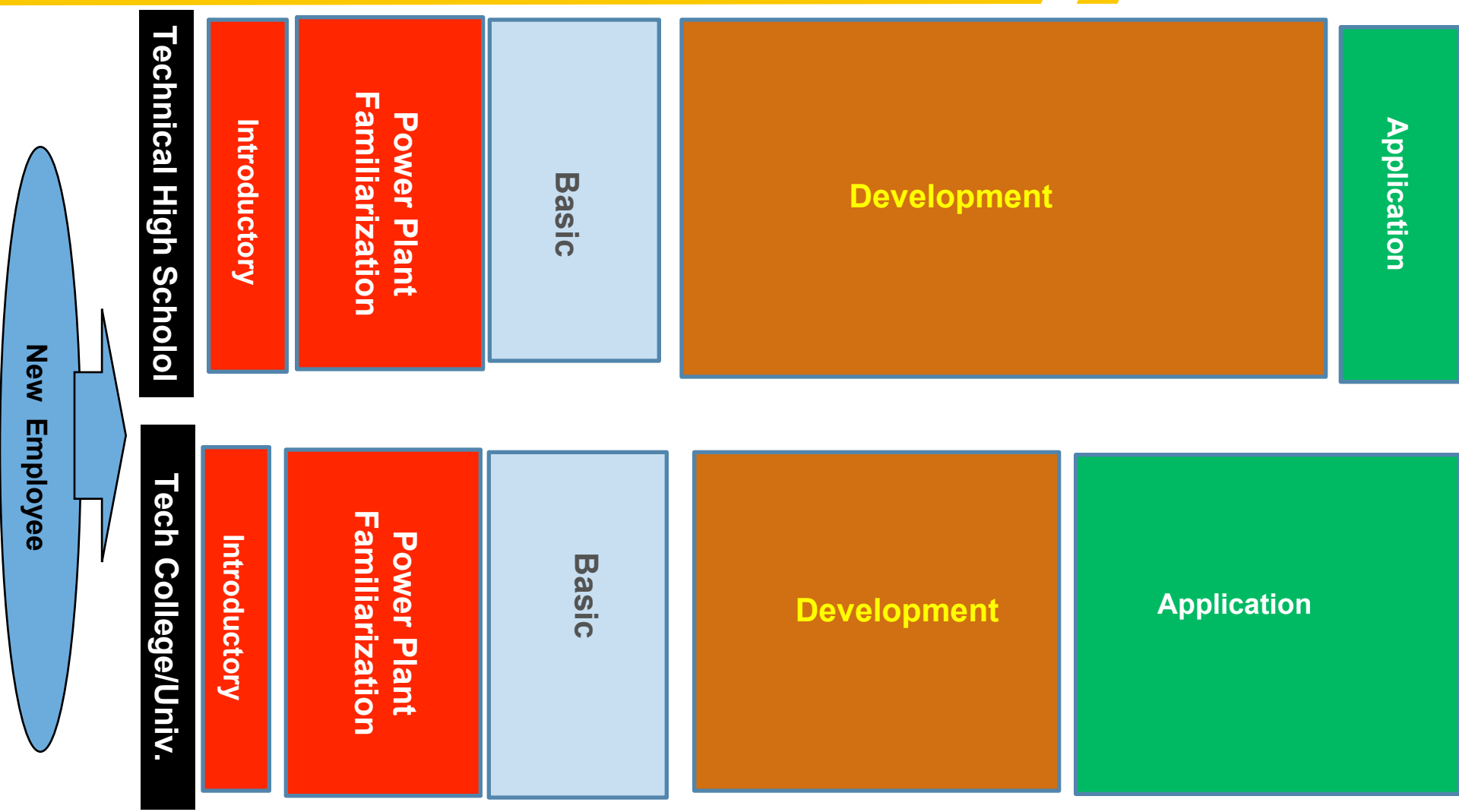
Training Sequence



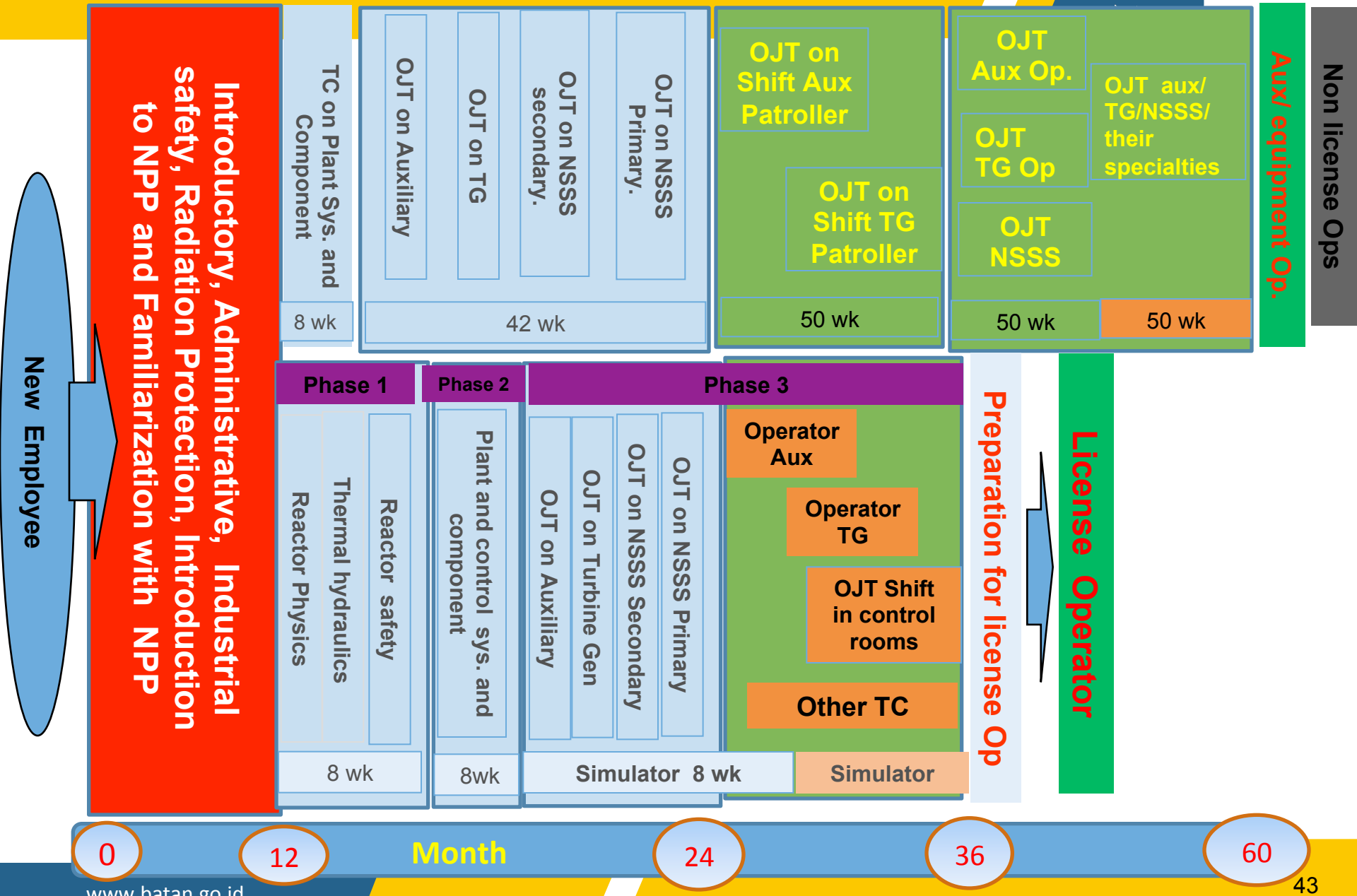
Introductory Training for New Employee



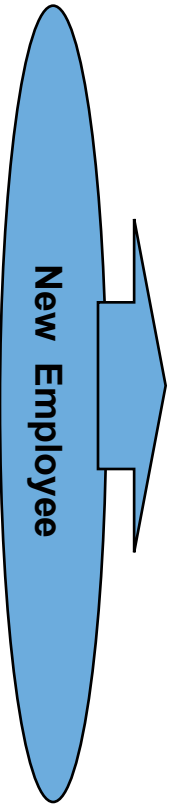
Training Scheme for Operator



Training Scheme for Operator



Training Scheme for maintenance



Technical High school

Tech. College/Univ.

Introductory ,Administrative, Industrial Safety, Radiation Protection, Introduction to NPP and Familiarization with NPP

Basic

Dev. In Instrumentation

Dev. In Electrical

Dev. In Mechanical

Dev In Civil and architecture

Application

Basic

Dev. In Instrumentation

Dev In Electrical

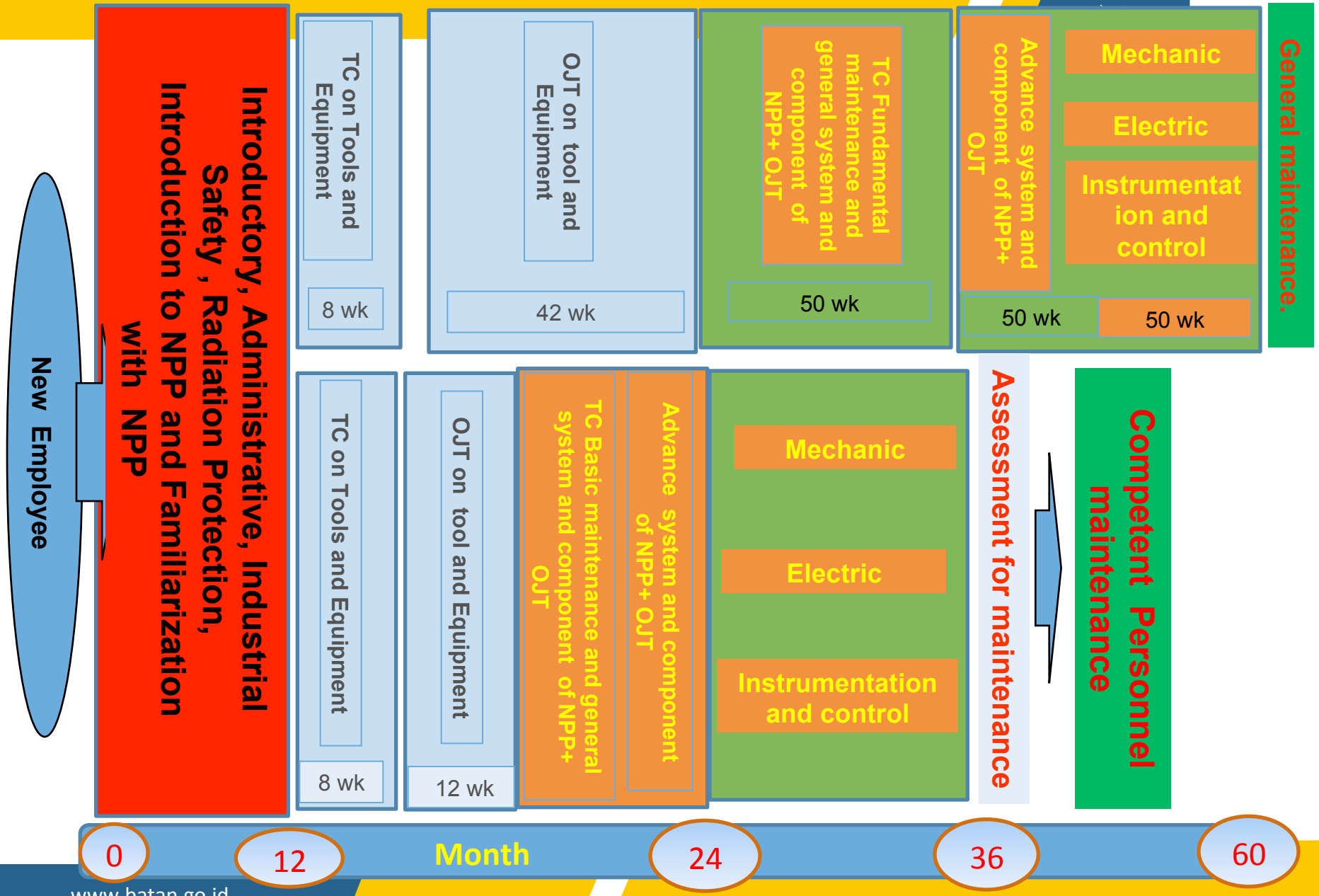
Dev In Mechanical

Dev. In Civil and architecture

Application

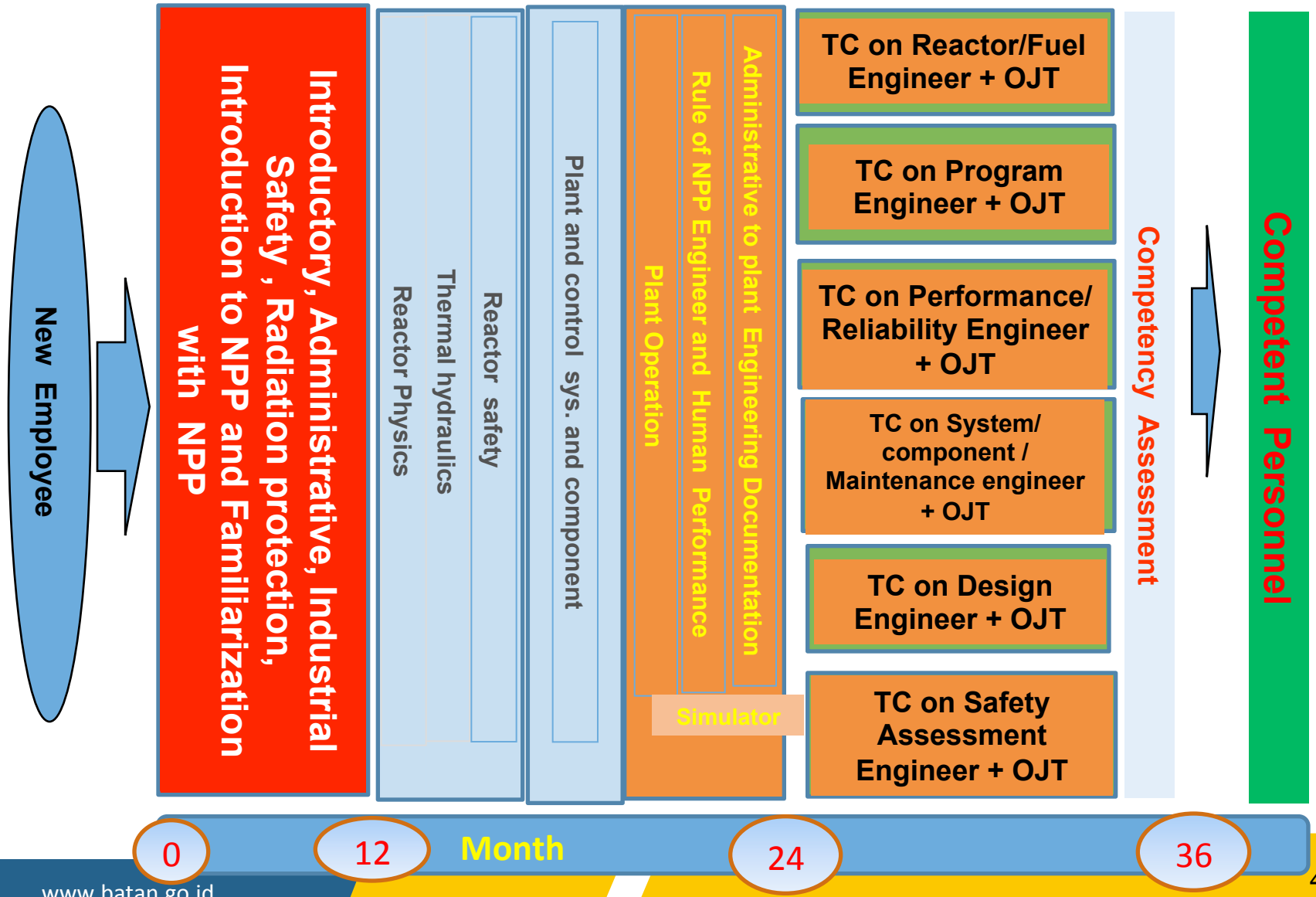
0 12 Month 24 36 60

Detail Training Scheme for Maintenance

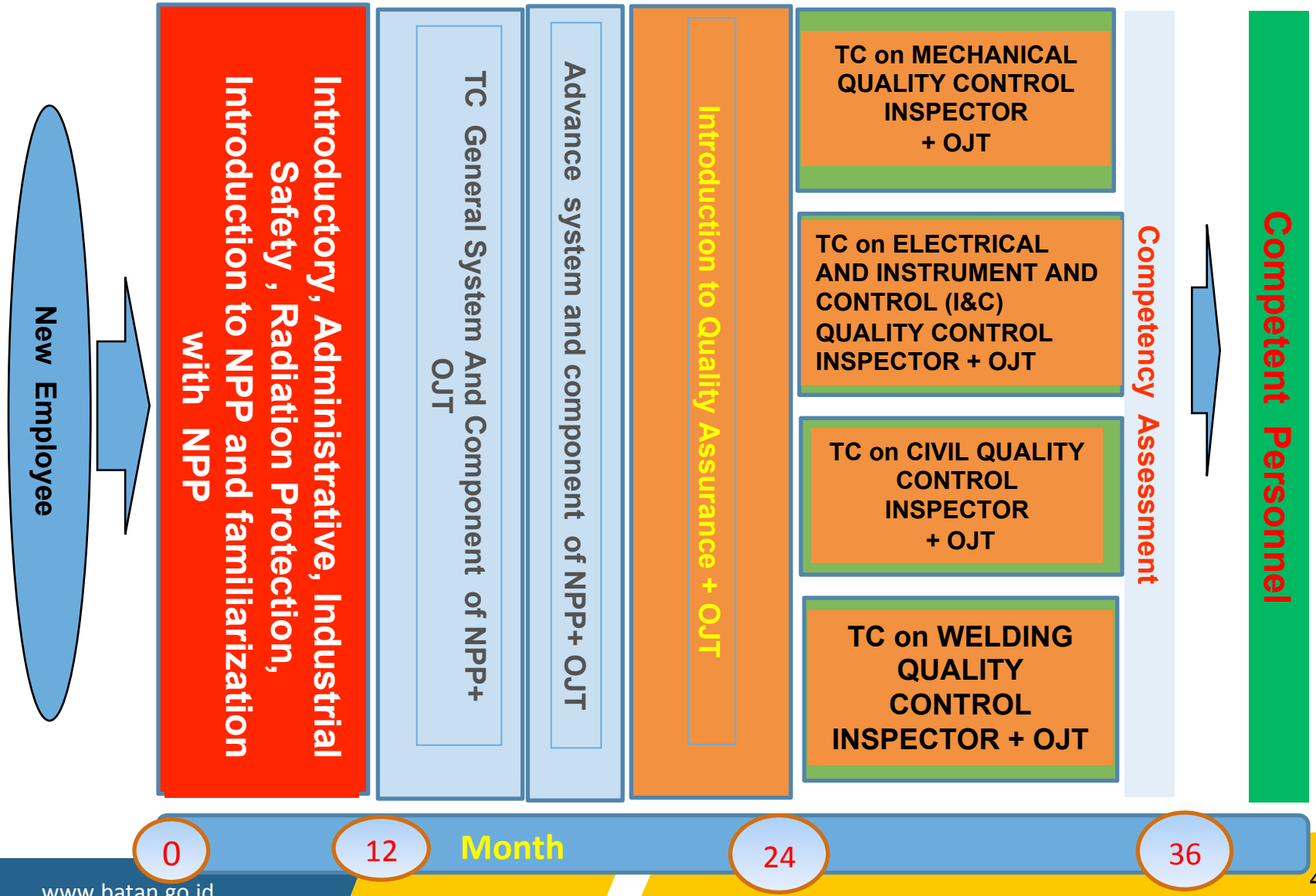


Training Scheme for Radiation Protection, Chemistry , Waste and environment personnel

Training Scheme for Engineer



Training scheme for new plant construction quality assurance auditor, quality control inspector, and nondestructive examination



Conclusion

- Human resource development is an important component of nuclear infrastructure and needs a long term commitment from the stakeholders.
  - Infrastructure readiness
  - Program readiness
- The HRD program for NPP is essential to be developed and implemented:
  - to develop adequate number of qualified human resource timely
  - to to convince the public that Indonesian personnel are capable

Conclusion

- Considerable effort has to be devoted to design and develop training materials, and to prepare instructors as well as training facilities.
- Cooperation with stakeholders are very beneficial in order to develop and implement the HRD program.

Thank You
Any Questions?

BADAN TENAGA NUKLIR NASIONAL

Jl. Kuningan Barat, Mampang Prapatan Jakarta, 12710

(021) 525 1109 | Fax. (021) 525 1110

humas@batan.go.id

Humas Batan @humasbatan badan_tenaga_nuklir_nasional Humas Batan