ROSATOM

ROSATOM STATE CORPORATION FOR NUCLEAR ENERGY

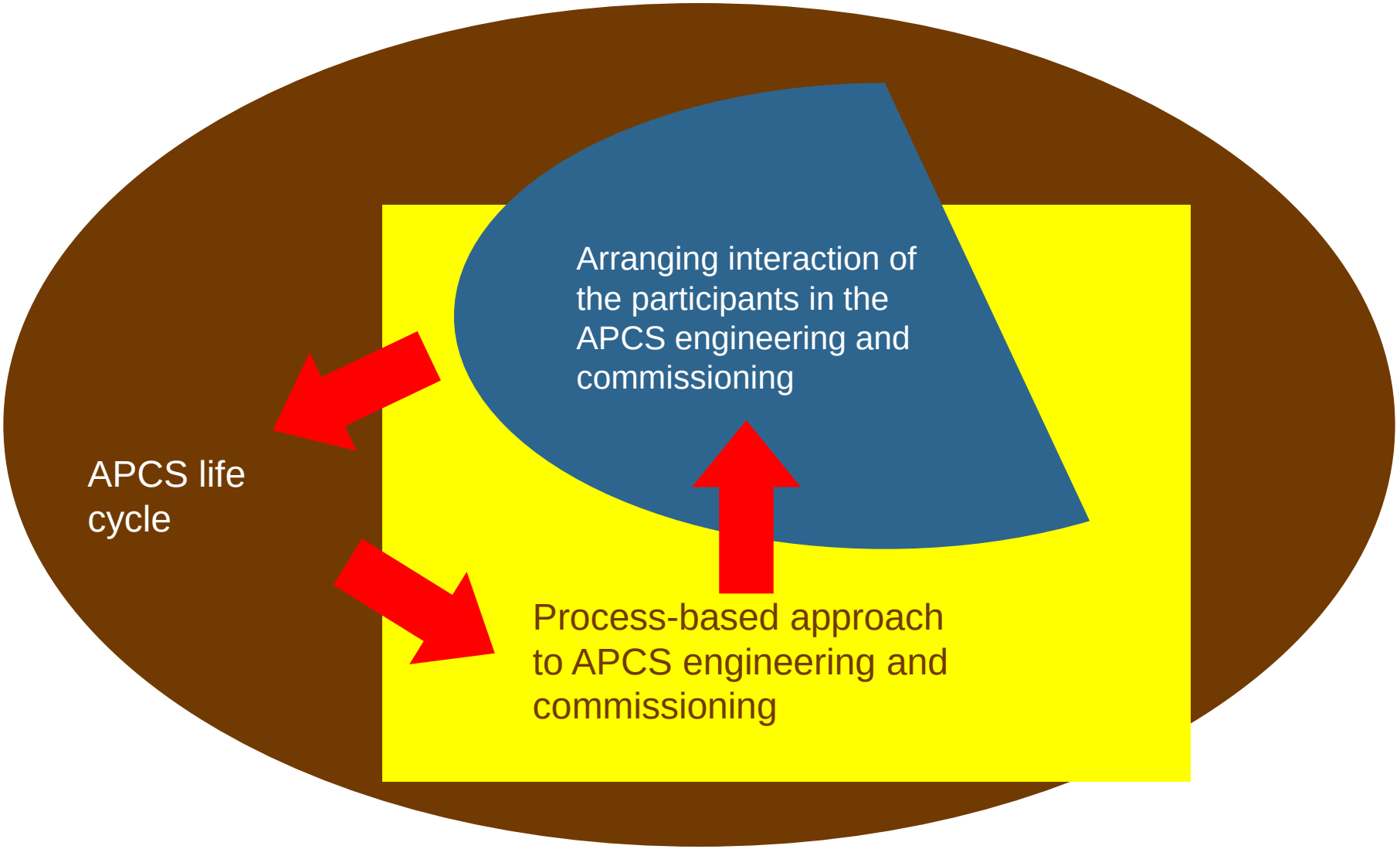
Application of system integration practices in the interaction with suppliers of process control systems

A.N. Anokhin

Deputy Director of the Department –
Head of the Functional
Analysis, HMI, and Ergonomics Department
Rusatom Automated
Control Systems JSC

IX International Forum
ATOMEXPO 2017
Moscow, November 14-16, 2017.

Contents


Arranging interaction of the participants in the APCS engineering and commissioning
APCS life cycle
Process-based approach to APCS engineering and commissioning

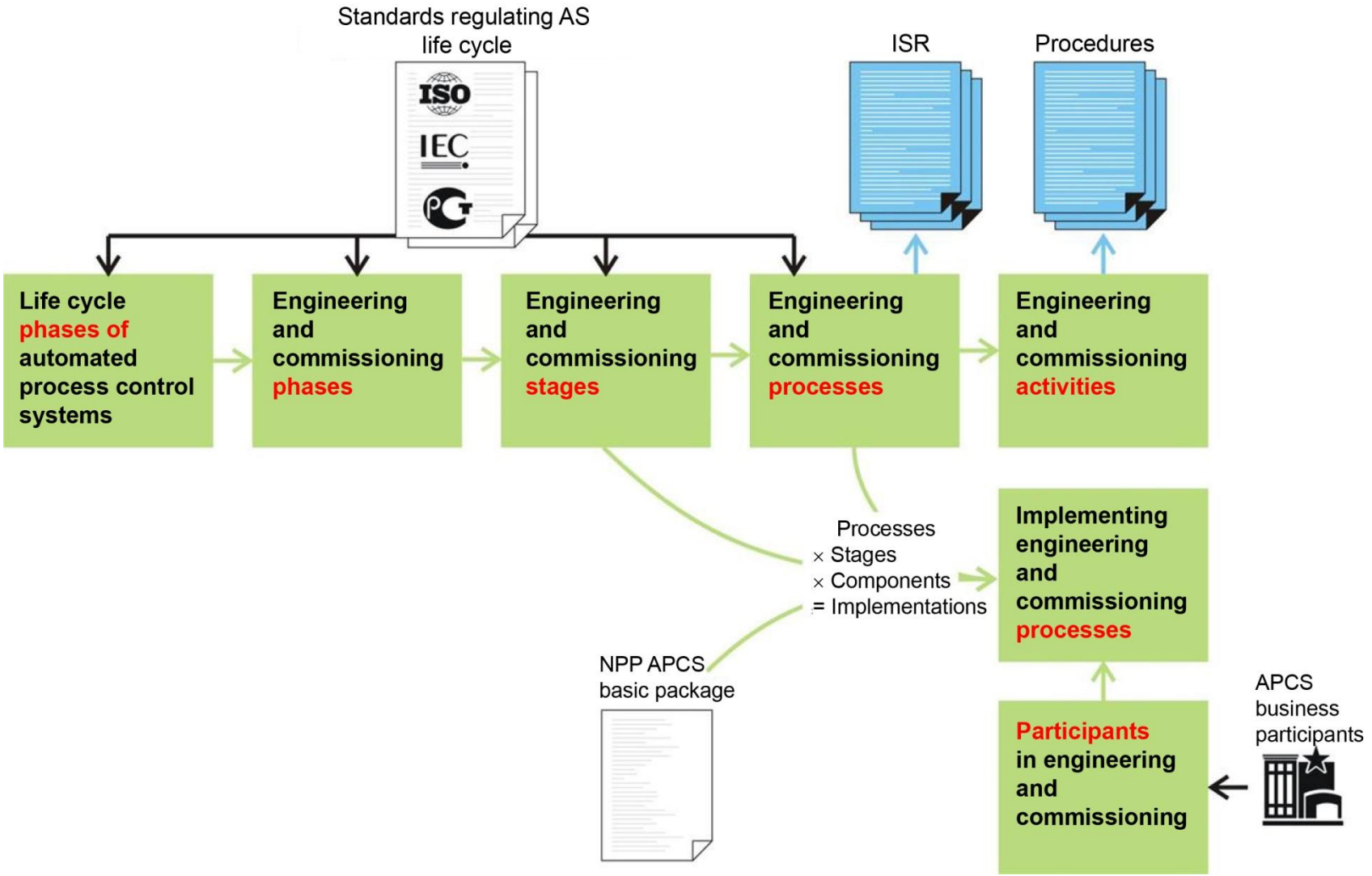
System integration

System integration is a part of the system engineering meant to ensure APCS engineering and commissioning using the applicable set of processes and through the monitoring of process execution by the organizations (divisions) involved in APCS engineering and commissioning. System integration, along with the process-based approach, creates the basis for the successful implementation of expensive branching NPP APCS projects.

System integration is often confused with architectural complexing and design as defined in GOST R ISO/IEC 15288-2005 as follows:

The purpose of *complexing* is to build the system as per the architectural design. In this process, the system elements shall be combined in such a way as to shape a configuration of the entire system or a part thereof and create the product in accordance with the system requirements specified.

APCS LC model structure



Life cycle phases of automated process control systems

GOST R 57193-2016
R 50-605-80-93
IAEA NES NP-T-3.12
GOST R ISO 61513-2011
GOST R IEC 61508
IAEA SSG-39
GOST 34.601-90

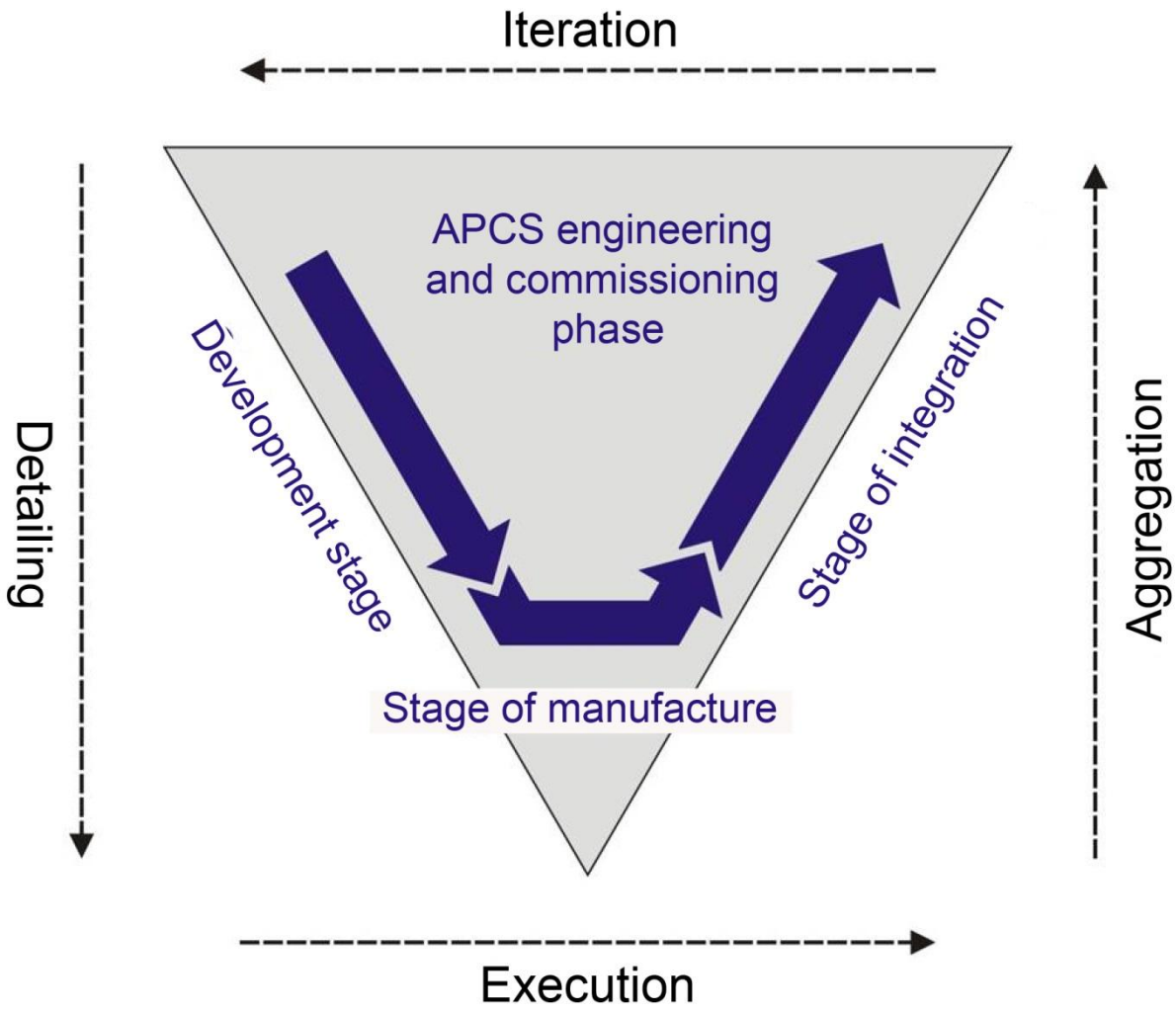
Operation and modernization phases can cyclically alternate several times until the system is decommissioned

APCS engineering and commissioning phase

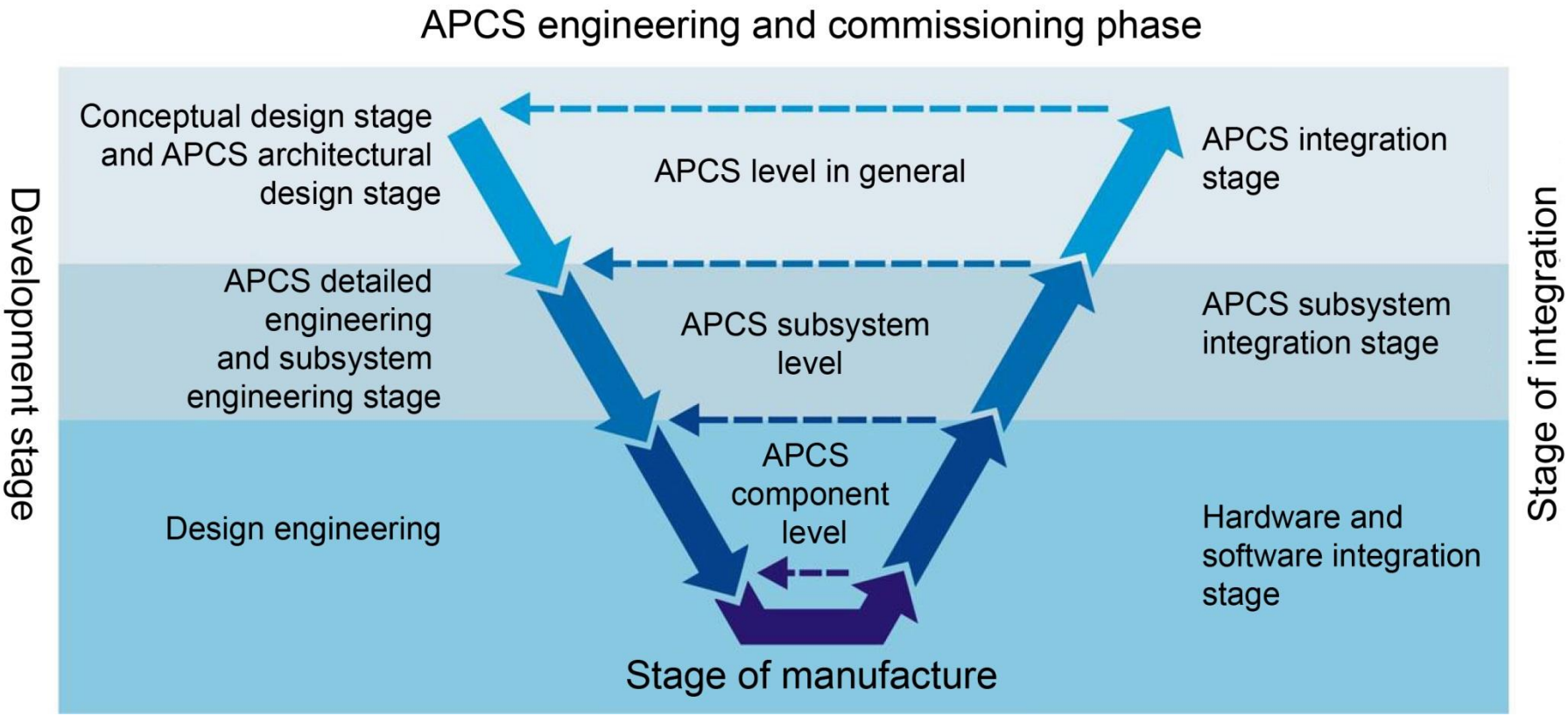
Stage	LC processes incorporated in the phase	APCS status upon the completion of the phase
Development phase	The processes that are performed from the commencement of work until the beginning of manufacturing	Readiness for manufacturing, which is confirmed by the availability of a complete set of documentation required for APCS manufacturing
Stage of manufacturing	The processes that are performed from the commencement of development until the beginning of complexing	Readiness for complexing, which is confirmed by the availability of complexing elements and documents required for APCS complexing
Phase of complexing	The processes that are performed from the completion of manufacturing until the beginning of operation	Readiness for operation, which is confirmed by the availability of the APCS complexed and the documents required for APCS operation

APCS engineering and commissioning phases

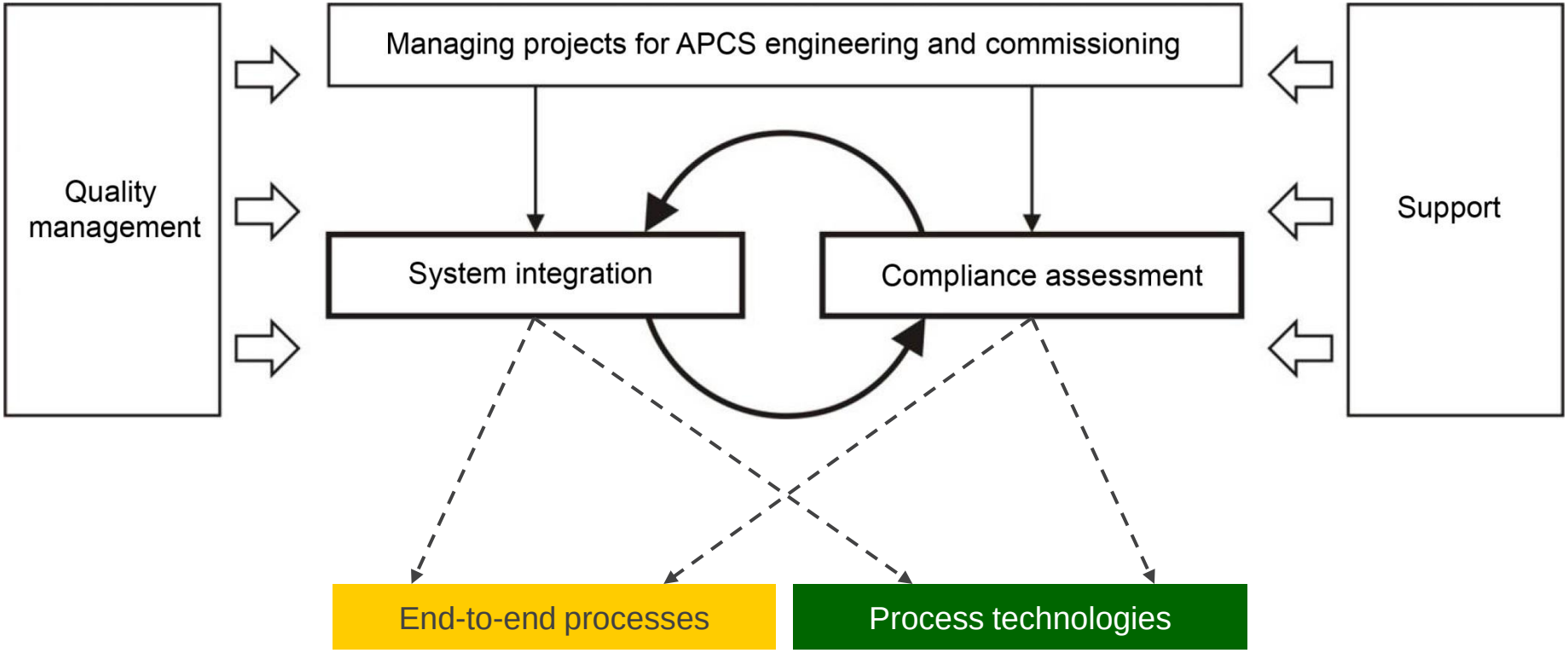
GOST R 57193-2016
R 50-605-80-93
IAEA NES NP-T-3.12
GOST R ISO 61513-2011
GOST R IEC 61508
IAEA SSG-39
GOST 34.601-90



APCS engineering and commissioning stages



Groups for implementing APCS engineering and commissioning processes



APCS engineering and commissioning processes

ROSATOM

GOST 34.003-90
GOST R 57193-2016
R 50-605-80-93
IAEA NES NP-T-3.12
GOST R ISO 61513-2011
GOST R IEC 61508
IAEA SSG-39
GOST 34.601-90

In-house
experience of RASU JSC

System integration

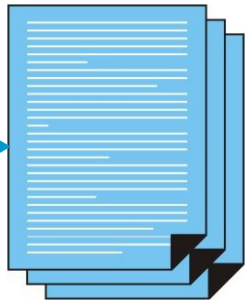
Development	Manufacturing	Integration
Functional design	Equipment manufacture	Installation and setup
Architectural design		
Software development		
Dataware development		
Knowledge base modeling and design		
Hardware development		
Human machine interface (HMI) design		
Workplace and control station design		
Reliability and safety analysis and assurance		
Cyber security design		
Orgware development		
Designing operation facilities		

- Managing requirements
- Managing configuration (changes, inconsistencies)
- Considering human factors
- Managing reliability, aging, and maintenance
- Managing cyber security (IT and computer security)
- Managing models
- Metrological support
- Considering the best operating practices

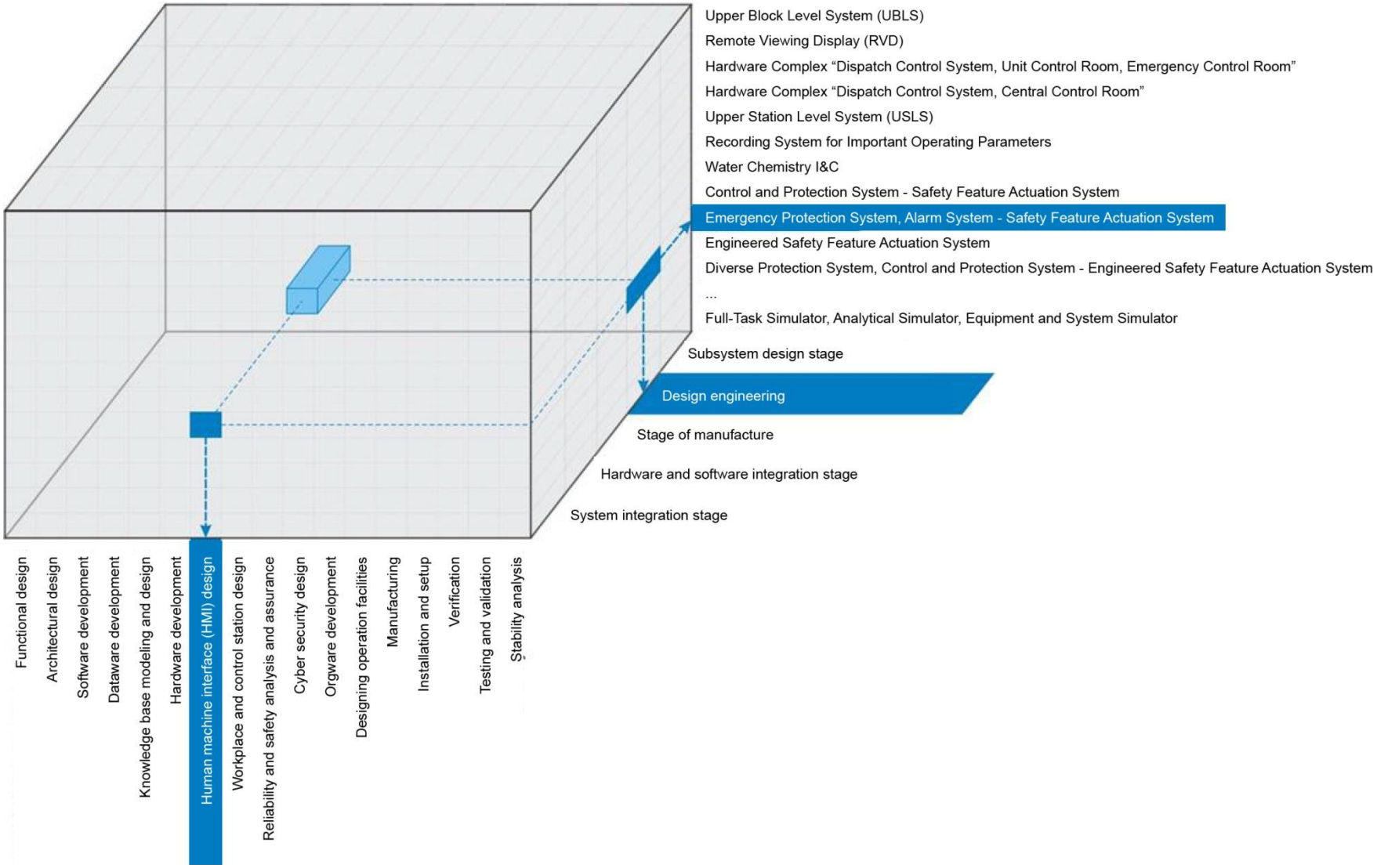
Compliance assessment

Verification | Testing and validation | Stability analysis

ISR



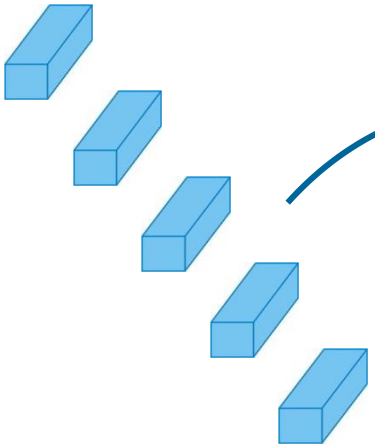
Implementing APCS engineering and commissioning processes



Participants in APCS engineering and commissioning

Roles in relation to the process

Designer | Owner | Contractor



Implementing
APCS engineering
and commissioning processes

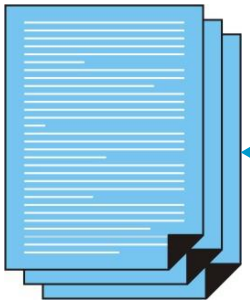
APCS business participants

APCS engineering and commissioning activities (sub-processes)

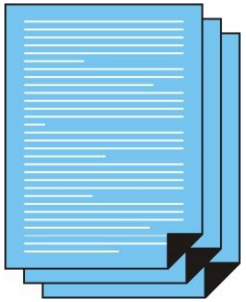
ROSATOM

Process	Stage			Business	Describing level-based activities	
	Development	Manufacturing	Integration		APCS in general	APCS subsystem
Human machine interface (HMI) design	●			Analyzing operator's tasks to control and manage processes	Developing HMI and alarm system concepts	
				Developing rules for encoding information		
				HMI prototyping		
				Developing video frames, panels, and control stations		
Workplace and control station design	●			Analyzing operator's tasks on communicating and document handling		
				Simulation, modeling, and ergonomic analysis of work-places and control stations		
				Workplace and control point ergonomic design		
Reliability and safety analysis and assurance	●			Failure tree analysis (FTA)		
				Functional chart analysis		

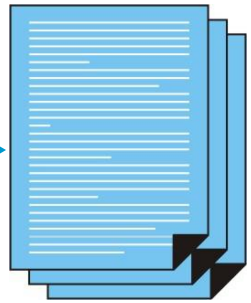
ISR



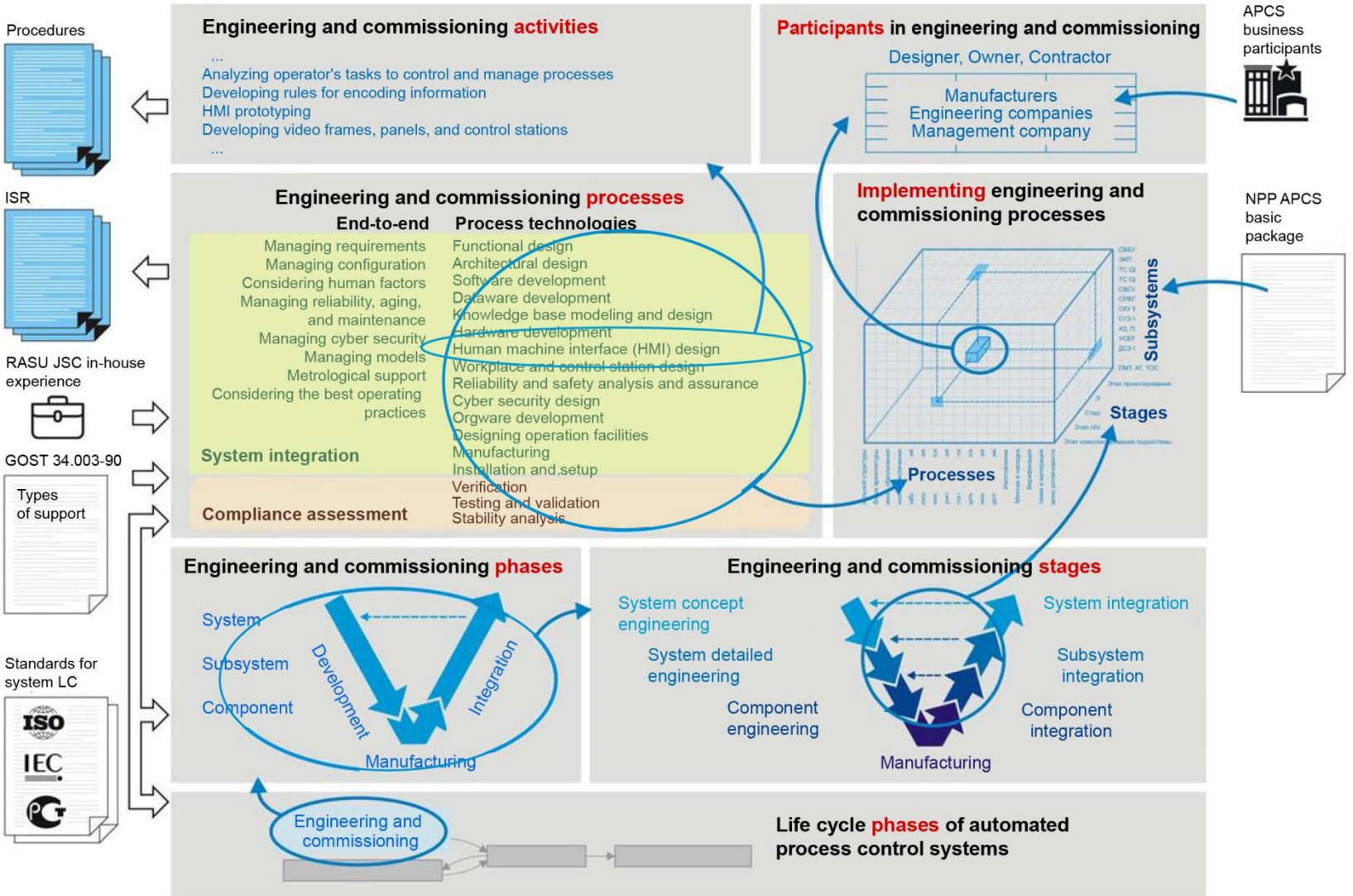
Design documents



Methodology guidelines



Model of participants' interaction in the APCS engineering and commissioning



ROSATOM STATE CORPORATION FOR NUCLEAR ENERGY

ROSATOM

Any questions?

Application of system integration practices in the interaction with suppliers of process control systems

A.N. Anokhin
Deputy Director of the Department –
Head of the Functional Analysis, HMI,
and Ergonomics Department