



# Outline of "APEC Guideline for Quality Electric Power Infrastructure (1<sup>st</sup> draft)"

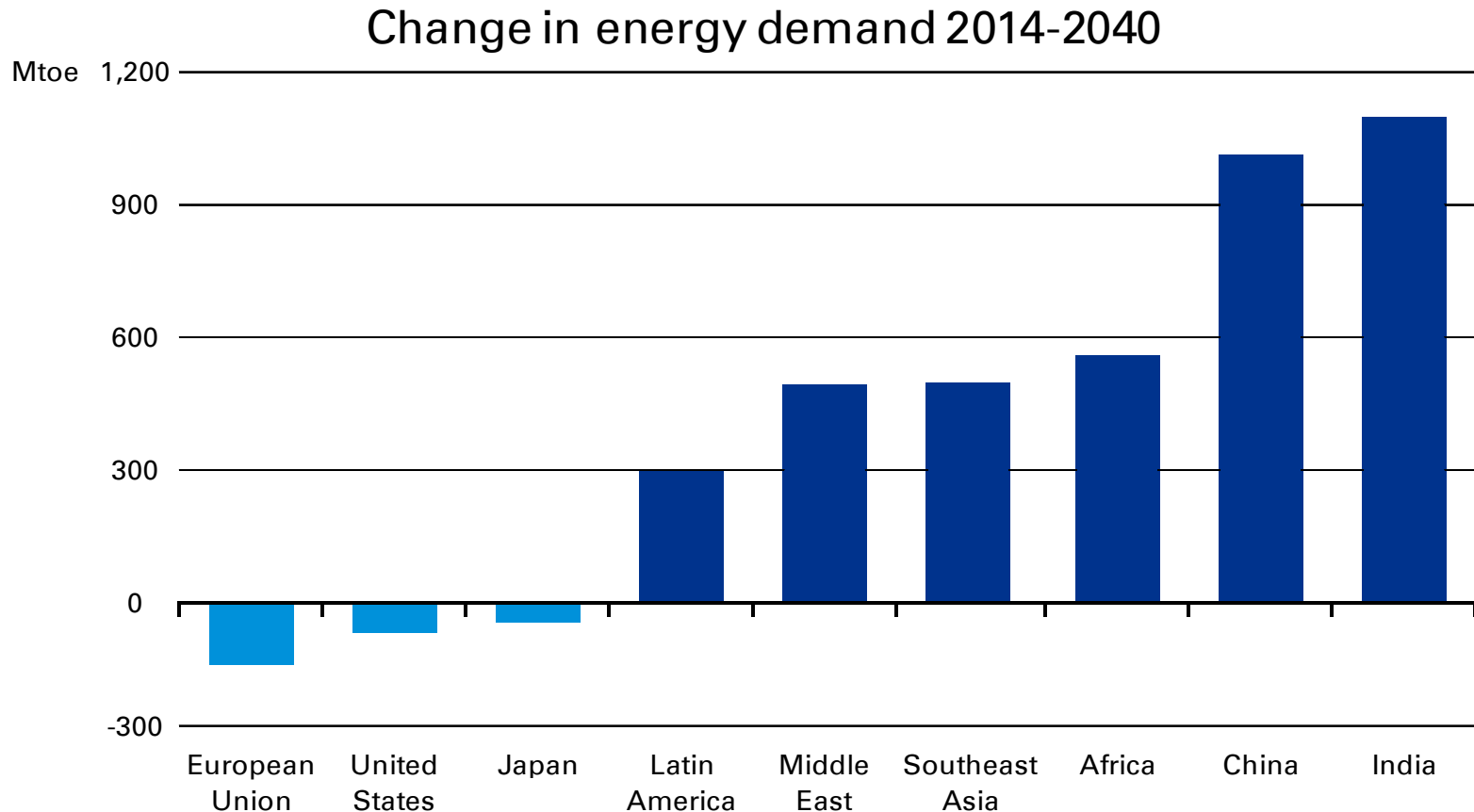
30 August 2016



# Overview

# (1) Background - Energy Demand

In many APEC economies, energy demand will increase mainly due to its rapid economic growth.

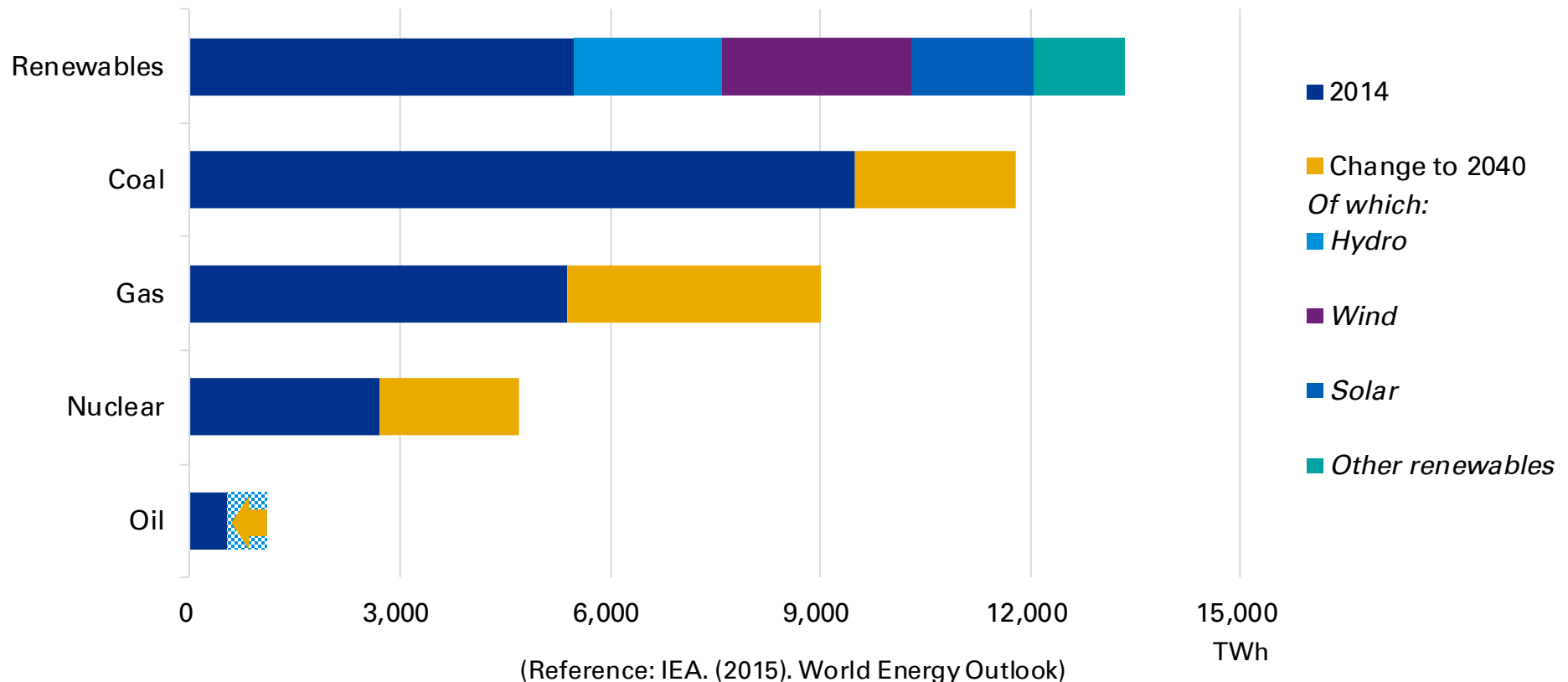


(Reference: IEA. (2015). World Energy Outlook)

# (2) Background - Electricity Generation by Source

In 2040, renewables become the largest power source, but thermal power generation remains the important power source.

World electricity generation by source



(Reference: IEA. (2015). World Energy Outlook)

## (3) Background - Quality of Infrastructure

- Bad electricity infrastructure causes shortage of electricity, delayed start of operation and frequent outages, may hamper economic growth.
- To continuously rely on thermal power generation, environmental issues such as CO<sub>2</sub> emission reduction should be considered in selecting electricity infrastructure.



**Developing high quality electric power infrastructure is one of the most important and urgent tasks for APEC economies.**

## (4) APEC Initiative for Enhancing the Quality of Electric Power Infrastructure

- Based on this background, “APEC Initiative for Enhancing the Quality of Electric Power Infrastructure” has been launched in June 2015.
- This initiative is cosponsored by the Philippines, Peru, Chinese Taipei and the United States, in order to develop high-quality electric power infrastructure and provide stable supply of electricity in the region.
- At the EMM12 in Cebu, APEC Energy Ministers welcomed the launch of this initiative.

# (2) What and Why the Guideline?

## 1. Objective

- To share knowledge and best practices each economy has for assuring the Quality of Electric Power Infrastructure.

## 2. Scope

- Main focus is on thermal power plant, but the concept is universal to all source.

## 3. Contents

- Definition of “Quality”.
- Elements to be considered and metrics to be used for evaluation.

## 4. Potential users

- Electric power providers including IPP.
- Government officials involving electricity policy.

## (3) Structure of the Guideline

- The Guideline consists of 5 parts: Introduction, Part I to III, and 4 Appendixes.
- Part I defines the “Quality of Electric Power Infrastructure (QEPI here on)”.
- Part II and III provides factors to be considered to secure the quality during feasibility study, planning and construction phase and operation phase respectively.



# (4) Conceptual Diagram

**Part I** What is “the Quality of Electric Power Infrastructure (QEPI)”?



**Part II**  
FS, planning and construction  
phase

**Part III**  
Operation phase

## Appendix



1. Metrics of performance during FS, planning and construction phase
2. Examples of evaluation criteria for the P/Q
3. Examples of qualification criteria in bidding specification

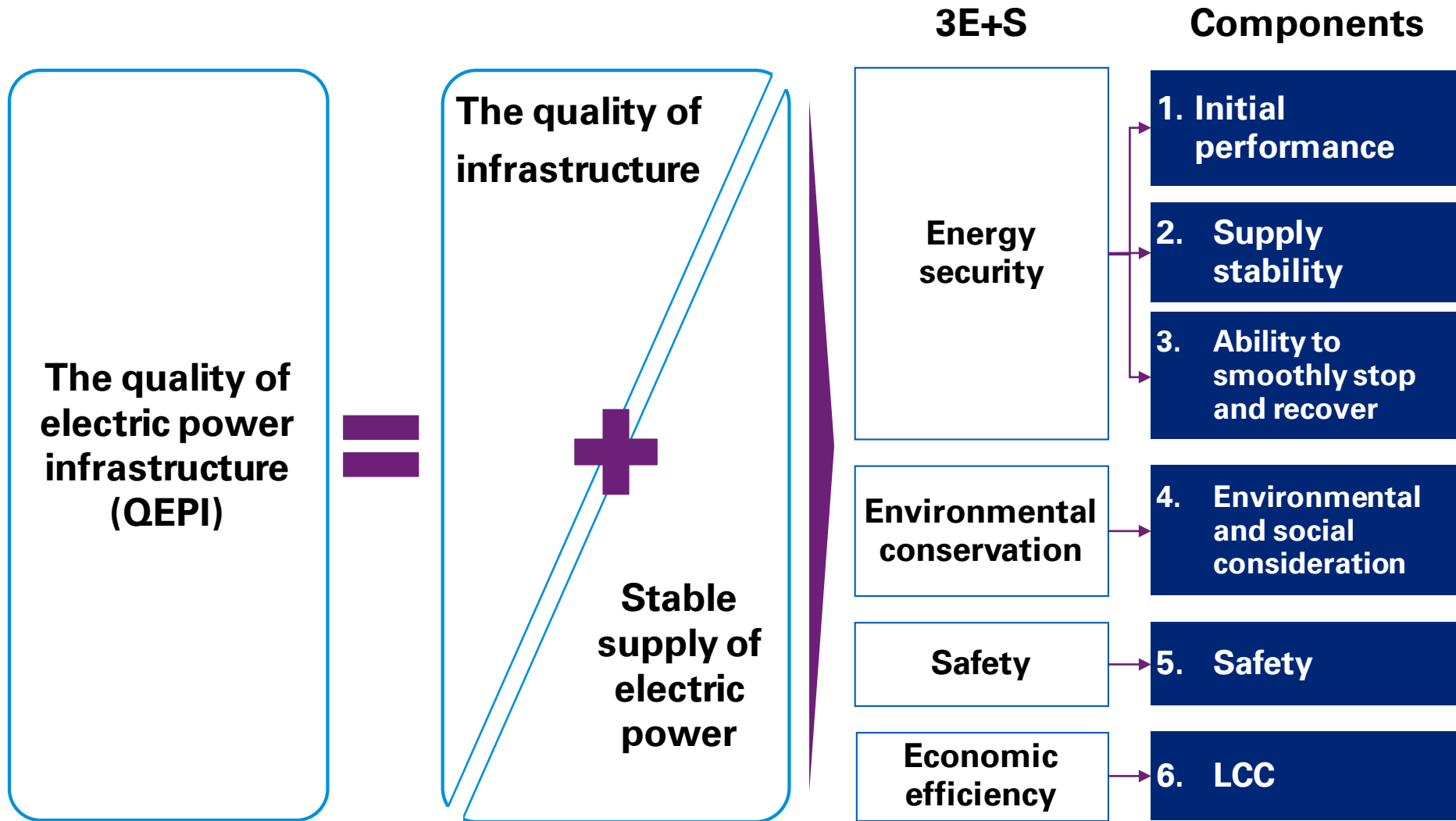
4. Metrics of performance indicators in operation phase



# Part I

What is “the Quality of Electric Power Infrastructure (QEPI)”?

# (1) What is “the Quality of Electric Power Infrastructure (QEPI)”?

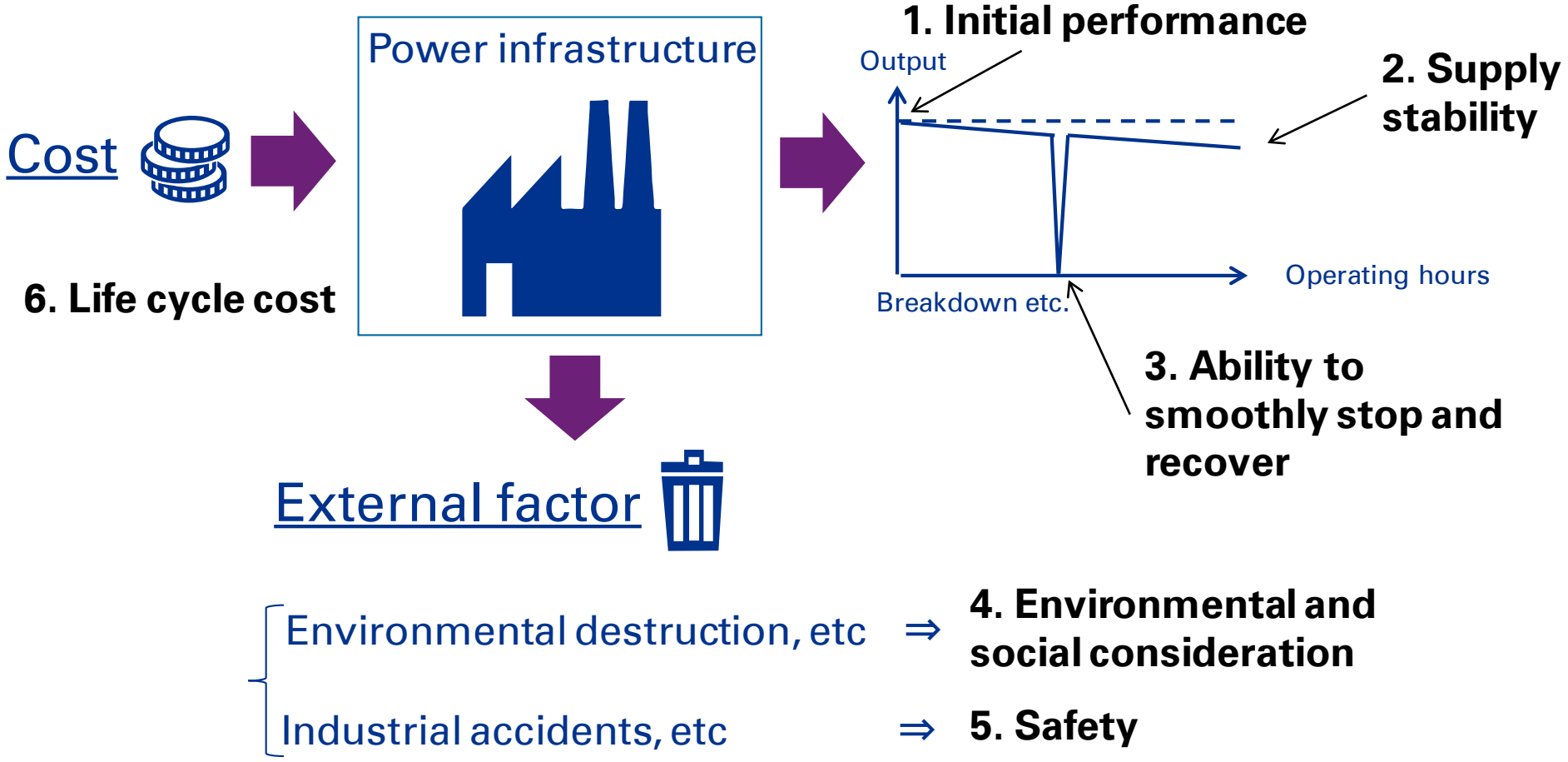


## (2) Components of the “QEPI” (Definition)

- The 6 components can express, mutually exclusive and collectively exhaustive, what exactly “QEPI” is.
- The 6 components may be allocated to one of the 3 attributes; Performance, External factor and Cost
- Definition of 6 components of the “QEPI” is to be modified between the 2 phases – Feasibility Study, planning and construction phase and Operation phase.
- Smooth transition between the 2 phases is a mandatory key to high level “3E+S”

# (3) Components of the "QEPI" (Conceptual Diagram)

Performance 



# (4) Components of the "QEPI" During Each Phase

—Components—

— Definition of components during each phase —

**FS, planning and construction phase**

**Operation phase**

**1. Initial performance**

**Ability to commence operation as scheduled**

**(Initial performance does not apply to operation phase)**

**2. Supply stability**

**Ability to establish a foundation for stable operation as scheduled**

**Ability to continue operation as scheduled**

**3. Ability to smoothly stop and recover**

**Ability to determine function and equipment to reduce forced outage**

**Ability to reduce downtime in case of trouble**

**4. Environmental and social consideration**

**Ability to secure environmental and social consideration**

**Ability to prevent and suppress external damages attributable to environment / co-existence with the community**

**5. Safety**

**Ability to secure safety**

**Ability to suppress damages to human and facility due to factors not related to environment**

**6. LCC**

**Ability to configure the plant considering the total cost through the FS to operation phase**

**Ability to minimize the total cost while maintaining the other components of the "QEPI"**





# Part II

## Feasibility Study, Planning and Construction Phase

# (1) Definition of Components of "QEPI"

Components	Definition during FS, planning and construction phase
1. Initial performance	<ul style="list-style-type: none"> <li>• Ability to commence operation as scheduled</li> </ul>
2. Supply stability	<ul style="list-style-type: none"> <li>• Ability to establish a foundation for stable operation as scheduled</li> </ul>
3. Ability to smoothly stop and recover	<ul style="list-style-type: none"> <li>• Ability to determine functions and equipment to reduce forced outage</li> </ul>
4. Environmental and social consideration	<ul style="list-style-type: none"> <li>• Ability to secure environmental and social consideration during construction phase</li> <li>• Ability to secure environmental and social consideration during operation phase</li> </ul>
5. Safety	<ul style="list-style-type: none"> <li>• Ability to secure safety during construction</li> <li>• Ability to secure safety during operation phase</li> </ul>
6. LCC	<ul style="list-style-type: none"> <li>• Ability to construct a plant considering the total cost including consideration for the risk of social cost throughout life cycle</li> </ul>



## (2) Evaluation of Applicants' Financial Capabilities

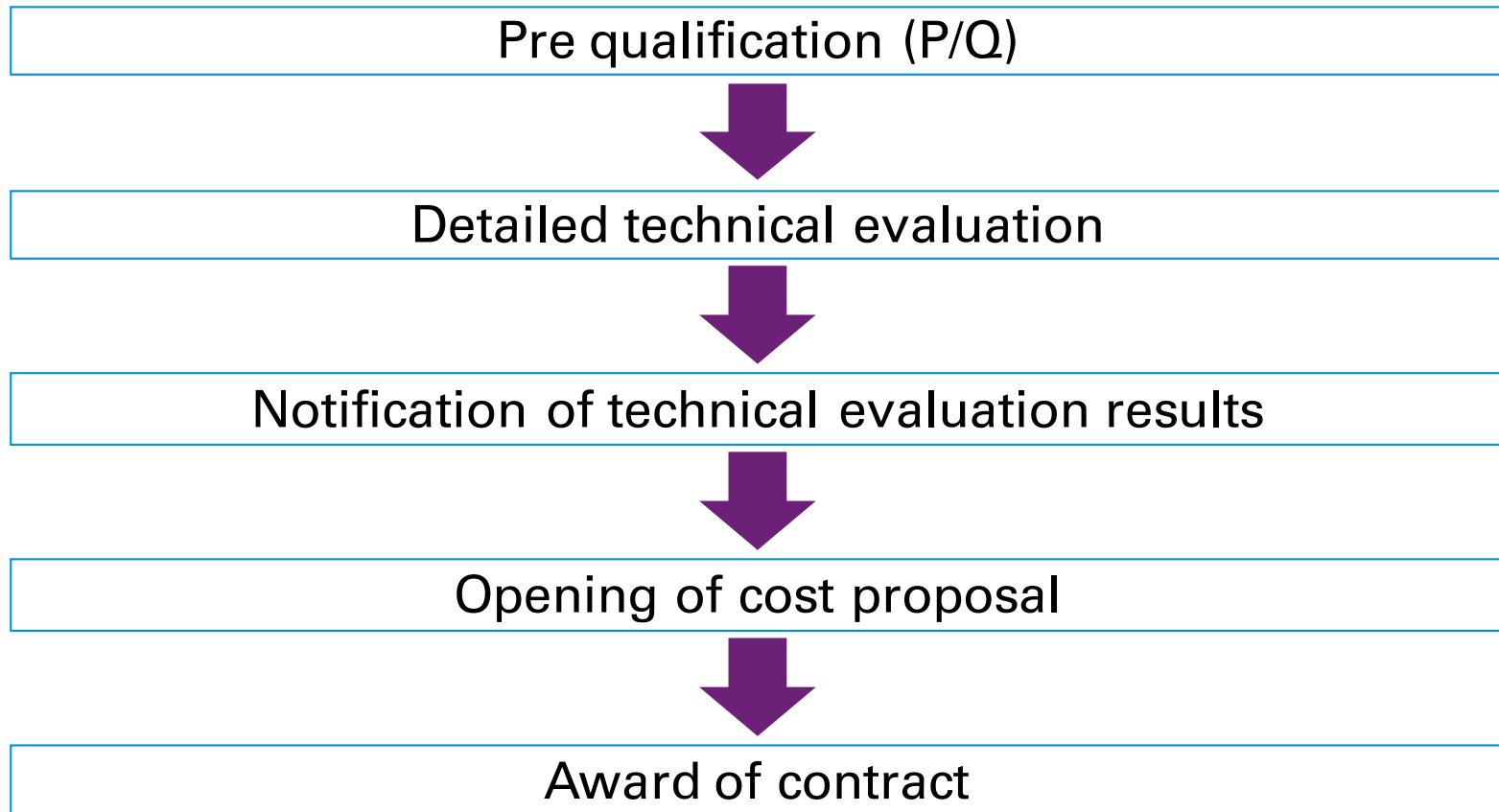
- The risk of contractor's default will remain, even if the contractor satisfied all other components. Therefore, the contractor's financial capability is to be evaluated separately from their technical capabilities.
- Performance indicators of financial capabilities are Turnover, Liquid asset and Safety.

## (3) Requirements of Bidding Procedure for Construction of Electric Power Infrastructure

- Pre-Qualification (P/Q) and bidding specifications will specify criteria of the "QEPI" that should be secured by the thermal power plant.
- Applicants with sufficient ability to achieve the requirements are eligible to participate in the bidding.

# (4) Bidding Procedure for Construction of Electric Power Infrastructure

## **General bidding procedure for a thermal power plant**





Part III

Operation Phase

# (1) Definition of Components of "QEPI"

Components	Definition during operation phase
1. Initial performance	(N/A)
2. Supply stability	<ul style="list-style-type: none"><li>• Availability</li><li>• Increase of heat rate</li><li>• Ability to adjust power supply and demand</li></ul>
3. Ability to smoothly stop and recover	<ul style="list-style-type: none"><li>• Forced Outage Rate (FOR)</li><li>• Long-term FOR</li></ul>
4. Environmental and social consideration	<ul style="list-style-type: none"><li>• SOx and NOx discharge rate</li><li>• CO<sub>2</sub> emission rate</li><li>• Water quality</li><li>• Noise/vibration</li><li>• Waste recycle rate</li><li>• Employment rate from an economy concerned</li></ul>
5. Safety	<ul style="list-style-type: none"><li>• Number of deaths caused by industrial accidents</li></ul>
6. LCC	<ul style="list-style-type: none"><li>• LCC considering all other 5 components</li></ul>

## (2) Self-Elevating Mechanism

- The quality of installed equipment such as boiler and turbine is the main determinant of the QEPI.
- However, power infrastructure generally degrades over time.
- So adequate maintenance and a mechanism to further enhance the QEPI during operation phase are also an essential element.

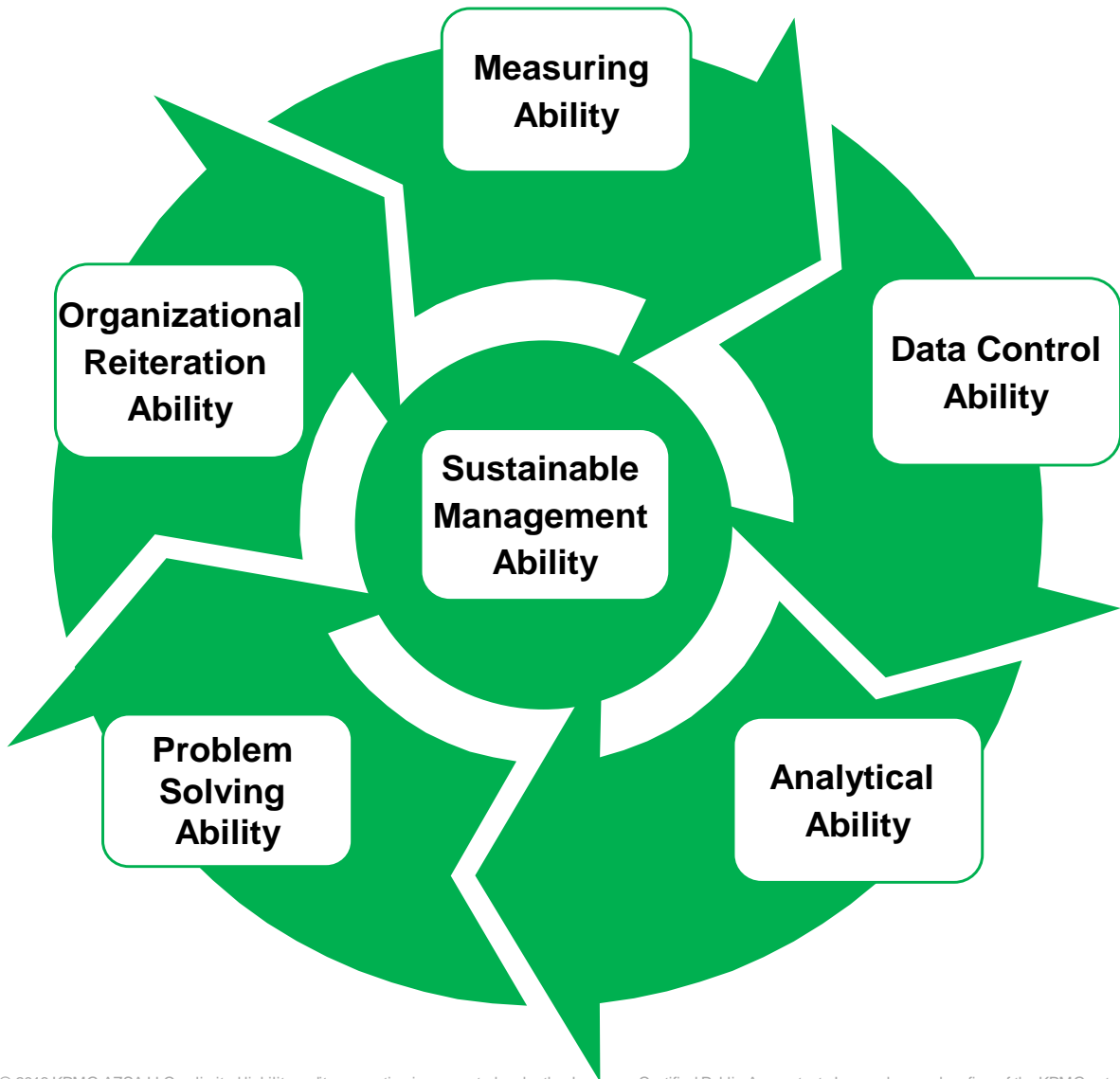


The QEPI can be achieved through appropriate O&M cycle, which in this Guideline is defined as “Self-Elevating Mechanism”.

# (3) Details of "Self-Elevating Mechanism"

O&M requirements	Definition
1. Measuring ability	Ability to measure and collect data
2. Data control ability	Ability to comprehensively record, manage and store data
3. Analytical ability	Ability to identify problems through comprehensive consideration and interpretation of the collected data
4. Problem-solving ability	Ability to identify and solve causes of unexpected problems/risk factors through use of analytical data
5. Organizational reiteration ability	Ability to reiterate the entire process from measuring data to problem-solving
6. Sustainable management ability	Ability to design an organization which maximizes the potential of an electric power infrastructure

# (4) Image of "Self-Elevating Mechanism"



# (5-1) 6 O&M Requirement for Successful Self-Elevation Mechanism

## 1. Measuring ability

<b>Classification</b>	<b>Details of the requirement</b>
Measure/Collect	<ul style="list-style-type: none"><li>• System in place to enable timely measurement</li><li>• Clarity of the points to measure</li><li>• Optimal measuring frequency</li><li>• Appointment of personnel responsible for measuring and monitoring</li><li>• Ability to determine an appropriate measuring method</li></ul>



# (5-2) 6 O&M Requirement for Successful Self-Elevation Mechanism

## 2. Data control ability

<b>Classification</b>	<b>Details of the requirement</b>
Organizational measures	<ul style="list-style-type: none"><li>• Improved system and clarification of the authority and responsibility for protecting information</li></ul>
Physical measures	<ul style="list-style-type: none"><li>• Physical protection (e.g. lock, stipulation of criteria for taking data out) of equipment and device for preventing data leakage and damage</li></ul>
Technical measures	<ul style="list-style-type: none"><li>• Technical protection (e.g. access authorization, introduction of an antivirus software) of system for preventing data leakage</li></ul>

# (5-3) 6 O&M Requirement for Successful Self-Elevation Mechanism

## 3. Analytical capability

<b>Classification</b>	<b>Details of the requirement</b>
Hiring personnel with analytical capability	<ul style="list-style-type: none"><li>• Hiring employees with high analytical capability, appointment of employees to appropriate positions</li></ul>
Equip analytical tools	<ul style="list-style-type: none"><li>• Provision of tools necessary to conduct data analysis</li></ul>

# (5-4) 6 O&M Requirement for Successful Self-Elevation Mechanism

## 4. Problem solving ability

<b>Classification</b>	<b>Details of the requirement</b>
Reaction to sign of risk	<ul style="list-style-type: none"><li>• Prompt identification of the sign of risk</li><li>• Selection/planning/implementation of appropriate measures to cope with identified cause of signs</li><li>• Implementation of appropriate preventive measures to cope with the identified risk factors in the future</li><li>• Monitoring the effectiveness of remedy/recurrence prevention measures, sharing the progress with relevant stakeholders</li></ul>
Reaction to realized risk	<ul style="list-style-type: none"><li>• Prompt identification of causes</li><li>• Selection/planning/implementation of appropriate measures to cope with identified causes</li><li>• Implementation of appropriate preventive measures to cope with identified causes of the problem in the future</li><li>• Monitoring the effectiveness of remedy/recurrence prevention measures, sharing the progress with relevant stakeholders</li></ul>

# (5-5) 6 O&M Requirement for Successful Self-Elevation Mechanism

## 5. Organizational reiteration ability

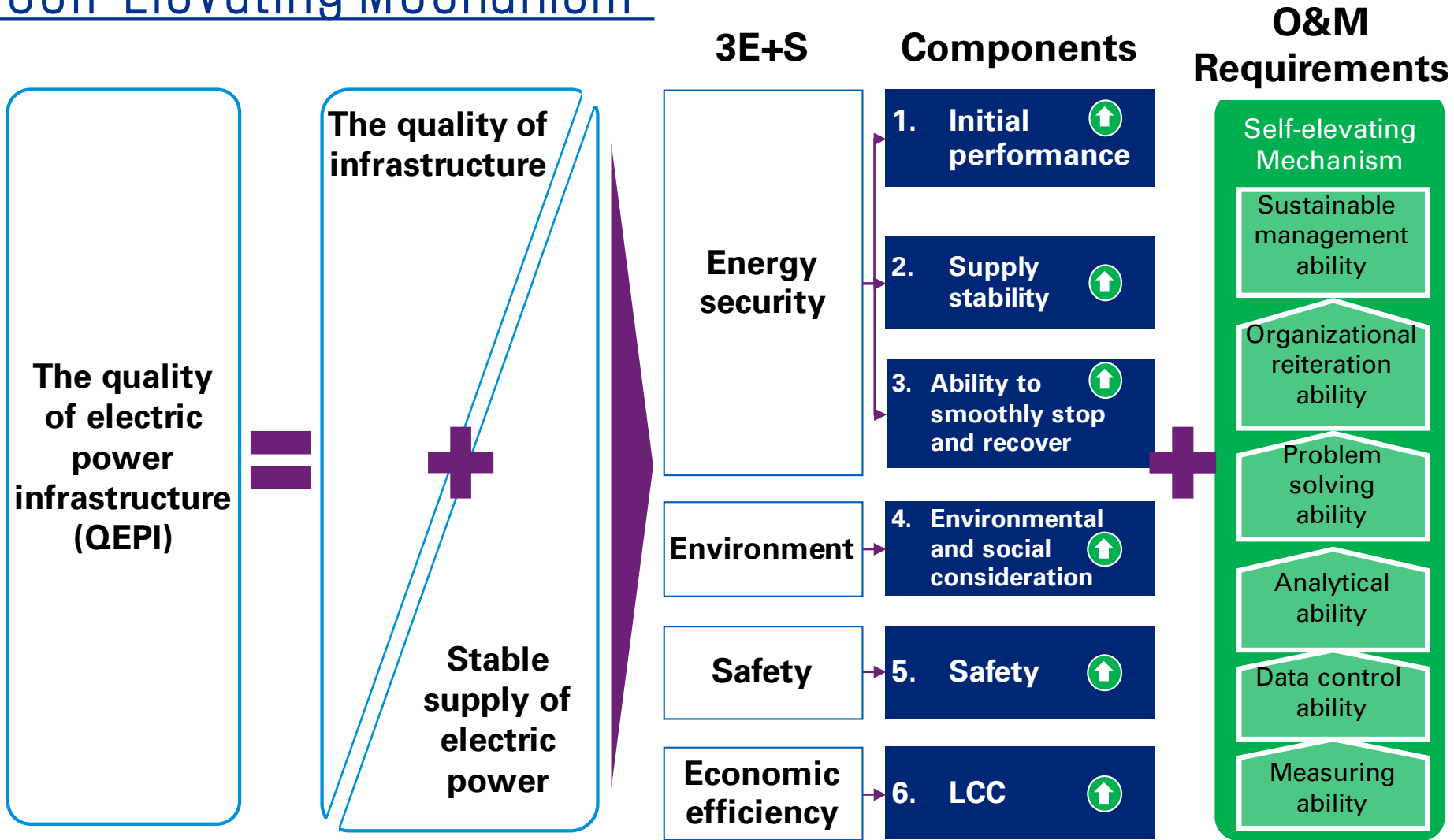
<b>Classification</b>	<b>Details of the requirement</b>
Transfer of know-how through explicit knowledge	<ul style="list-style-type: none"><li>• Establishment, update and usage of database with sets of know-how</li></ul>
Transfer of know-how through human resource development	<ul style="list-style-type: none"><li>• Systematic implementation of human resource development programs aimed at measuring capability, data control capability, analytical capability and problem-solving capability</li></ul>

# (5-6) 6 O&M Requirement for Successful Self-Elevation Mechanism

## 6. Sustainable management ability

<b>Classification</b>	<b>Details of the requirement</b>
Corporate execution system	<ul style="list-style-type: none"><li>• Establishment of a management system/chain of command regarding the quality of power infrastructure, O&amp;M requirement, and efficient operation of several power plants considering relevant factors</li><li>• Operating a power plant efficiently, while maintaining compliance to various O&amp;M requirements</li></ul>
Transfer of know-how through human resource development	<ul style="list-style-type: none"><li>• Systematic implementation of human resource development programs aimed at measuring capability, data control capability, analytical capability and problem-solving capability</li></ul>

# (6) Realization of the Enhancement of the "QEPI" Through "Self-Elevating Mechanism"



## (7) Training for O&M Workers

Worker training is a decisive element for the “Quality”.

## (8) Utilization of IoT

Internet of Things (IoT) can optimize O&M.



# Appendix



# Appendix

- This Guideline has 4 Appendixes to support the technical discussion of Part II and III.
- Appendix provides metrics of performance in each phases and examples of criteria to secure the “QEPI”

# (Appendix 1) Metrics of Performance Indicators During Feasibility Study, Planning and Construction Phase

No.	Performance indicator	Related component
1.	Number of construction completion	Initial performance
2.	Conformity with specified performance	
3.	Record of contract termination	
4.	Track record of faulty constructions including delay in completion	
5.	Track record of faulty maintenance within the warranty period	Supply stability
6.	Track record of long term forced outages within the warranty period	Ability to smoothly stop and recover
7.	Track record in relation to non-conformance with the environment protection law	Environmental and social consideration
8.	Track record in relation to employment from the economy	
9.	Track record of fatal accidents	Safety
10.	LCC considering all other 5 components	LCC
11.	Turnover	Financial capability
12.	Liquid asset	
13.	Soundness	

# (Appendix 2) Examples of Evaluation Criteria for P/Q

<b>No.</b>	<b>Evaluation criteria</b>	<b>Subject</b>
1.	Eligibility	1.1 Conflict of interest 1.2 Ineligibility
2.	Historical contract non-performance	2.1 History of non-performing contracts 2.2 Pending litigation
3.	Financial situation	3.1 Financial performance 3.2 Average turnover
4.	Applicant's qualification	4A. Experience 4.1 General construction experience 4.2 Specific construction experience 4.3 Specific operating experience, etc. 4B. Equipment capabilities 4.11 Operating experience of reference gas turbines 4.12 Similarity of proposed gas turbine 4.13 Heat Recovery Steam Generator (HRSG), etc.



# (Appendix 3) Examples of Qualification Criteria in Bidding Specification

<b>No.</b>	<b>Requirement</b>
1.	Update of information
2.	Financial resources
3.	Personnel
4.	Equipment
5.	Subcontractors/manufacturers
6.	Additional experiences certificates

# (Appendix 4) Metrics of Performance Indicators in Operation

## Phase

No.	Performance indicator	Related component
1.	Availability	Supply stability
2.	Increase of heat rate	
3.	Ability to adjust power supply and demand	
4.	Forced Outage Rate (FOR)	Ability to smoothly stop and recover
5.	Long-Term FOR	
6.	SOx and NOx discharge rate	Environmental and social consideration
7.	CO2 emissions rate	
8.	Water quality	
9.	Noise / vibration	
10.	Waste recycling rate	
11.	Employment rate from an economy concerned	
12.	Number of casualties caused by industrial accidents	Safety
13.	LCC considering all other five components	LCC



# Column

# Column

This Guideline has 14 columns to provide examples of best practice for securing the “QEPI”:

No.	Title
1.	Example of ECI - ESK River Hydropower Project in New Zealand
2.	ASEAN Clean Coal Technology Handbook
3.	Safety and health regulations for workers at power plants in the United States
4.	Cyber security measures to protect power infrastructure in the United States
5.	The trend of standardization in the field of control systems
6.	Mechanism of information exchange among utility companies in ASEAN
7.	P/Q standards regarding initial performance of thermal power plant in Malaysia
8.	Measures to improve the supply stability of thermal power plants in India
9.	Efforts to ensure workplace safety in Indonesia
10.	Example of calculating LCC of power plants by international agencies
11.	Bidding in comprehensive successful bid system for transmission line construction in Canada
12.	The measurement of increase of heat rate in Japan
13.	The measurement of actual FOR in Japan
14.	Training employees in thermal power plants in Thailand



# Upcoming Sessions



# Upcoming Sessions

- We will be looking forward to hearing your opinions, insights and comments about this Guideline during the second half of afternoon session on 30 August.
- We will have a discussion about this Guideline during the morning session on 31 August.



Thank you