Appendix 10. Power generation

Sector Specific Annex to Audit Guideline under the EE Incentive Scheme for energy intensive industries in Vietnam

1 Introduction

The purpose of this annex is to secure that the most important opportunities for energy efficiency improvements in the power generation industry are investigated.

The annex is prepared to provide more sector-specific guidance than what is presented in the general energy audit guideline prepared under the Danish/Vietnamese cooperation.

As such, the guideline describes the most important focus areas within the key technologies of:

- **Combustion** is the transformation of energy from fuel to steam.
- **Generation** is the transformation of energy from steam to electricity.
- **Insulation:** all surfaces of equipment, pipes and valves must be at a low temperature.
- **Water:** good water quality is essential for energy efficient operation.

Auxiliary equipment:

- **Motors** are required for many applications in power generation industry like pumps, fans etc.
- **Fans** are required to establish fluid bed circulation and for ventilation and extraction system.
- **Pumps** are required in hydraulic systems, water circulation, etc.
- **Compressed air** is required for machine operation.

Below, important energy efficiency measures for each of these areas are described.

2 Technology review compared with Best Current Practice

In the table below, best practice energy efficiency projects are listed for each of the technologies above. The energy audit should consider the possible viability of each of the measures in the specific context.

The energy audit report should document how these potential measures have been considered. For each measure it should be stated whether it is practically relevant for the specific enterprise. If it could be relevant, the report must make a pre-assessment of the technical and financial viability.

No.	Technology	Energy efficiency measures
1	Combustion	• Is the plant running with the fuel quality that it is designed for and is it operated according to the original parameters? • Does the combustion process achieve full combustion of the fuel? • Is the combustion air monitored and controlled to achieve proper combustion? • Is combustion stable? Are there fluctuations in steam temperature and/or pressure? • Is the combustion system and fuel feeding system maintained regularly to avoid build-up of residues in the combustion chambers? • Is the burning control capable of controlling the temperature so slag adhesion is avoided? • Is an efficient system for removing residues under operation installed? • What is the oxygen percentage (O_2) of the flue gas?

No.	Technology	Energy efficiency measures
		• What is the temperature of the flue gas out of the chimney? • Is the combustion system designed for condensation and if so, is condensation achieved? • Are de-NOx and SOx removal included?
2	Generation	• Generation efficiency, is the share of electricity output maximized? (min. 45% for super-critical technology) • Is the steam pressure utilized for power generation to as low as possible? • Is the energy in the turbine exhaust steam utilized? • Can water droplets be avoided? • Is the vacuum in the condenser maintained within the designed parameters?
3	Insulation	• Are all surfaces of the combustion system and related ducts insulated properly? • Are all pipes, valves and fittings properly insulated?
4	Water	• Is the feed water quality as high as possible to lower the maintenance on the turbine? • Is the loss of water / condensate minimized?
5	Auxiliary equipment	• Are VSD's used where relevant? • Is motor efficiency similar to IE4 or IE5 requirements? • Are pumps and fans designed for the actual working conditions and is the total pump / fan efficiency high?

No.	Technology	Energy efficiency measures
		• Are compressor systems designed to be energy efficient in the actual working range?
6	Fans	• Do fans have high efficiency? • Are VSD's used and operation optimized according to variation in loads?
7	Compressed air	• Is the electricity consumption per m^3 low? • Is compressor set-up optimal with a mixture of direct drive and VSD control? • Is the heat reused from the compressors?
8	Heat recovery	• Heat can be recovered from flue gas, compressors, cooling systems and reused to a higher degree? The potential in heat recovery is large, but the challenge is to find good usage. - Assessment of internal possibilities. - Assessment of possible export to neighboring enterprises.
9	Cooling water system	• Is the circulating water pump system operating optimally?
10	Fuel handling system (coal, fuel oil, gas)	• Is the fuel handling system operating optimally? • Do coal mills operate effectively (coal fineness, air leakage, power consumption, etc.)?