These tables are extracted from ISO 27919-1. The user is permitted to make copies of these tables. The following colour code is applied to Table F.1 to Table F.7.

**Colour code**

|  |  |
| --- | --- |
| **Information classification** | **Numbers/Values** |
| The basic information on the plant and/or the project required for evaluation of KPI | Input cell: value to be entered by those who evaluate the process as appropriate for calculation |
| The basic information required but not necessarily directly related with evaluation of KPI | Input cell: value to be entered by those who evaluate the process as appropriate as clarification |
| The information required for evaluation of KPI calculated from the input values | Calculating value by the input data of this sheet |
| Voluntary data or indicators | Default value, to be corrected by those who evaluate the process as appropriate |

**Table F.1 — Outline and specification of project**a,e

|  |  |  |  |
| --- | --- | --- | --- |
| **Item No. and its description** | | **Check** | **Option** |
| **General Plant Information** | | | |
| 1 | Plant (Project) Name |  |  |
| 2 | Company (Purchaser) |  |  |
| 3 | Country of installation |  |  |
| 4 | Stage of the plant/project |  | 1: FS, 2:Pre-FEED, 3:FEED, 4:EPC, 5:Demonstration test, 6:Commercial operation |
| 5 | Green field or retrofit |  | 1: Green field, 2:Retrofit |
| 6 | CO2 capture plant process |  | 1: amine, 2: ammonia, 3: amino acid, 4: others (In this case, specify the fuel properties) |
| 7 | The number of the flue gas source |  |  |
| 8 | Type of the host power plant |  | 1: boiler, 2: combined cycle gas turbine, 3: others |
| 9 | Fuel of the flue gas source |  | 1: coal, 2: natural gas, 3: LFO, 4: HFO, 5: others (In this case, specify the fuel) |
| 10 | Thermal energy supply source |  | 1: the host power plant, 2: the auxiliary GT, 3: the auxiliary boiler, 4: combination of "1" with "2" or "3" |
| 11 | Main type of the thermal energy |  | 1: steam, 2: hot oil, 3:hot water, 4: combination of "1", "2" , "3" |
| 12 | Flue gas treatment ratio |  | 1: full treatment, 2: partial treatment (In this case, specify the equivalent capacity as MWe) |
| **Evaluation Boundaries of PCC plant**b | | | |
| 13 | Flue gas supply points to PCC plant |  | 1: the stack, 2: FGD outlet before flue gas reheating, 3: before FGD, 4: mixture of "2" and "3" |
| 14 | Treated flue gas return or release points |  | 1: the stack, 2: FGD outlet before flue gas reheating, 3: Top of CO2 absorber |
| 15 | Cooling medium |  | 1: fresh water, 2: sea water, 3: air fin cooler integrated with process, 4: combination |
| 16 | CW generation |  | 1: one through cooling, 2: CW recycle with mechanical cooling tower or air fin cooler, 3: combination |
| 17 | CW utilization from the host power plant |  | 1: no, 2: yes (In case of yes, specify if it is partly or fully) |

**Table F.1**(*continued*)

|  |  |  |  |
| --- | --- | --- | --- |
| **Item No. and its description** | | **Check** | **Option** |
| 18 | Power supply |  | 1: a host power plant, 2: auxiliary GT or boiler, 3: grid (or externally), 4: combination |
| 19 | Type of auxiliary thermal energy supply, if any |  | 1: boiler, 2: GTCC, 3: Single cycle GT with HRSG, 4: others |
| **Existing AQCS (air quality control system) and an additional pre-treatment for PCC plant** | | | |
| 20 | Existing FGD and its type, if any |  | 1: yes, 2: no In case of yes, specify its process (Limestone gypsum process. etc.) |
| 21 | Existing flue gas reheating and its type, if any |  | 1: yes, 2: no (Non-leak or Regenerative type GGH, etc.) |
| 22 | Existing De-NOx and its type, if any |  | 1: yes, 2: no In case of yes specify its process (SCR. etc.) |
| 23 | Existing De-Dusting and its type, if any |  | 1: yes, 2: no In case of yes specify its process (ESP. etc.) |
| 24 | Additional FGD c before Item No.29 below |  | 1: yes, 2: no |
| 25 | Additional De-NOx c |  | 1: yes, 2: no |
| 26 | Additional De-Dusting c |  | 1: yes, 2: no |
| 27 | Flue gas reheating requirement of the treated flue gas |  | 1: yes, 2: no |
| **Configuration and operating pattern of the PCC plant** | | | |
| 28 | Process type |  | 1: Chemical absorption, 2: others |
| 29 | Deep FGD and its process type, if any |  | 1: yes, 2: no In case of yes, specify its process type |
| 30 | Flue gas fan position |  | 1: before Pre-treatment, 2: after Pre-treatment and before CO2 capture |
| 31 | CO2 compressor type |  | 1:single shaft in line centrifugal,2:integrally geared centrifugal,3:reciprocated,  4: others |
| 32 | CO2 purification equipment requirement |  | 1: no, 2: moisture removal (dehydrator), 3: oxygen removal, 4: "2" and "3" |
| 33 | Type of dehydrator if required |  | 1: solid desiccant type, 2: liquid type, 3: others (In case of “3”, define its type) |
| 34 | Type of oxygen removal, if required |  | 1: hydrogen combustion, 2: others In case of “2” specify its type |
| 35 | Absorbent cleaning and its type, if any |  | 1: yes, 2: no |
| 36 | Treatment method of the waste |  | 1: on-site treatment, 2. by others through transportation |
| 37 | Large rotating equipment driver (Flue gas fan, CO2 compressor) |  | 1: motor, 2: steam turbine, 3: combination of both (In this case, define each driver) |
| 38 | Operation pattern of PCC plant |  | 1: stable load, 2: load following by host power plant demand, 3: frequent start/stop |
| 39 | Long time partial load operation requirement |  | 1: yes, 2: no |

**Table F.1**(*continued*)

|  |  |  |  |
| --- | --- | --- | --- |
| **Item No. and its description** | | **Check** | **Option** |
| **Waste heat utilization between the host power plant and PCC plant** | | | |
| 40 | Waste heat of the host power plant supplied to PCC plant |  | 1: yes, 2: no |
| 41 | Waste heat of PCC plant utilized for the host power plant |  | 1: yes, 2: no |
| **Power plant information** | | | |
| 41 | Generation of the host power plant (in case of a coal fired boiler) |  | 1: ultra-supercritical, 2: supercritical, 3: subcritical generation |
| 42 | Nominal net power output of the host power plant |  | [MW] |
| 43 | Any output limitation in case PCC plant not in operation due to addition of PCC plant compared with the case without PCC plant |  | 1: yes, 2: no |
| 44 | Category of Fuel [1]f for the host power plant |  | 1: Coal, 2: HFO, 3: LFO, 4: Natural gas,5: others |
| 45 | Fuel (1)a consumption at the plant reference condition without PCC |  | [t/a] or [1 000 Nm3/a] |
| 46 | Lower heating values of Fuel [1]f (Typical) |  | [kJ/kg] or [kJ/Nm3] |
| 47 | Heat rate (=Thermal energy input/Net electrical energy output) of the host power plant at the plant reference condition without PCC plant |  | [kJ/kWh] |
| 48 | Fuel [1]f a specific emission (Typical) |  | [kg/kJ] |
| 49 | Nominal net power output of the auxiliary unit |  | [MW] |
| 50 | Heat rate of the auxiliary unit at the plant reference condition without PCC plant |  | [kJ/kWh] |
| 51 | Category of Fuel [2]f for the auxiliary unit |  | 1: Coal, 2: HFO, 3: LFO, 4: Natural gas, 5: others |
| 52 | Fuel [2]f consumption at the plant reference condition without PCC |  | [t/a] or [1 000 Nm3/a] |
| 53 | Lower heating values of Fuel [2]f (Typical) |  | [kJ/kg] or [kJ/ Nm3] |
| 54 | Fuel [2]f specific emissiond |  | [kg/kJ] |
| a Additional column should be prepared as appropriate according to the reply of noted items.  b Spatial interface is as close as the PCC plant itself.  c Including reinforcement of the existing one.  d Refer to Formula (D.4) of Annex D.  e Check the project outline and major configuration which can affect the evaluation hereafter referring to Figure 2.  f Number in the blanket shows the a kind of fuel specified in Option column. | | | |

**Table F.2 — Process requirement and measured parameters**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | | **Key No.** | **Applied or not** |  | **Parameters** | | | **Measurement Method** | **Test condition with PCC in operation** | |
| **Items** | | **Unit** | **Plant reference condition value** | **As tested** |
| Inlet flue gasb | Flue Gas from Boiler (Host power plant)a | 10 | Y |  | Flow rate | | Nm3/h | d |  |  |
| Flue Gas from GTCC (Host power plant)a | 10 | Y | Density | | kg/Nm3 | d |  |  |
| Flue Gas from Auxiliary boiler or GTa | 11 | Y | Component | H2O | vol % | d |  |  |
|  |  |  | CO2 | vol %-dry | d |  |  |
| O2 | vol %-dry | d |  |  |
| N2/Ar | vol %-dry |  | Balance | Balance |
| Impurities | NOX | mg/Nm3-dry |  |  |  |
| NO2 | mg/Nm3-dry |  |  |  |
| SOX | mg/Nm3-dry |  |  |  |
| SO3 | mg/Nm3-dry |  |  |  |
| HCl | mg/Nm3-dry |  |  |  |
| HF | mg/Nm3-dry |  |  |  |
| NH3 | mg/Nm3-dry |  |  |  |
| VOC | mg/Nm3-dry | c |  |  |
| PM | | mg/Nm3-dry |  |  |  |
| Mist (water droplet) | | mg/Nm3-dry |  |  |  |
| Temperature | | oC | d |  |  |
| Pressure(gauge) | | kPa | d |  |  |

**Table F.2**(*continued*)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | | **Key No.** | **Applied or not** |  | **Parameters** | | | **Measurement Method** | **Test condition with PCC in operation** | |
| **Items** | | **Unit** | **Plant reference condition value** | **As tested** |
| Treated flue gas | Treated Flue Gas to atmosphere | 101 | Y |  | Flow rate | | Nm3/h | d |  |  |
| Treated Flue Gas to Stack | 7 | N | Density | | kg/Nm3 | d |  |  |
| Component | H2O | vol % | d |  |  |
| CO2 | vol %-dry | d | e |  |
| O2 | vol %-dry |  |  |  |
| Impurity | NOX | mg/Nm3-dry |  |  |  |
| SOX | mg/Nm3-dry |  |  |  |
| VOC | mg/Nm3-dry | c |  |  |
| Absorbent | mg/Nm3-dry | c |  |  |
| Absorbent degradation product | mg/Nm3-dry | c |  |  |
| PM | | mg/Nm3-dry |  |  |  |
| Mist | | mg/Nm3-dry |  |  |  |
| Temperature | | oC | d |  |  |
| Pressure (gauge) | | kPa | d |  |  |
| Product CO2 stream | | 5 | Y |  | Flow rate | | t/h | d |  |  |
| Component | CO2 | mol %-dry | d |  |  |
| H2O | mg/Nm3-dry | d |  |  |
| O2 | mg/Nm3-dry |  |  |  |
| Impurities | N2 | mg/Nm3-dry |  |  |  |
| Absorbent | mg/Nm3-dry | c |  |  |
| Absorbent degradation product | mg/Nm3-dry | c |  |  |
| Dehydrant | mg/Nm3-dry |  |  |  |
| PM | | mg/Nm3-dry |  |  |  |
| Temperature | | oC | d |  |  |

**Table F.2**(*continued*)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **Key No.** | **Applied or not** |  | **Parameters** | | | **Measurement Method** | **Test condition with PCC in operation** | |
| **Items** | | **Unit** | **Plant reference condition value** | **As tested** |
|  |  |  |  | Pressure (gauge) | | kPa | d |  |  |
| Site Condition | Dry bulb temperature | | | | | oC |  |  |  |
| Wet bulb temperature | | | | | oC |  |  |  |
| Absolute humidity | | | | kg-water/kg-dry air | |  |  |  |
| Ambient air pressure(gauge) | | | | kPa | |  |  |  |
| Elevation | | | | m above sea level | |  |  |  |
| a In all flue gas ducts entering into the PCC plant, all the components listed in corresponding parameters columns should be made clear and the flue gas information to the PCC plant should be calculated in this case appropriate mixing of flue gas should be considered to avoid reaction or condensation of the gas phase.  b The impurity concentration of the flue gas affects the Pre-treatment specification and definition of these components is utilized to evaluate the related chemical consumption in Table F.3 and Table F.6.  c Definition and measurement method depends on the local regulation, if required.  d Refer to Table C.2.  e CO2 capture efficiency of the absorber is calculated in Formulas (1), (2) and (3) in 5.3. | | | | | | | | | |

**Table F.3 — Utility summary list a**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Utility Item** | **(1) Electrical energy** | | | | **(2) Steam /Thermal Energy Source** | | | **(3) CW** | **(4) Chemical (Reporting)** | | |
| **Details or specification** | **Quencher or flue gas pre-treatment** | **CO2 capture** | **CO2 stream compression** | **Utility facilities** | **HP Steam** | **MP Steam** | **LP Steam** | **Absorbent** | **Chemical 1**b | **Chemical 2**b |
| **Inlet Pressure (gauge) (MPa)** | | | | **Phase as received** | | |
|  |  |  |  |  |  |  |
| **Inlet Temperature (°C)** | | | | **Concentration as received (wt%)** | | |
|  |  |  |  |  |  |  |
| Consumption | Power (MW) | | | | Flow rate (kg/h) | | | CW duty (MW) | (kg/t-CO2) as 100wt% purity | (kg/h)as 100wt% purity | (kg/h)as 100wt% purity |
| PCC plant (Normal Operation) |  |  |  |  |  |  |  | f |  |  |  |
| PCC plant (Intermittent Operation)c |  |  |  |  |  |  |  |  |  |  |  |
| Electrical power requirement for CW pumpd | f | | | |  |  |  |  |  |  |  |
| Totale | g | | | |  |  |  |  |  |  |  |
| Remarks | CO2 pressure (gauge) at the inlet of CO2 compression. (kPa): | | | | See details in Table F.4 Key 35A/B, 40 and/or stream 36, 41 (in Figure 2) should be referred. | | | See details in Table F.5 | Consumption in Table F.6 can be corrected to the reference condition based on Table F.2 | | |
| a Test condition is the plant reference condition or other agreed condition among the related parties with value at the PCC plant boundary  b Actual substance name should be provided and add the columns as appropriate.  c If an intermittent operation is necessary for, such as, cleaning or regeneration of the absorbent or catalyst, the average figures during this period should be provided with intervals and duration information.  d  Electrical power requirement for CW pump defined in the Formula (6) in 6.4.1 and calculated in Figure F.5.  e  Average figures over a normal operation and an intermittent operation considering three cycles as minimum.  f The figure of the corresponding column “total” of PCW andΦCW in Table F.5 respectively  g Electrical power requirement for the PCC plant (PPCC) | | | | | | | | | | | |

**Table F.4 — Thermal energy consumption calculation**a

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Key**a | **Stream Description** | **From** | **To** | **Heat Medium** | **Normal(N) or Intermittent(I) operation use** | 𝑃LGPb,f | QTb | FH b | **Inlet or outlet** | | | **Cpmean**b,c |
| THb | PHb  **(gauge)** | EHb |
| **MW** | **kJ/s** | **kg/h** | **oC** | **MPa** | **kJ/kg** | **kJ/(kgK)** |
| 35A | LP steam | Host power plant | Steam distribution system | Steam (In) | N |  |  | d | d | d |  |  |
| 35B | HP or MP steam | Host power plant | Steam distribution system | Steam (Out) | I |  |  | d | d | d |  |  |
| 40 | SCb return to Host power plant | Steam distribution system | Host power plant | SC (Out) | N |  |  | d | d | d |  |  |
| 37A | LP steam | Steam distribution system | PCC plant | Steam (In) | N | ― |  |  |  |  |  |  |
| 37B | HP or MP steam | Steam distribution system | PCC plant | Steam (Out) | N | ― |  |  |  |  |  |  |
| 37C | MP or HP steam to STb drive | Steam distribution system | PCC plant  (ST drive) | Steam (In) | N | ― |  |  |  |  |  |  |
| 38 | ST exhaust steam | PCC plant  (ST drive) | Steam distribution system | Steam (Out) | N | ― |  |  |  |  |  |  |
| 39A | SC from PCC plant | PCC plant | Steam distribution system | SC (Out) | N | ― |  |  |  |  |  |  |
| 39B | SCfrom ST drive | PCC plant  (ST drive) | Steam distribution system | SC (Out) | N | ― |  |  |  |  |  |  |

**Table F.4 — Thermal energy consumption calculation**a

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Key**a | **Stream Description** | **From** | **To** | **Heat Medium** | **Normal(N) or Intermittent(I) operation use** | 𝑃LGPb,f | QTb | FH b | **Inlet or outlet** | | | **Cpmean**b,c |
| THb | PHb  **(gauge)** | EHb |
| **MW** | **kJ/s** | **kg/h** | **oC** | **MPa** | **kJ/kg** | **kJ/(kgK)** |
| 115 | Utilization of waste heat of steam distribution system by PCC (Return) | PCC plant | Steam distribution system | Liquid (Out) | N | ― |  |  |  |  |  |  |
| 116 | Utilization of waste heat of steam distribution system by PCC (Feed) | Steam distribution system | PCC plant | Liquid (In) | N | ― |  |  |  |  |  |  |
| 57 | Power plant waste heat for PCC plant  Feed (Key 57)  Return (Key 58) | Host power plant | PCC plant | Liquid (In) | N |  | e |  |  |  |  |  |
| 58 | PCC plant | Host power plant | Liquid (Out) | N |  | e |  |  |  |  |  |
| a Refer to Figure 2 and Figure 4 for the position of the stream and select as appropriate according to actual condition.  b Definition of Keys and abbreviations are as follows.  𝑃LGP: The change in gross power output due to the steam extraction from the host power plant steam cycle and/or auxiliary unit.  QT: Heat duty = FH × EH/3 600, FH: Mass flow rate, TH: Temperature, PH: Pressure, EH: Enthalpy, Cpmean: Mean specific heat at the constant pressure.  ST: Steam turbine, SC: Steam condensate.  c Mean values in case of no phase change.  d The value in the key 35A/B and 40 should be input of item 2 and 7 in Table F.7. If the steam is supplied from the auxiliary steam generation the stream No 35 and 41 should be added in Table F.4 to evaluate the influence on the steam supply source.  e This value may be utilized in the fuel efficiency calculation in item 34 and 35 in Table F.7 to evaluate the influence of the heat integration with PCC plant.  f Should be evaluated by the simulation. | | | | | | | | | | | | |

**Table F.5 — CWa duty summary**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Key**a | **Items** | **From** | **To** | **Cooling Medium** | **Normal(N)**  **or Intermittent(I) operation use** | *P*CWbb | *Φ*CWbb | **Supply side** | | **Return side** | | *C*PCWb | **ρ**CWb | FCWb | *η* pb,c | *η* Mb,c |
| *T*CWinb | *P*CWinb  **(gauge)** | *T*CWoutb | *P*CWoutb  **(gauge)** |
| **MW** | **kJ/h** | **K** | **kPa** | **K** | **kPa** | **kJ/(kgK)** | **kg/m3** | **m3/h** | **%** | **%** |
| 42A | CW feed | CW generation | Pre-treatment | CW | N |  |  |  |  |  |  |  |  |  |  |  |
| 43A | CW return | Pre-treatment | CW generation | CW | N |
| 42B | CW feed | CW generation | CO2 capture | CW | N |  |  |  |  |  |  |  |  |  |  |  |
| 43B | CW return | CO2 capture | CW generation | CW | N |
| 42C | CW feed | CW generation | CO2 stream compression | CW | N |  |  |  |  |  |  |  |  |  |  |  |
| 43C | CW return | CO2 stream compression. | CW generation | CW | N |
| 44A | Rejected heat of the air-fin cooler integrated into the process | Pre-treatment | ATM. | Air | N | d | d |  |  |  |  |  |  |  |  |  |
| 44B | CO2 capture | ATM. | Air | N | d | d |  |  |  |  |  |  |  |  |  |
| 44C | CO2 stream compression. | ATM. | Air | N | d | d |  |  |  |  |  |  |  |  |  |
| 55 | PCC waste heat for Host power plant or return of key 56 | PCC plant | Host power plant | CNDb | N | e | e |  |  |  |  |  |  |  |  |  |
| 56 | Host power plant waste heat for PCC or return of key 55 | Host power plant | PCC plant | CNDb | N |
| 110 | CW feed | Host power plant CW system | CW generation | CW | N | h | g |  | f |  | f |  |  |  |  |  |
| 111 | CW return | CW generation | Host power plant CW system | CW | N |
| Total | | | | | |  |  |  | | | | | | | | |
| a Refer to Figure 2 and Figure 5 for the position of the stream and select as appropriate according to actual condition.  b Definition of Keys and abbreviations are as follows.  *P*CW: Electrical power requirement of CW pump, *Φ*CW: Cooling heat duty, *T*CWin: CW temperature at supply side, *P*CWin: CW pressure at supply side,  *T*CWout: CW temperature at return side, *P*CWout: CW pressure at return side, *c*p CW: CWspecific heat, *ρ*CW: CW density, *F*CW: CWflow rate, *η* P: pump efficiency, *η* M: pump efficiency, CND: Condensate.  c Assumed.  d *P*CW is the hypothetical value of the electrical power requirement of CW pump as one through CW basis and the electrical power requirement of the air-fin cooler itself should be deducted from the calculation. If such deduction is not possible, both *P*CW and *Φ*CW of this Key is not included in the total.  e This value may be utilized in item 9 of Table F.7 to consider the influence of heat integration with PCC plant and not to be included in the total of this table.  f Additional CW pressure required at the PCC plant boundary.  g The value of this column should be deducted from the total to calculate the electrical power requirement for CW pump.  h If the additional pump is needed to supply and return, its electrical power requirement should e added. | | | | | | | | | | | | | | | | |

**Table F.6****— Absorbent and chemical consumption boundary conditions**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Key**a | **Category** | **Item** | **Concentration as tested** | **Normal(N) or Intermittent(I) operation use** | **Flow rate at the test condition with PCC in operation (kg/h) as tested**c | | | | |
| **[wt%]** | **Quencher or flue gas pre-treatment** | **Additional pre-treatment** | **CO2 capture** | **CO2 stream compression** | **Utility facilities** |
| 18 | Absorbent and Chemical (kg/h) | Absorbent  /Additives |  | N |  |  |  |  |  |
| 48D | Defoamer |  | I |  |  |  |  |  |
| 48 | Chemicals (Fill the corresponding columns of chemical applied. The followings are typical) | | | | | | | |
| 48D | Caustic Soda |  | N |  |  |  |  |  |
| Caustic Soda |  | I |  |  |  |  |  |
| 48D | Sulfuric Acid |  | I |  |  |  |  |  |
| 48D | Triethylene glycol (Dehydrant) |  | I |  |  |  |  |  |
| 48Db | b |  | I |  |  |  |  |  |
| a Please refer to Figure 2.  b Additional column should be prepared as appropriate according to the reply, if additional chemicals are required.  The chemical for treatment of the waste water and the waste can be put after the specification of waste water and the regulated or required limit of effluent composition are specified.  c Averaged figures during test or measured period. | | | | | | | | | |

**Table F.7 — Calculation procedure sample of KPI related to power plant with large scale condensing turbine**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No** | | **Measured/Calculation items**  **(reason for the deviation from the reference condition)**a | | **Conditions of items with PCC in operation and /without PCC (Reference plant) (2 cases)** | | **Unit** | | **Plant reference value** | **As tested** | **Correction to the plant reference condition** | |
| **Heat input** | **Power output** |
| **ADDITIVE CORRECTION FACTORS IN FUNDAMENTAL PERFORMANCE EVALUATION**e,i | | | | | | | | | | | |
| 1 | Process steam for the host power plant (Operational) | | | Flow (Thermal efflux) | | kg/s | |  |  | ω１ | Δ１ |
| Pressure | | kPa | |  |  |
| Temperature | | oC | |  |  |
| 2 | Process steam for PCC plant in operation  (Operational) | | | Flow (Thermal efflux) | | kg/s | |  |  |
| Pressure | | kPa | |  |  |
| Temperature | | oC | |  |  |
| 3 | Power factor for each generator (Operational) | | | Gas turbine | | — | |  |  | ω２ | Δ２ |
| Steam turbine | | — | |  |  |
| 4 | Steam generator blow down (Operational) | | | Boiler | | % | |  |  | ω3 | Δ3 |
| HRSG (HP) | | % | |  |  |
| HRSG (LP) | | % | |  |  |
| 5 | Makeup water (Operational) | | | Temperature | | oC | |  |  | ω4 | Δ4 |
| Flow (Make-up or Excess) | | kg/s | |  |  |
| 6 | Process condensate for the host power plant(External) | | | Temperature of secondary heat input | | oC | |  |  |
| Pressure | | kPa | |  |  |
| 7 | Process condensate from PCC plant in operation (External) | | | Flow | | kg/s | |  |  |
| Pressure | | kPa | |  |  |
| 8 | Process condensate return ratio (External) | | | | | % | |  |  |
| 9 | Waste heat from PCC plant to the host power plant (Secondary heat input) (Operational) | | | | | kJ/s | |  |  |
| 10 | Ambient air temperature (External) | | | | | oC | |  |  | ω5A | Δ5A |
| 11 | CW inlet temperature (External) | | | | | oC | |  |  | ω5B | Δ5B |
| 12 | Auxiliary power usage measured (*Pmeas, Aux*) as average = *Pmeas, Aux PP + P PCC* f (Operational) | | | | For the power plant g (*Pmeas, Aux PP*) | kW | |  |  | ω6 | Δ6 |
| For a PCC plant (*P PCC*) deducted by electrical power requirement for CW pump in Table F3 | kW | |  |  |
| 13 | Condenser pressure (External) | | | | | kPa | |  |  | ωSC | ΔSC |
| 14 | Measured power difference than specified, if the goal is the predetermined power or operating deposition slightly different than required, if a specified deposition test | | | | | kW | |  |  | ω7 | Δ7 |
| **MULTIPLICATIVE CORRECTION FACTORS IN FUNDAMENTAL PERFORMANCE EVALUATION**dh | | | | | | | | | | | |
| 15 | Inlet temperature including fuel and air temperature (External) | | | | | | oC |  |  | β１ | α１ |
| 16 | Ambient air pressure (External) | | | | | | kPa |  |  | β2 | α2 |
| 17 | Ambient Relative humidity (External) | | | | | | % |  |  | β3 | α3 |
| 18 | Fuel supply temperature (for GTCC) (External) | | | | | | oC |  |  | β4 | α4 |
| 19 | Coal Ultimate analysis and Absorbentk analysis (External) | | Composition (wt %) (Carbon. Sulfur, Hydrogen, Moisture, Nitrogen, Oxygen, Ash), HHV (kJ/kg) | | | | wt% kJ/kg |  |  | β4 | α5 |

**Table F.7**(*continued*)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No** | | **Measured/Calculation items**  **(reason for the deviation from the reference condition)**a | | | | | **Conditions of items with PCC in operation and /without PCC (Reference plant) (2 cases)** | | | **Unit** | **Plant reference value** | **As tested** | | **Correction to the plant reference condition** | | |
| **INPUT ENERGY BY FUEL CALCULATION OR FUEL EFFICIENCY BY STEAM GENERATOR ENERGY BALANCE** | | | | | | | | | | | | | | | | **Results** |
| 20 | Energy Balance Method | | Loss (QrL) | Net sum of the energy transferred by the mass flow stream entering (excluding fuel combustion energy) plus exothermic chemical reaction and motive power energy of the auxiliary equipmentb, (kW) | | | | | | | | | | | |  |
| 21 | Credit (QrB) | Net sum of the energy extracted (excluding external steam output) by the mass flow stream leaving plus endothermic chemical reaction occurred and convective heat transferred to the environmentc, (kW) | | | | | | | | | | | |  |
| 22 | Energy output(QrO) i | | | | | =①+②+③−④−⑤+⑥−⑦−⑧ (Typical case around the steam generator) | | | | | | | |  |
| 23 | Primary stream (Out) | | | | | Flow (kg/s) | Enthalpy(kJ/kg) | | | | Energy(kW) ① | | |  |
| 24 | Auxiliary steam (Out) | | | | | Flow (kg/s) | Enthalpy(kJ/kg) | | | | Energy(kW) ② | | |  |
| 25 | Bow-down (Out) | | | | | Flow (kg/s) | Enthalpy(kJ/kg) | | | | Energy(kW) ③ | | |  |
| 26 | Feed water (In) | | | | | Flow (kg/s) | Enthalpy(kJ/kg) | | | | Energy(kW) ④ | | |  |
| 27 | Circulation pump injection water (In) | | | | | Flow (kg/s) | Enthalpy(kJ/kg) | | | | Energy(kW) ⑤ | | |  |
| 28 | Hot reheat stream (Out) | | | | | Flow (kg/s) | Enthalpy(kJ/kg) | | | | Energy(kW) ⑥ | | |  |
| 29 | Desuperheater water for Hot reheat steam (In) | | | | | Flow (kg/s) | Enthalpy(kJ/kg) | | | | Energy(kW) ⑦ | | |  |
| 30 | Cold reheat steam (In) | | | | | Flow (kg/s) | Enthalpy(kJ/kg) | | | | Energy(kW) ⑧ | | |  |
| 31 | Input energy in fuel (QrF)j =QrO+QrL-QrB (QrF can be obtained by calculating heat balance typically) | | | | | | | | | | Energy(kW) | | |  |
| 32 | Fuel efficiency (%) =100x(Q100-QpL-QpB where QpL=100x(QrL/QrF)% and QpB =100x(QrB/QrF)% | | | | | | | | | | % | | |  |
| 33 | Fuel calculation method | | | | HHV: higher heating value of the fuel corrected to constant pressure basis ⇒Calculate LHV using item 19 | | | | | | | | kJ/kg | | |  |
| 34 | QrFmes = qm x HHV where qm (kg/s) is fuel combustion rate | | | | | | | | kW | | |  |
| **HEAT RATE CALCULATION AND ANALYSIS** | | | | | | | | | | | | | | | **Unit** | **Results** |
| 35 | Measured gross power (Pg,meas)  (N=an individual generator, k=total number of generator) | | | | | | | | | | | | | | kW |  |
| 36 | Measured net plant power (Pmeas) Pmaes = Pg,meas – Pmeas,Aux – Ptransformer loss – Pline loss | | | | | | | | | | | | | | kW |  |
| 37 | Corrected net power (Pcorr) | | | | | | | | | | | | | | kW |  |
| 38 | Heat input (Qmeas) Qmeas =[(HHV)x(qm)]fuel  or = (QrO )x(Fuel efficiency) /100 e | | | | | | | | | | | | | | kW |  |
| 39 | Corrected heat input (Qcorr) | | | | | | | | | | | | | | kW |  |
| 40 | Heat rate (HRmeas) HRmeas = 3600ｘQmeas / Pmeas | | | | | | | | | | | | | | kJ/kWh |  |
| 41 | Corrected Heat rate (*HRcorr*) HRcorr =3600ｘQcorr / Pcorr | | | | | | | | | | | | | | kJ/kWh |  |
| 42 | Power decreased by the steam extraction from steam cycle (PLGP) | | | | | PLGP = [Pg,meas]without PCC operation − [Pg,meas]with PCC operation | | | | | | | | | kW |  |

**Table F.7**(*continued*)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No** | | **Measured/Calculation items**  **(reason for the deviation from the reference condition)**a | **Conditions of items with PCC in operation and /without PCC (Reference plant) (2 cases)** | **Unit** | **Plant reference value** | **As tested** | **Correction to the plant reference condition** | | |
| 43 | [Captured CO2]with PCC operation = (q m CO2) | | | | | | | t/h |  |
| 44 | Fuel specific emission(FSE) = 44/12x(𝑤𝐶/100)x(1/LHVfuel) see Formula (D-4) | | | | | | | kg/kJ |  |
| 45 | Specific equivalent electrical energy consumption (SEEC) =(PLGP + PPCC) / (q m CO2) | | | | | | | kWh/t |  |
| 46 | CO2 emission from a reference power plant (qm CO2e,ref) = (3,6)x[Qcorr]without PCC operation x(FSE)x(LHV)/(HHV) | | | | | | | t/h |  |
| 47 | CO2 emission from a power plant with PCC plant ( qm CO2e,cap) = (3,6)x[Qcorr]with PCC operation x(FSE)x(LHV)/(HHV)- q m CO2 | | | | | | | t/h |  |
| 48 | Specific reduction in CO2 emissions (SRCE) = qm CO2e,ref /[Pcorr]without PCC operation - qm CO2e,cap /[Pcorr]with PCC operation | | | | | | | t/MWh |  |
| a Operating condition (=Operational) or uncontrollable external condition (=External) requires correction and, in needed, the column should be added.  b CW, dry gas, water from burning fuel, water vapor in a gaseous fuel, moisture in air, etc. are considered. Refer to ASME PTC 4-2013.  c Entrainment dry air, moisture in inlet air, sensible heat in fuel, sulfation, auxiliary equipment power, etc. are considered. Refer to ASME PTC 4-2013.  d Some items are significant and the others can be ignored depending on the case. Double correction should not be performed between heat input and power output.  e If the fuel flow cannot be directly measured, Qmeas can be calculated from QrO and the steam generator fuel efficiency.  f In case of equipment with intermittent operation, the average period should cover at least three cycle of its operation.  g It may include AQCS, material/waste handling for the power plant. Utility system, the power usage increase by the reinforcement of existing FGD or addition of FGD for PCC plant, power usage reduction on CW supply by a PCC plant, if any, should be included in this category.  h Dependence of *ω*n,Δn,αn and *β*n on each correction parameter should be prepared in each project. Refer to ASME PTC-46 -1996.  i Energy absorbed by the working fluid that is not recovered within the steam generator boundary.  j Maximum amount of energy available when the fuel is completely burned.  k Absorbent used in the power plant side. | | | | | | | | | |