<table>
<thead>
<tr>
<th>Project:</th>
<th>MULTI FUEL CFB BOILER SIMULATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author:</td>
<td>JJA</td>
</tr>
<tr>
<td>Approved:</td>
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<tr>
<td>Language:</td>
<td></td>
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<tr>
<td>Document title:</td>
<td>SYSTEM DESCRIPTION</td>
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<tr>
<td></td>
<td>FLY ASH SYSTEM DESCRIPTION</td>
</tr>
<tr>
<td>Submitted for:</td>
<td>Employer reference:</td>
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<td></td>
<td>Other information:</td>
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1. GENERAL

A part of the fly ash, that passes through the separator, falls out of the flue gas as it turns through the boiler. To remove this ash there is hoppers located under the back passes and bag house. Hoppers are made of insulated carbon steel plate and steeply sloped to allow the flow of fly ash.

The fly ash conveying system of ESB West Offaly Power comprises the ash removal system, which serves the plant and is intended to collect fly ash from the five different places.

These five places are located to be hoppers of economizers (called also back pass one), hoppers of air-preheaters (called also back pass two) and the three fields of bag house pneumatic conveyors/transmitters.

Rest of a fly ash is removed in the end of the flue gas duct at the bag house. Bag house’ pneumatic conveyors are in order first two as parallel and last two in series, equalling altogether three sender pairs.

Ash itself is discharged from the mentioned hoppers to a system of pneumatic conveyor. The conveyors transport the ash to the fly ash silo before removal from the power plant.

The fly ash silo is furnished with two separate discharge/unloading systems:
- wet discharging system S1 ETK10
- dry discharging system S1 ETK20.

Fly ash is discharged from the silo through the rotary feeder, either to the wet or dry discharge. Rotary feeder rotates with constant speed and works with nominal filling grade. Bottom cones of the silo are equipped with fluidizing piping, which facilitates the ash discharge. From the rotary feeder the ash falls into the humidifier or in the other line straight into the lorry.
2. DESIGN DATA

2.1. General

The fly ash pneumatic conveying system is designed to convey fly ash from boiler back-pass ash hoppers and discharge points of fly ash at flue gas cleaning device to fly ash storage silo.

2.2. Ash analysis

The primary fuel of the Lough Ree Power and West Offaly Power peat fired plants is milled peat. Milled peat has the following typical characteristics:

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose bulk density</td>
<td>kg/m³</td>
<td>140 – 600</td>
</tr>
<tr>
<td>Moisture content</td>
<td>%</td>
<td>30 – 70</td>
</tr>
<tr>
<td>Ash content (dry basis)</td>
<td>%</td>
<td>2 – 10</td>
</tr>
<tr>
<td>Sulphur content (dry basis)</td>
<td>%</td>
<td>0.11 – 2.25</td>
</tr>
</tbody>
</table>

Ash analysis

- SO₃ % 7,2
- Fe₂O₃ % 6,6
- SiO₂ % 24,4
- CO₃ % 5,3
- Al₂O₃ % 5,8
- CaO % 19,6
- MgO % 26,2
- Na₂O % 1,3
- K₂O % 0,3
- P₂O₅ % N/A
- TiO₂ % N/A
- B₂O₃ % N/A
- Cl % 1,3
- Moisture content % 2,1

Ash deformation point, °C 1170 – 1205

Ash density kg/m³ ~600
2.3. Wet discharge main equipment from the fly ash silo

2.3.1. Rotary feeder S1 ETK10 AF501

Rotary feeder transfer the material from ash silo to the fly ash humidifier. Before rotary feeder can operate must the manually operated slide gate, which is located above the rotary feeder, be open. Rotary feeder is equipped with rotation sensor which gives one signal from every round of the rotary feeder. The volume of the rotary feeder is 150 m$^3$/h. Rotary feeder is equipped with local control switch. Local control switch returned Forward-0-Back typed switch. Backward drive for the rotary feeder is limited to 5 seconds. The new try to backward is allowed when feeder is been driven first to forward.

2.3.2. Fly ash humidifier FAH 1100 S1 ETK10 AF301

Fly ash humidifier FAH 1100 humidifies incoming material from rotary feeder and transfer it to the rail cars ash container. Fly ash humidifier is equipped with high pressure cleaning device which cleans the humidifier screw automatically if the cleaning sequence is chosen by the operator. Fly ash humidifier is equipped with lubrication unit which lubricate humidifier and rotary feeder automatically and independently.

2.4. Dry discharge main equipment from the fly ash silo

2.4.1. Rotary feeder ALF 50/50 S1 ETK20 AF501

Rotary feeder transfer the material from ash silo to the dry ash outloading equipment. Before rotary feeder can operate must the manually operated slide gate which is located above the rotary feeder be open. Rotary feeder is equipped with rotation sensor which gives one signal from every round of the rotary feeder. The volume of the rotary feeder is 150 m$^3$/h. Rotary feeder is equipped with local control switch. Local control switch returned Forward-0-Back typed switch. Backward drive for the rotary feeder is limited to 5 seconds. The new try to backward is allowed when feeder is been driven first to forward.

2.4.2. Dry ash outloading equipment S1 ETK20 AF901

Dry ash outloading equipment transfers dry ash from ash silo to dry ash container rail. The volume of dry ash outloading is 120 m$^3$/h. Dry ash outloaded is equipped with local control switches which start and stops the outloading sequence.
3. **EQUIPMENT DATA**

3.1. **Pneumatic conveyors**

3.1.1. **First and second back pass**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Pneuplan Oy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of senders</td>
<td>2</td>
</tr>
<tr>
<td>Number of senders</td>
<td>2</td>
</tr>
<tr>
<td>Capacity</td>
<td>0.359 kg/s</td>
</tr>
<tr>
<td>Temperature max.</td>
<td>300 °C</td>
</tr>
<tr>
<td>Temperature</td>
<td>170 °C</td>
</tr>
</tbody>
</table>

First back pass S1 ETG10
Second back pass S1 ETG20

- Type: Pneumatic conveyor unit 40T/200
- Volume: 40 litre
- Structural pressure: 10 bar
- Material: cast iron
- Fill-up valve: NS 200 dome valve
- Stainless steel dome, sealing material viton and first back pass water-cooled
- Rotameter with limit switch for cooling water
- Air inlet valve group: 1 pc for 2 conveyors
- Hopper: upper side of hopper 327x327 slide gate service valve. Equipped with a level probe.
- Instrument box, with necessary solenoid valves and pressure switches for local control, 1 pcs for two conveyors.
- Control through DCS systems
### 3.1.2. First two hoppers of bag house

**Manufacturer**
- Pneuplan Oy

**Number of senders**
- 1 S1 ETG30
- 1 S1 ETG35

**Capacity**
- 8.1 kg/s / sender S1 ETG30/35

**Temperature**
- max. 170 °C S1 ETG30/35

- **First bag house hopper at the left side** S1 ETG30
- **First bag house hopper at the right side** S1 ETG35

- **Type**
  - Pneumatic conveyor unit 1800/300
- **Volume**
  - 1800 litre
- **Structural pressure**
  - 10 bar
- **Material**
  - structural steel
- **Fill-up valve**
  - NS 300 dome valve stainless steel dome, sealing material butyl
- **Air inlet valve group**
  - 1 set for 1 conveyor
- **Hopper**
  - upper side of hopper 327x327 slide gate service valve. Equipped with a level probe.
- **Instrument box, with necessary solenoid valves and pressure switches for local control,**
  - 1 pcs per conveyor
- **Control through DCS systems**

- **Hopper volume**
  - 2 m³
- **Hopper material**
  - structural steel
- **Ventilation pipe**
  - DN 100, ~ 12 m

### 3.1.3. Last two hoppers of bag house

**Manufacturer**
- Pneuplan Oy

**Number of senders**
- 2 S1 ETG80

**Capacity**
- 0.869 kg/s
- 0.435 kg/s per hopper

**Temperature**
- max. 170 °C

- **Bag house’ last two hoppers constructed in series** S1 ETG80

- **Hopper volume**
  - 200 litre
- **Hopper material**
  - structural steel
- **Ventilation pipe**
  - DN 100, ~ 12 m
Type: Pneumatic conveyor unit 200T/200
Volume: 200 litre
Structural pressure: 10 bar
Material: structural steel
Fill-up valve: NS 200 dome valve
Air inlet valve group: 1 set for 1 conveyor
Hopper: upper side of hopper 327x327 slide gate service valve
Instrument box: equipped with a level probe

Control through DCS systems

3.2. Pipelines

3.2.1. Back pass

Pipeline size: DN 100 pipe with special flanges
Number of lines: 2
Curves: special cast basalt curves, 8 pcs / pipeline
Auxiliary: All necessary pipe clamps, screws, nuts and o-rings
End box: 2x DN 150
2x DN 100
shared with bag filter conveying lines

3.2.2. Bag filter

Pipeline size: DN 200 pipe with special flanges
Number of lines: 2
Piping: ~125 m
8x 90° pipe bends
Curves: Special cast basalt curves, 8 pcs / pipeline
Auxiliary: All necessary pipe clamps, screws, nuts and o-rings
3.3. Fly ash silo equipments

3.3.1. Air filter

Manufacturer: Pneuplan Oy
Location: top of the fly ash silo, with counter flange
Number of filters: 1 pc
Surface area: 30 m²
Function: counter pressure cleaning
Blower: 2.2 kW (ABB motor, 400 V)
R1/2 “ ball valve for instrument air

3.3.2. Relief valve

Manufacturer: Pneuplan Oy
Over pressure valve size: DN 200
Number of valves: 1 pc
Vacuum valve size: DN 100
Number of valves: 1 pc

3.3.3. Silo fluidization

Number of fluidization rings: 2 pcs
Fluidization ring: with 4 pcs of one way nozzles
Other equipment: R1” manual ball valve 1 pc
R1” pressure regulator 1 pc
R1” ball valve with actuator 1 pc

3.4. Fly ash silo discharge equipment

3.4.1. Manually operated slide gates

Manufacturer: Raumaster Oy
Number of gates: 2
Size: 500 x 500
Material:
- frame: carbon steel
- slide: stainless steel
- plate: steel
3.4.2. Rotary feeders

Manufacturer: Raumaster Oy
Number of units: 2
Type: ALF 50/50
Capacity: 150 m³/h
Rotation speed: 20 rpm
Motor: 5.5 kW (Siemens 400 V; 50 Hz; 1500 rpm)
Filling grade: 85%
Rotors volume: 146 l
Gear: Kumera TFM-3140H1-71-LA-38F265
Bracket for zero switch and volume indicator: Z = 4 and Z = 1
Zero switch: Telemecanique XSA-V11801
Volume indicator: Telemecanique XS1-M30MA230B
Shaft sealing: Packing housing (3 seals and a grease ring)
Lubrication: Safematic central lubrication system
Materials:
- inner lining of cells: Stainless steel
- other parts: Carbon steel

3.4.3. Fly ash humidifier

Manufacturer: Raumaster Oy
Type: FAH 1100
Capacity: 150 m³/h
Rotation speed: 75 rpm
Motor: 45 kW (Siemens 400 V; 50 Hz; 1500 rpm)
Gear: Kumera RFM-3180H1-20-LA-60F400
Bracket for zero speed switch: Z = 9
Zero switch: Telemecanique XSA-V11801
Mixing screws: 2 pieces, Ø 630 mm
- paddles: PL15 mm stainless steel with ceramic wearing parts
Shaft sealing: Packing housing (3 seals and a grease ring)
Lubrication: Safematic central lubrication system
Material (through): PL 6 mm stainless steel

The humidifier is equipped with humidification piping, which is dealt to separate humidification areas by magnet valves. It contains closing valve (ball valve), filter for coming water and water spray nozzles. Outlet chute is equipped with flexible (fabric) lower part L= ~1.5 m.
3.4.4. **Cleaning system for fly ash humidifier**  

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>Raumaster Oy</td>
</tr>
<tr>
<td>Type</td>
<td>FAH 1100</td>
</tr>
<tr>
<td>Rotating washing nozzles</td>
<td>6 pcs</td>
</tr>
<tr>
<td>Capacity</td>
<td>21 L/min with high pressure pump</td>
</tr>
<tr>
<td>Motor</td>
<td>5.5 kW</td>
</tr>
<tr>
<td>Water consumption</td>
<td>~200-250 L/wash</td>
</tr>
</tbody>
</table>

3.4.5. **Automatic lubrication unit**  

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>Safematic</td>
</tr>
<tr>
<td>Greasing points</td>
<td>10 pcs - shaft sealings 4 pcs in FAH 1100 and 2 pcs in ALF 50/50 - bearings 2 pcs in FAH 1100 and 2 pcs in ALF 50/50</td>
</tr>
<tr>
<td>Piping</td>
<td>Ø6 mm stainless steel</td>
</tr>
<tr>
<td></td>
<td>The lubrication unit is mounted to the frame of the humidifier</td>
</tr>
</tbody>
</table>

3.4.6. **Dry out loading unit**  

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>Raumaster Oy</td>
</tr>
<tr>
<td>Number of units</td>
<td>2</td>
</tr>
<tr>
<td>Capacity</td>
<td>120 m³/h each</td>
</tr>
<tr>
<td>Material temperature</td>
<td>&lt; 200 °C</td>
</tr>
<tr>
<td>Motor</td>
<td>0.55 kW (Siemens 400 V; 50 Hz; 1500 rpm)</td>
</tr>
<tr>
<td>Gear</td>
<td>SEW-Eurodrive SA57 17rpm / min</td>
</tr>
<tr>
<td>Outlet chute</td>
<td>D = 600 mm, movement 2500 mm, glass fibre and steel cones</td>
</tr>
<tr>
<td>Infeed chute</td>
<td>L = 2 m</td>
</tr>
<tr>
<td>Dust removal system</td>
<td>DN 150, pneumatic actuator</td>
</tr>
</tbody>
</table>

Needed air quantity for dust removal 2000 m³/h, 2000 Pa (by customer). Dust extraction pipe from dry loader is led to the upper part of the silo. The dry outloading unit is equipped with housing, control unit, terminal box, and regulating unit.
4. AUTOMATION AND INSTRUMENTATION

In this section automation is explained only basic level and more detailed descriptions can be found in Automation Descriptions

4.1. Ash conveying to the fly ash silo from the conveyors S1 ETG10/20/80 AF501…502
   S1 ETG10 AF501…502 equals conveyors of the first back pass
   S1 ETG20 AF501…502 equals conveyors of the second back pass
   S1 ETG80 AF501…502 equals conveyors of the second field of the bag house

1. Starting point
   - Sealing pressure is ON
   - Transfer pressure is OFF
   - In-line valve is CLOSED
   - The fill-up valve (dome valve) are CLOSED

2. Conveying cycle starts when ash level is high (level probe activated)
   - Sealing pressure OFF
   - Fill-up waiting time (4s)

3. Fill-up
   - Both fill-up valves OPEN.
   - Fill-up time (20s)
   - When fill-up time is over: Fill-up valves CLOSED
   - After four second waiting time, sealing pressure ON
4. **Conveyance**
- As soon as the sealing pressure reaches (5.5 bar) an adequate level, the line valve **OPEN**.
- Once the in-line valve have reaches the open point, the discharge valve **OPEN**.
- The pressure inside the conveyor builds up, and the ash moves through the pipeline.

5. **The conveying process is over**
- Transfer pressure is **OFF**.
- The discharge valve is **CLOSED**.
- In-line valve is **CLOSED**.
- The fill-up valve (dome valve) are **CLOSED**.
- Sealing pressure is **"ON"**.
- The conveyor waits for a new start signal from the level probe.
4.2. Ash conveying to the fly ash silo from the conveyors S1 ETG30/35 AF501 L1 ETG30/35 AF501 equals conveyors of the first field of the bag house

1. **Starting point**
   - The fill-up valve (dome valve) is **CLOSED**.
   - Sealing pressure (fill-up) is **ON**.
   - Transfer pressure is **OFF**.
   - In-line valve is **CLOSED**.
   - Sealing pressure (in-line valve) is **ON**.

2. **Conveying cycle start when ash level is high (level probe activated)**
   - Sealing pressure (fill-up) **OFF**
   - Fill-up waiting time (4s)
3. Fill-up
- Fill-up valve (dome valve) OPEN.
- Fluidization: Open and Close after five second.
- Fill-up time (20s)
- When fill-up time is over: Fill-up valve CLOSED.
- After four second waiting time, sealing pressure (fill-up) ON.
- As soon as sealing pressure (fill-up) reaches (5 bar) an adequate level, the sealing pressure (in-line valve) OFF.
4. **Conveyance**

- After four second waiting time (sealing off), the in-line valve **OPEN**.
- Once the in-line valve have reaches the open point, the discharge- and extra-air valves **OPEN**
- The pressure inside the conveyor builds up, and the ash moves through the pipeline.
5. **Conveyance**
   - The conveying process continues until the transfer pressure falls and the minimum conveying time has passed.
   - Transfer air goes out from silofilter.
6. The conveying process is over
   - Transfer pressure is OFF.
   - The discharge- and extra-air valves are CLOSED.
   - In-Line valve is CLOSED.
   - The fill-up valve (dome valve) is CLOSED.
   - Sealing pressure is "ON”.
   - The conveyors waits for a new start signal from the level probe.
4.3. Wet discharge from silo

4.3.1. Fly ash outloading sequence

1. OUTLOADING SEQUENCE READY
   – Automatic mode selected.
   – No alarms.

2. START ORDER FROM OPERATOR
   – Start switch at control panel.

3. START THE HUMIDIFIER SCREW S1ETK10AF301-M01

4. DELAY 5 SECONDS.

5. OPEN HUMIDIFIER WATER VALVE 1 S1GHH10AA901 AND START THE FLUIDIZATION.

6. START ROTARY FEEDER S1ETK10AF501-M01

7. DELAY 5 SECONDS

8. OPEN HUMIDIFIER WATER VALVE 2 S1GHH10AA902

9. DELAY 5 SECONDS

10. OPEN HUMIDIFIER WATER VALVE 3 S1GHH10AA903

11. OUTLOADING SEQUENCE RUNNING.

12. STOP ORDER FROM OPERATOR.
   – Stop switch at control panel.

13. STOP THE ROTARY FEEDER S1ETK10AF501-M01 AND STOP THE FLUIDIZATION.

14. DELAY 10 SECONDS.

15. CLOSE THE HUMIDIFIER WATER VALVE 1 S1GHH10AA901

16. DELAY 10 SECONDS

17. CLOSE THE HUMIDIFIER WATER VALVE 2 S1GHH10AA902

18. DELAY 10 SECONDS.
19. CLOSE THE HUMIDIFIER WATER VALVE 3 S1GHH10AA903
   S1ETK__-MDC6003 FUNCTIONAL DESCRIPTION FOR FLY ASH
   DISCHARGE EQUIPMENT 7(10) FLY ASH HANDLING SYSTEM

20. IF THE WASHING SEQUENCE IS SELECTED GO TO STEP 21. IF THE
    WASHING SEQUENCE IS NOT SELECTED JUMP TO STEP 47.
    – Washing sequence is selected switch at control panel.

21. OPEN THE WASHING VALVE 1 S1GHH11AA901

22. START HIGH PRESSURE PUMP S1GHH11AP101-M01

23. DELAY 100 SECONDS.

24. OPEN THE WASHING VALVE 2 S1GHH11AA902

25. DELAY 15 SECONDS

26. CLOSE THE WASHING VALVE 1 S1GHH11AA901

27. DELAY 100 SECONDS.

28. OPEN THE WASHING VALVE 3 S1GHH11AA903

29. DELAY 15 SECONDS

30. CLOSE THE WASHING VALVE 2 S1GHH11AA902

31. DELAY 100 SECONDS.

32. OPEN THE WASHING VALVE 4 S1GHH11AA904

33. DELAY 15 SECONDS

34. CLOSE THE WASHING VALVE 3 S1GHH11AA903

35. DELAY 100 SECONDS

36. OPEN WASHING VALVE 5 S1GHH11AA905

37. DELAY 15 SECONDS.

38. CLOSE THE WASHING VALVE 4 S1GHH11AA904

39. DELAY 100 SECONDS.

40. OPEN WASHING VALVE 6 S1GHH11AA906
41. DELAY 15 SECONDS.

42. CLOSE THE WASHING VALVE 5 S1GHH11AA905

43. DELAY 100 SECONDS.

44. STOP THE HIGH PRESSURE PUMP S1GHH11AP101-M01

45. DELAY 5 SECONDS.

46. CLOSE THE WASHING VALVE 6 S1GHH11AA906

47. DELAY 30 SECONDS.

48. STOP THE HUMIDIFIER SCREW S1ETK10AF301-M01

49. OUTLOADING SEQUENCY STOPPED.
4.4. Dry discharge from the silo

4.4.1. Dry ash outloading sequence

1. Manually open slide gate S1ETK20AA001

2. Drive outloading bellows to down position. Bellows is driven manually from local control switch. When the control switch is not pushed then the bellows is stopped. Bellows movement is automatically stopped when the limit switch S1ETK20CG102 is activated.

3. When the bellows is dropped from upper limit switch S1ETK20CG101.
   - The outloading control valve S1ETK20AA902 open.
   - The outgoing air valve S1ETK20AA101 open.
   - Dust filter fan motor S1ETH10AN401-M01 is started.

4. Rotary feeder S1ETK20AF501 can be started from local control switch start outloading. Rotary feeder can be stopped from local control switch stop outloading.

5. When the outloaded material level reaches the high level and level switch S1ETK20CL101 is activated then the rotary feeder S1ETK20AF501 is automatically stopped. The rotary feeder can be re-started from local control switch when the level in container is dropped and the level switch S1ETK20CL101 is deactivated.

6. When the material outloading is stopped the bellows is driven up position manually from local control switch. When the control switch is not pushed then the bellows is stopped. Bellows movement is automatically stopped when the limit switch S1ETK20CG101 IS activated.

7. When the bellows reach the upper limit switch S1ETK20CG101.
   - The outloading control valve S1ETK20AA902 closed.
   - Delay 30 second
   - Dust filter fan motor S1ETH10AN401-M01 stop.
   - The outgoing air valve S1ETK20AA101 close.

8. Dry ash outloading sequence ready.
5. OPERATION

See also the manufacturer documentation of the Pneuplan Oy and Raumaster Oy. Manufacturer operation, safety and maintenance instructions has to be noted and followed.

5.1. Start-up pre-check

Check, that:
- any device of the system is not damaged
- all devices maintenance and mandoors has been closed
- all controlled devices are electrically connected
- all manually controlled equipments are in correct position: opened / closed
- all devices are ready for safe operation (f.e. over pressure valves are checked =OK, etc.)

5.2. Start-up

5.2.1. Starting up the conveyors

Ensure, that first and second back pass:
- fly ash closing valves, S1 ETG10/20 AA001…002, are opened
- pressure air hand valves, S1 ETP10/20 AA002, are opened
- instrument air hand valves, S1 QFD10/20 AA002, are opened
- closed cooling water hand valves, S1 PGE11/12 AA001, are opened.
- closed cooling water flows, S1 PGF11/12 CF001/101, are normal.
- fly ash backwards discharge valves, S1 ETG10/20 AA810 and S1 ETG10/20 AA020, are closed.

Ensure, that bag house first and second field:
- fly ash closing gates from bag house, S1 ETG30/35/80 AA____, are opened
- conveyors hand valves, S1 ETG30/35 AA001, S1 ETG80 AA001...002, S1 ETG30/35 AA810 and S1 QFD30/35/80 AA003, are closed
- pressure air hand valves, S1 ETP30/31/35/36/80 AA002, are opened
- instrument air hand valves, S1 QFD30/35/80 AA002, are opened

After that go through locally each conveyor and:
a) Open the service valve
b) Open the air intake valve
c) Open instrument air valve
d) Make sure the supply pressure is higher than 5 bars
e) Turn the conveying cycle to position “1”.
f) Turn the fill-up switch to position “1”.

Both conveyor systems, mentioned at pictures 1. a and 2. a on the following page, has local switch board, where the switch has to be drawn to position “1”.
Picture 1. a  S1 ETG10/20/80 conveyors

1. Conveyor
2. Dome valve
3. In-line valve
4. Service valve
5. Air-intake
6. Hopper
7. Level probe (in hopper)
8. Dome valve limit switch
9. In-line valve limit switch

Picture 1. b
Explanations to picture 1. a numbering.

Picture 2. a  S1 ETG30/35 conveyors

1. Conveyor
2. Dome valve
3. In-line valve
4. Service valve
5. Air-intake
6. Extra air ring
7. Level probe (in conveyor)
8. Dome valve limit switch
9. In-line valve limit switch

Picture 2. b
Explanations to picture 2. a numbering.
5.2.2. Starting up wet fly ash unloading from the silo

Ensure, that:
- fluidisation hand valve, S1 ETP40 AA002, to the hopper cone fluidisation ring is opened.
- water hand valves, S1 GHH10/11 AA001, are opened to the humidifier.
- fly ash silo filter’ working air hand valve, S1 QFC10 AA002, is opened.
- Closing damper, S1 ETK10 AA001, is opened.

Fly ash is unloaded from the ash silo to the trains rail car ash containers. Operator starts and stops the unloading sequence from control panel switch located under ash silo and near the railway track. Operator must move and change the rail car during loading of the train. Before the moving and changing of the rail car must unloading sequence be stopped.

The humidifier washing sequence is started automatically after unloading sequence, if the washing sequence is selected from switch located in the same control panel as the start and stop switches for unloading sequence.

NOTICE: The washing sequence must be carry out once after every train or if the unloading is stopped longer time for any reason.

5.2.3. Starting up dry fly ash wet unloading from the silo

Ensure, that:
- fluidisation hand valve, S1 ETP45 AA002, to the hopper cone fluidisation ring is opened.
- sealing air hand valve, S1 ETP45 AA003, to the outlet chute spout is opened.
- fly ash silo filter’ working air hand valve, L1 QFC10 AA002, is opened.
- Closing damper, S1 ETK20 AA001, is opened.

Unloading hose is laid down and then the fly ash silo fan on the top of silo starts. After this the rotary feeder is started.
5.3. Normal operation

All systems needs normal monitoring from the DCS system, but also local controlling in daily period to see, that there are no unusual noises, leakages, breakdowns or other unusual observations to be noticed.

DCS systems shows from the continuous measurement function of the pneumatic conveyors as well the need for the fly ash silo unloading.

With the help of DCS system alarms, operator is able noticed f.e. malfunction at the pneumatic conveying. If there is a blockage at the system, operator is needed to resolve/discharge blockage locally.

All pneumatic conveyors should work properly and send sly ash automatically to the fly ash silo from the level indicator signal (level indicators of senders are needed to be tuned in the commissioning period to the correct fly ash conductivity) or after certain minimum cycle.

Fly ash silo unloading is needed to discharge locally – either with dry or wet unloading system (for which the lorry is ordered). Fly ash silo filter (S1 ETH10 AT201) functions automatically from the silo unloading signal or anyway after a timer.

5.4. Shut down

5.4.1. Shut down of a pneumatic conveyor

Each pneumatic conveyor can be taken away from operation or shut down from DCS or/and locally. From the DCS sender will be switched OFF and locally switch will be turned to position “0”.

5.4.2. Shut down of the wet fly ash unloading

If emergency stop is pushed or some other interlock stops the sequence operation is stopped immediately and when the alarms is been resetting the sequence starts from step 1. Every equipment has its own 0 / start-selector switch.

All the delay times in description are preliminary and the right times must be checked during commissioning.

5.4.3. Shut down of the dry fly ash unloading

When the level switch gives indication "truck full", the rotary feeder stops. The unloading hose is lifted up and then the fly ash silo fan stops. Every equipment has its own 0 / start-selector switch.