Plant Services Impairment Guidelines:

Electrical Power Impairment

1.
    a. Advise personnel of risks associated with loss of power. Ensure sufficient emergency lighting and/or flashlights.
    b. Verify standby cooling wind and cooling water systems are operational. Not operating – see Emergency Procedures – Cooling Wind Impairment or Cooling Water Impairment.
    c. If forming systems are not operational then control forehearth drains to a minimum.
2.
    a. Verify standby furnace, working end and forehearth firing systems are operational. Not operating – see Emergency procedures – Furnace Firing Impairment or Working End Firing Impairment or Forehearth Firing Impairment.
    b. Establish neutral to slightly positive furnace, working end and forehearth pressures.
    c. Ensure cullet handling capacity is adequate.
    d. Verify critical measurements. Utilize manual measurement methods if necessary.
3.
    a. Reduce electrical load and start standby electrical power if available.
    b. Verify all standby system breakers are closed and equipment is operational.
    c. Inspect for water accumulation/flooding.
4.
    a. Verify fuel levels for standby machinery and establish a refueling schedule.
    b. Contact supplier for fuel delivery. Limited fuel – see Emergency Procedures – Asset Protection.
    c. Contact electrical utility and determine expected power resumption schedule. Long term outage – see Emergency Procedures – Forced Furnace Cooldown.
5.
    a. Confirm batch making and delivery. Not operating – see Emergency Procedures – Batch Delivery Impairment.
    b. Confirm raw material inventory is sufficient.
    c. Contact raw material suppliers to confirm delivery schedules.
    d. Clear forming, annealing, cold end and packaging equipment.
6.
    a. Establish emergency command structure.
    b. Assign responsibilities and shift coverage.
    c. Develop a communication strategy.
    d. Contact key stakeholders and customers.
    e. Advise employees of layoffs and/or changes in shift schedule.
7.
    a. Prepare for factory start up.

See

Plant Services Impairment Guidelines

Fuel Delivery Impairment

1. Furnace see Furnace Firing Impairment.
2. Working End see Working End Firing Impairment
3. Forehearth see or Forehearth Firing Impairment
4. Annealing Lehrs
    a. For short duration interruptions and If production can be sustained, continue to put hot bottles into the lehr.
    b. Reduce cooling and exhaust to maintain temperature.
    c. If annealing cannot be sustained then consider interrupting production, emptying lehr and closing entry and exit doors. Maximize internal temperature to facilitate restarting.

See

Plant Services Impairment Guidelines

Electrical Power Impairment

Cooling Wind Impairment

1. Reduce furnace pull, firing rate and electroboost to levels suitable to the available cooling wind.
2. Direct available cooling wind flow to critical furnace equipment and locations such as electrodes, throat, areas of weak refractory, equipment and binding steel in heat intensive environments. Apply compressed air and/or portable spot cooling fans if available.
3. Have water lances available and monitor critical areas.
4. Monitor and record temperatures for hot spots. Use handheld pyrometers if needed.
5. Record changes in process set points.
6. Consider shutting off electric boosting and adjusting furnace pull if cooling wind to electrodes cannot be sustained.
7. Consider significantly reducing furnace pull and temperature if cooling wind to an air-cooled throat cannot be sustained.
8. Reduce furnace, working end and forehearth pressure to neutral to reduce sting outs and their effect on equipment and binding steel.
9. Determine length of impairment and reset operating parameters appropriately.

See

Plant Services Impairment Guidelines

Electrical Power Impairment

Cooling Water Impairment

Cooling Water Impairment

1. Reduce furnace pull, firing rate and electroboost to levels suitable to the available cooling water.
2. Direct available cooling water flow to critical furnace equipment and locations such as electrodes, throat, water jackets, areas of weak refractory, equipment in heat intensive environments. Apply compressed air and/or portable spot cooling fans if available.
3. Have water lances available and monitor critical areas.
4. Monitor and record temperatures for hot spots. Use handheld pyrometers if needed.
5. Record changes in process set points.
6. Consider shutting off electric boosting and adjusting furnace pull if cooling water to electrodes cannot be sustained.
7. Consider significantly reducing furnace pull and temperature if cooling water to a water-cooled throat cannot be sustained.
8. Reduce furnace, working end and forehearth pressure to neutral to reduce sting outs and their effect on equipment and binding steel.
9. Determine length of impairment and reset operating parameters appropriately.

See

Plant Services Impairment Guidelines

Electrical Power Impairment

Cooling Wind Impairment

Furnace Firing Impairment

1. Fuel and/or Oxygen Impairment
    a. Reduce furnace pull to minimum.
    b. Reduce air/oxygen to minimum.
    c. Set exhaust damper to maintain positive furnace, working end and forehearth pressure.
    d. Maintain electric boosting if available.
    e. Record changes in process set points.
    f. Establish backup firing if available.
    g. Confirm length of impairment. For prolonged outages or where there is a risk of glass freezing see – Emergency Procedures – Forced Furnace Cooldown.
2. Combustion Air Impairment
    a. Reestablish gas/air firing at minimum.
    b. Maintain electric boosting if available.
    c. Record changes in process set points.
    d. Establish backup combustion air system if available.
    e. Set combustion air fan damper to allow for natural draft.
    f. Adjust furnace pressure to enhance natural draft.
    g. Observe flames for rich/lean condition. Use a combustion analyzer to optimize.
    h. Gradually increase fuel and combustion air using natural draft until desired firing rate is achieved or natural draft capability is at maximum.
    i. Confirm length of impairment. For prolonged outages or where there is a risk of glass freezing see – Emergency Procedures – Forced Furnace Cooldown.
3. Exhaust System Impairment
    a. Reduce furnace firing to maintain a suitable furnace pressure.
    b. Maintain electric boosting if available.
    c. Match furnace boost to available input energy.
    d. Maximize furnace superstructure openings such as peepholes to alleviate pressure.
    e. Caution workers about the risk of excessive furnace pressure.
    f. Record changes in process set points.
    g. Confirm length of impairment. For prolonged outages or where there is a risk of glass freezing see – Emergency Procedures – Forced Furnace Cooldown.

See

Plant Services Impairment Guidelines

Electrical Power Impairment

Working End Firing Impairment

Forehearth Firing Impairment.

Working End Firing Impairment

1. Fuel and/or Oxygen Impairment
    a. Reduce pull to minimum.
    b. Reduce air/oxygen to minimum.
    c. Set exhaust damper to maintain positive working end and forehearth pressure.
    d. Maintain electric boosting if available.
    e. Record changes in process set points.
    f. Establish backup firing if available.
    g. Confirm length of impairment. For prolonged outages or where there is a risk of glass freezing see – Emergency Procedures – Forced Furnace Cooldown.
2. Combustion Air Impairment
    a. Reestablish gas/air firing at minimum.
    b. Maintain electric boosting if available.
    c. Record changes in process set points.
    d. Establish backup combustion air system if available.
    e. Set combustion air fan damper to allow for natural draft.
    f. Adjust working end pressure to enhance natural draft.
    g. Observe flames for rich/lean condition. Use a combustion analyzer to optimize.
    h. Gradually increase fuel and combustion air using natural draft until desired firing rate is achieved or natural draft capability is at maximum.
    i. Match furnace pull to available temperature and energy input.
    j. Confirm length of impairment. For prolonged outages or where there is a risk of glass freezing see – Emergency Procedures – Forced Furnace Cooldown.
3. Premix Fuel System Impairment
    a. Maintain electric boosting if available.
    b. Record changes in process set points.
    c. Establish backup combustion system if available.
    d. Adjust working end pressure.
    e. Observe flames for rich/lean condition. Use a combustion analyzer to optimize.
    f. Match furnace pull to available temperature and energy input.
    g. Confirm length of impairment. For prolonged outages or where there is a risk of glass freezing see – Emergency Procedures – Forced Furnace Cooldown.
4. Exhaust System Impairment
    a. Reduce working end firing to maintain a suitable pressure.
    b. Maintain electric boosting if available.
    c. Maximize working end superstructure openings such as peepholes to alleviate pressure.
    d. Caution workers about the risk of excessive furnace pressure.
    e. Record changes in process set points.
    f. Match furnace pull to available temperature and energy input.
    g. Confirm length of impairment. For prolonged outages or where there is a risk of glass freezing see – Emergency Procedures – Forced Furnace Cooldown.

See

Plant Services Impairment Guidelines

Electrical Power Impairment

Furnace Firing Impairment

Forehearth Firing Impairment.

Forehearth Firing Impairment

1. Fuel and/or Oxygen Impairment
    a. Reduce pull to minimum.
    b. Reduce air/oxygen to minimum.
    c. Set exhaust dampers to maintain positive forehearth pressure.
    d. Maintain electric boosting if available.
    e. Record changes in process set points.
    f. Establish backup firing if available.
    g. Confirm length of impairment. For prolonged outages or where there is a risk of glass freezing see – Emergency Procedures – Forced Furnace Cooldown.
2. Premix Fuel System Impairment
    a. Maintain electric boosting if available.
    b. Record changes in process set points.
    c. Establish backup combustion system if available.
    d. Adjust working end pressure.
    e. Observe flames for rich/lean condition. Use a combustion analyzer to optimize.
    f. Match furnace pull to available temperature and energy input.
    g. Confirm length of impairment. For prolonged outages or where there is a risk of glass freezing see – Emergency Procedures – Forced Furnace Cooldown.

See

Plant Services Impairment Guidelines

Electrical Power Impairment

Working End Firing Impairment

Furnace Firing Impairment

Forced Furnace Cooldown

1. This procedure is suggested to mitigate an impairment of furnace systems that will likely result in a furnace operating temperature drop below 2100 F for a substantial period.
    - **a.** Stop batch charging.
    - **b.** Shut off and lock out fuel and oxidant.
    - **c.** Minimize furnace exhaust.
    - **d.** Seal up all openings to maintain heat in furnace.
    - **e.** Reduce glass level as much as possible to facilitate reheating later. Consider sacrificing forehearth/working end electrodes. If possible, dam several forehearths to protect electrodes and sacrifice electrodes in one.
    - **f.** Remove heat absorbing colorants from batch formula if time permits to facilitate reheating. Note that this may cause a redox change requiring batch modifications at start up and lead to other start up delays. Evaluate accordingly.
    - **g.** Once minimum possible glass level is achieved, shut off and lock out the electroboost.
    - **h.** Remove all glass contact equipment from the glass before it freezes including level probes, thermocouples and sensors.
    - **i.** Keep batch charger pushers out of the glass. Remove batch chargers completely if furnace is to be brought to ambient temperature before restarting.
    - **j.** Contact third party heat up burner providers and expedite their arrival to site. They will need electrical power and natural gas/oil to provide heat.
    - **k.** If the furnace temperature falls below 2100 F begin to adjust the furnace binding steel to properly support the refractory as it contracts.
    - **l.** If on-site expertise allows, drill, install and activate throat bubblers to assist with reheating throat glass.
    - **m.** Develop a reheating/heat up plan.

See

Plant Services Impairment Guidelines

Electrical Power Impairment

Furnace Firing Impairment

Working End Firing Impairment

Forehearth Firing Impairment.

Batch Delivery Impairment

1. When batch delivery impairment is immediate or exceeds batch day bin capacity, even at low pull, then:
    a. Reduce pull to minimum.
    b. To prevent throat glass from freezing, maximize furnace glass temperature while respecting refractory limitations. If available, adjust electric boosting to maintain bottom glass temperature in a normal operating range.
    c. To prevent throat glass from freezing, maximize working end glass temperature while respecting refractory limitations.
    d. Energize throat electrodes if available. If not available and if on-site expertise allows, consider reconfiguring a working end ground electrode as an active electrode firing through the throat to the melter.
    e. If on-site expertise allows, drill, install and activate throat bubblers to assist with reheating throat glass.
    f. Consider how to protect forehearth electrodes as glass level falls.
    g. Develop a pull ramp up plan that includes regular verification that glass is flowing through the throat. Be cautious of overfilling the melter due to a frozen throat.
2. When batch delivery impairment does not exceed batch day bin capacity, then:
    a. Reduce pull to match available batch with production levels. Allow a reserve.
    b. Adjust operating parameters to match pull rate.
    c. Develop a pull ramp up plan that includes regular verification that glass is flowing through the throat. Be cautious of overfilling the melter due to a frozen throat.
    d. If further impairment occurs, then see condition 1 above.
    e. Develop a reheating/heat up plan.

See

Plant Services Impairment Guidelines

Electrical Power Impairment