AMERICAN FOREST & PAPER ASSOCIATION

OPERATION & MAINTENANCE SUBCOMMITTEE

IMPACT CONSIDERATIONS FOR EXTENDED RUN TIME BETWEEN RECOVERY BOILER INSPECTION OUTAGES

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FOREWORD

These guidelines for Impact Considerations for Extended Run Time were developed by the Operation & Maintenance Subcommittee for the use of member companies in developing or upgrading policies and procedures when considering extending run time between outages on Kraft Recovery Boilers.

These guidelines were developed as a result of an initiative driven by the AF&PA Operation and Maintenance Subcommittee led by Frank Navojosky of International Paper Company and Wes Hill of Georgia-Pacific. This effort was initiated due to an interest by the Operation and Maintenance Subcommittee attending members and guests as a high priority issue.

As a result, the Operation and Maintenance Subcommittee decided to drive an effort to better understand the benefits or the negative impacts when extending run time between outages.

Contents

Purpose and Scope

The purpose of this publication is to share experience and suggestions for member companies to consider when developing or upgrading policies, procedures, or specifications when considering extended run time on Kraft Recovery Boilers. The scope of this document is not intended to replace the detailed due diligence required when establishing or upgrading policies and / or procedures, modifying, or constructing chemical recovery equipment, or training employees. It is provided in the spirit of capturing years of operating, maintenance, and engineering experience and making it available to member companies to aid in the decision making process for extended run time on Kraft Recovery Boilers.

Planning

If you plan to go extended months, you need to develop a plan that is commensurate for extended months, not a 12 month plan then ask to go longer.

Budgeting of this extended vs 12 month run cycle should be done during the prior year in the budgeting process

Maintenance

A. Auxiliaries

Due to accelerating wear, some auxiliaries may see replacement needs vs repair needs as wear / leakage develops

Auxiliary equipment on the boiler proper may not make it to 18 or more months before required maintenance.

Examples of auxiliary equipment on the boiler proper could be:

Port rodders

Fans

Precipitators collecting surfaces may fall below permitting requirement on # of fields in service

Precipitator ash handling conveyors / feeders / agitators

Stack emissions sensors

Scrubber maintenance / plugging / cleaning

Liquor firing equipment / pumps / tanks (mix tank) / agitators / cascades / cyclones

Fire protection system on DCE

Liquor heaters indirect – wear of tubes

Liquor heaters direct injection – valve issues

Windboxes

SCAH coils

Condensate system piping repairs

Critical valves (trim may wear beyond repair)

Dissolving tank agitator bearings / blades / seals

Dissolving tank refractory, green liquor piping scaling

Sootblower maintenance needs / Lance durability / nozzle durability

Instrumentation / calibration/functional testing

Burner condition & maintainability, louvers, dampers,

NCG / SOG systems and burners

Water coil air heaters

Other mill equipment and other mill unit operating areas may not make it to 18 or more months before required maintenance.

Examples of other mill equipment and other mill operating areas could be:

Paper / pulp drying machine

Pulping / fibers / digesters / bleaching equipment / BSW

Evaporator pumps / heating surface fouling

Kiln / recaust

Woodyard

Waste treatment / sewer / effluent piping / clarifiers

Raw water treatment and pumps

Cooling towers

White and green liquor clarifiers

Turbine / generator

Electric Power Distribution system, thermal scan / hot spots, cleaning

UPS

Steam distribution / PRV / check valves / desuperheating stations

Fuel handling systems (Bark, coal, TDF,…)

Air compressors / compressed air system / dryers

Power boilers as waste incinerator MACT requirements

Deaerators

NCG / SOG systems and alternate incineration sources / incinerators

Energy recovery systems

B. Policy, Code, or Jurisdictional Requirements

Safety Relief Valve (SRV) test & rebuild required frequencies

Steam distribution header inspections (PRV / desuperheater)

Deaerator & feedwater storage system inspections, prior repair consideration on allowance to get extension (prior repair may have dictated to 12-month max to next inspection)

Unfired Pressure Vessels inspections

Tank inspections

DC battery load testing

Boiler MACT annual requirements

Non-return & stop valve inspections

Stack condition & inspection

BMS functional testing – flame safety documentation including BL functional testing

ESP testing frequencies

Steam drum waterside inspection

TG, MDT annual overspeed testing

Policy on chemical cleaning requirement maximum duration vs getting extension

C. Repair Contractor / supplier Availability

Contractor availability

Mill outage season peak times

Preferred team or contractor availability

Supplier may not be able to supply with other high demand periods

TG parts availability

Boiler parts availability / tubing

D. Interim Outage

Consider an interim or mini-outage to get to a longer 18 month major outage.

Interim scope based on history of the unit.

Primary air port inspection

Inspect composite cut line

Perform ESP test

Inspect or change smelt spouts based on unit operating history on spout issues and / or maximum time allowed to run a spout in service

Drum visual from outside.

Consider hydrotest on interim outage

Focused NDE inspection on areas of concern, review of prior data to ensure none are low

Consider boiler pluggage. May need to water wash mid cycle to make it to 18 months

Risk

A. Jurisdictional and Property Insurance Carrier Approval

Have Insurance carrier review data and recommend (or not recommend) extended run period to the jurisdiction.

Your own company corporate approval process may not approve

State / province jurisdictions are different as well. Most have a 30 day grace period. Some will not approve extensions far in advance, some require extension requests no more than 30 days ahead of operating permit expiration.

Jurisdictional allowances / requirements / approval process / approval process timing, and availability of boiler board to plead your case

Insurance carrier restrictions based on unit operating history

Un-completed audit tasks should be considered before asking for the extension

B. Pressure Part Leaks / Furnace Leaks / Forced outage

Operator Safety

Smelt leak potential in lower furnace

- Refractory at side wall – floor seal, membrane, airports, refractory closed ports may become opened up, stretcher doors (extended opening for two layers of brick)

Cracking in air ports from thermal fatigue / sootblower opening / manways / observation ports

Thermal cycling from trips, etc. during the previous run campaign damage refractory, casing, etc.

Balding of composite, weld overlay, or thermal spray

Overall availability may go down (limping in to 18 months) curtailing other mill operating units

NDE wear rate and predicted future thickness at extended date must be considered

Superheater shielding expected life

Superheater ties based on unit history may cause displacement / distortion / leaks if too many fail

Adequate number of spare tubes, components to insure against discovery work

C. Economics

Longer outage duration & increased costs as compared to 12 month outage cycle

- Increased punchlist repairs
- Increased inspection loading to not exceed maximum time between inspections
- Scope becomes more complex to satisfy required inspection durations
- May require additional inspectors to cover the required inspections in the time duration

Economics – extended runs may require replace vs repair if otherwise caught earlier

18 month outages take more calendar days, plus add in a potential interim outage calendar days

Prior year budget spend weighs into next year’s budget

Amortization of outage costs

D. Operational Changes

Operational changes could impact rate of corrosion or accelerate other pressure part damage mechanisms. For example - thermal fatigue

Examples of operational changes are: firing rate, nozzle type, sulfidity, excess O2 management, solids increase

Planned changes to water treatment / chemistry / providers

Level of operator training and experience level may also lead to operating the boiler in undesirable modes that may increase damage mechanisms

Not maintaining a bed and exposing the floor to higher heat

Intermittent bed caused thermal cycles

E. Seasonal Weather / Major storm season

Weather conditions may drive outage timing / restrictions

Extreme cold and freezing up the mill while down should be considered

Extreme heat / humidity greatly reduces workforce performance

Hurricanes / major storm season

Gas / fuel curtailments

Power curtailments

F. Pandemics

COVID has demonstrated the impact of mandated public health protocol and travel requirements

G. Environmental Permitting

Annual emission totalized limits could be of concern if skip outage in calendar year, total paper tons may also go up with less down days

Environmental performance of precipitators may degrade to the point of no longer able to maintain compliance / permit requirement for # of fields in service

Boiler MACT annual requirements

Legality of not meeting compliance

Areas of Concern

A. NDE Data:

NDE thickness trends based on wastage rates should be reviewed to ensure not approaching minimum thickness

Outage scope should consider the extent of testing required for longer cycle timing / inspection matrix maximum duration may force an earlier inspection / may not allow extension

Scaffolding needed for more extensive inspections takes more outage time to install / remove

Proactive tube replacements to go longer should be considered.

External corrosion of pressure parts / CSC

B. Smelt Spouts:

Smelt spout condition – interim inspections

- One report of 4-8 year life with 18 month inspections
- Options to inspect in place (with boiler down) or swap out and inspect while out of service

Data collection while in service, internal inspection – build a history / temperature / flow / pressure / cooling water chemistry

An upset may require an “early” replacement

C. Refractory:

Refractory wear may no longer provide protection to critical areas

- smelt spouts
- crotch refractory protecting knuckle bend of floor tubes, more particular in high smelt flow areas
- floor to sidewall seals
- floor to sidewall corner seals
- Air ports / windboxes
- Port casting mastic / refractory
- Generating bank sidewall
- Boiler doors
- Sootblower openings

Inspection ports,

Roof

Burner openings

Dissolving tank

Other areas

D. Lower Furnace High heat zones:

Airport sleeves & casting cracking / burnout

Membrane thermal fatigue cracking

Waterside condition / chemical cleaning needs – Records of water treatment excursion, may limit extension

Stud cracking / thermal fatigue

Smelt run good visual inspection for cracking and thinning

Burner openings cracking / thinning

Near membrane corrosion on tube surface

Corrosion barrier inspections / NDE thinning and balding

Floor bowing deflection / reverse slope from damage

Floor tube Near buttweld inspection to detect DNB thinning related to excessive push through

Floor to sidewall seal burn out

Carbon to clad / composite interface thinning – lower furnace or tertiary level

E. Lower Vestibule:

weak wash damage to lower headers / tubes at spouts

Supply tube age / condition / internal corrosion

Damage in vestibule from furnace-side impact / against floor support / bear claws

Crotch seal leakage

Sidewall seal leakage

F. Unit / component age and history:

As boilers become older, the potential for cold side corrosion and Stress Assisted Corrosion (SAC) increases

Has the boiler been well inspected in the past for these damage mechanisms and others

Past forced outages, past ESPs, tube leak history should be key drivers in inspection scope

Water side excursions should be evaluated

G. Boiler Inspector:

Boiler inspector should know plan to go to longer outage prior to initial outage and consider recommendations to replace vs repair.

Inspector needs to know the plan to adjust punchlist priorities.

Un-completed inspection findings should be clearly provided ahead of time to the boiler inspector

Adequate number of inspectors to properly inspect

H. Unknown / unforeseen issues

Business conditions are quite often key driver in outage timing

Capital project material delivery issues could dictate delays in outage timing

Previous outage may have been based on running 12 months to next outage

Spare parts availability / supply chain issues

Damage as result of leaks (salt, water, liquor etc…) and resulting corrosion / damage to electrical components that may not have been caught with a testing regime

I. Boiler design

If the opportunity of new boiler construction presents itself – work with supplier to design with 18 month outages in mind

Modern designed boilers have design features to reduce SAC potential

Consider spout smelt loading – provide some headroom to allow one spout out of service and not overload the remaining

Future capacity increases should be considered

Consider decanting over sloped

Consider metallurgy in lower furnace for those suited for RB service

J: Workforce Turn Over

Workforce may not have tenure to have performed outage tasks in the past

Training is critical to train new employees