IMPACT CONSIDERATIONS FOR EXTENDED RUN TIME BETWEEN RECOVERY BOILER INSPECTION OUTAGES

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IMPACT CONSIDERATIONS FOR EXTENDED RUN TIME FOR RECOVERY BOILER INSPECTION OUTAGES

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.
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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
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- 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
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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.
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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
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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
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- 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
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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
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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