SAPPI-SOMERSET RCFA REFERENCE MANUAL

Version 1.0 - Rev. 11/25

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INTRODUCTION

Welcome to Root Cause Failure Analysis!

At Sappi, everything we do is grounded in our purpose: to build a thriving world by unlocking the power of renewable resources to benefit people, communities, and the planet.

Our vision is equally clear—to be a sustainable business with an exciting future in wood fiber; one that provides relevant solutions, delivers enhanced value, and earns the trust of all our stakeholders.

Root Cause Failure Analysis (RCFA) plays a vital role in bringing this purpose and vision to life. By looking beyond symptoms to identify the true causes of problems, we:

- Protect the safety of our people and communities
- Strengthen the reliability and sustainability of our operations
- Prevent recurring failures that waste resources and limit value
- Build a culture of continuous learning and improvement

This manual is designed to equip you with the process needed to solve problems at their source. Remember that every RCFA we perform contributes to a safer workplace, a stronger business, and a more sustainable future.

Together, we are not just fixing problems—we are building resilience, protecting what matters most, and delivering on Sappi's promise of a thriving world.

PART I: RCFA Operations Guide

Root Cause Failure Analysis (RCFA) is more than a procedure – it's a mindset that drives us to understand not just *what* failed, but *why* it failed, and *how* to prevent it from happening again. At Sappi, this discipline supports our purpose: to build a thriving world by unlocking the power of renewable resources to benefit people, communities, and the planet.

Part 1: RCFA Operations Guide provides the foundation for consistent, high-quality execution of RCFA's across all operations. It serves as a practical guide for engineers, operators, facilitators, and maintenance professionals who lead or participate in investigations. The goal is to ensure that every failure – no matter how small – becomes an opportunity to learn, improve, and strengthen reliability across the mill.

This section outlines how the RCFA process begins, how teams are qualified and assigned, and how investigations are carried out from the field to final verification. It also establishes expectations for evaluating the long-term effectiveness of corrective actions – closing the loop between learning and lasting improvement.

The following chapters build framework:

1. **RCFA Triggers** – Defines the criteria and thresholds for initiating an RCFA, ensuring focus on the right events.
2. **Facilitator Qualifications** – Describes the skills, experience, and training required to effectively lead investigations.
3. **Field Investigation & Assignment** – Outlines how events are assessed, assigned, and documented to capture critical evidence.
4. **RCFA Execution Process** – Details the step-by-step workflow from problem definition through root cause verification.
5. **RCFA Effectiveness & Sustainability** – Provides the tools to measure whether corrective actions truly eliminate recurrence and add long-term value.

Together, these chapters create a repeatable process that transforms failures into data-driven insights, fosters collaboration, and strengthens our culture of reliability and continuous improvement.

"Every failure tells a story – our job is to listen, learn, and make sure it never repeats."

Chapter One: RCFA Triggers

Definition, Value, and Benefits

Not every failure deserves a full investigation, but every significant failure deserves *understanding*. The RCFA Trigger process defines **when** to initiate a Root Cause Failure Analysis and ensures that the organization focuses its energy on events with the greatest impact on safety, reliability, and performance.

An **RCFA Trigger** is a predefined condition, threshold, or event that signals the need for deeper investigation. Triggers bring consistency and discipline to the decision process, removing subjectivity and ensuring that significant events are addressed before they become chronic or systemic problems. Common examples include safety incidents, environmental releases, production losses, repetitive equipment failures, or events that exceed cost or downtime thresholds.

The **value of a well-defined trigger system** lies in its ability to direct limited resources toward the most meaningful opportunities for learning and prevention. By focusing investigations where the return on knowledge and reliability improvement is highest, Sappi ensures that RCFA's remains both effective and efficient.

Benefits of clearly defined RCFA triggers include:

- **Consistency** – Provides a standardized approach for identifying which events require RCFA, improving reliability program alignment across departments and sites.
- **Focus** – Prevents overuse of RCFA on minor issues while ensuring high-impact events are not overlooked.
- **Early Detection** – Encourages timely action by identifying repeat or chronic events before they escalate.
- **Accountability** – Creates transparency in how and why certain events are selected for investigation.
- **Continuous Improvement** – Builds a learning culture by systematically capturing lessons from significant failures and near-misses.

By establishing clear triggers, Sappi ensures that RCFA becomes a proactive tool for reliability improvement—not a reactive exercise performed after major losses. Properly defined triggers transform failure events into opportunities for learning, innovation, and sustainable performance.

Pulp Mill/U&R Triggers

Within the Pulp Mill and Utilities & Recovery (U&R) areas, certain events have a disproportionate impact on production, cost, and operational stability. To ensure consistent identification and response to these high-impact events, the following criteria define when an RCFA is required. These triggers ensure that significant failures are systematically reviewed to prevent recurrence and strengthen process reliability.

RCFA shall be initiated when any of the following conditions are met:

1. **Production Loss:** An equipment failure resulting in *lost digester revolutions equivalent to 500 tons or more* of production loss, whether caused by slowing back operations or fully shutting in a digester.

   Purpose: Ensures that production-limiting events affecting fiber output or overall mill throughput receive focused investigation to identify underlying process or equipment vulnerabilities.

2. **Repeat Failures:** Any *two repeat equipment failures within a three-month period*, regardless of immediate production impact.

   Purpose: Highlights chronic or recurring issues that may indicate deeper mechanical, procedural, or systemic causes requiring corrective action beyond repair.

3. **Cost Impact:** An equipment failure resulting in *repair or replacement cost of $100,000 or more*.

   Purpose: Ensures that financially significant failures are analyzed to uncover preventable causes and improve cost-effectiveness of maintenance and asset management decisions.

By establishing these clear, measurable triggers, Sappi's Pulp Mill and U&R Operations teams can prioritize investigations where they add the most value – reducing unplanned downtime, minimizing repeat incidents, and strengthening the reliability of critical process assets.

Woodyard Triggers

The Woodyard plays a critical role in maintaining stable fiber supply and overall mill reliability. Equipment reliability in this area directly influences digester feed consistency, chip quality, and downstream production continuity. To ensure significant events are captured and investigated effectively, the following criteria define when a RCFA shall be initiated within Woodyard Operations.

RCFA shall be initiated when any of the following conditions are met:

1. **Unscheduled Maintenance Downtime:** An equipment failure resulting in *six hours or more of unscheduled maintenance downtime*.

   Purpose: Ensures timely investigation of failures that disrupt woodyard throughput or delay chip delivery to the digester, impacting mill production and fiber balance.

2. **Repeat Failures:** Any *two repeat equipment failures within a three-month period*, regardless of downtime duration.

   Purpose: Identifies chronic or recurring issues that may indicate underlying mechanical, operational, or maintenance process weaknesses requiring long-term corrective action.

3. **Cost Impact:** An equipment failure resulting in *repair or replacement cost of $100,000 or more*.

   Purpose: Ensures that high-cost failures receive structured analysis to determine preventable causes and reduce future financial exposure.

By maintaining these clear and measurable triggers, Woodyard Operations can consistently identify events that offer the greatest opportunity for learning and improvement. This focus helps reduce chronic downtime, control maintenance costs, and strengthen the reliability of critical material-handling systems.

Paper Mill Triggers

The Paper Mill represents the final stage of product conversion, where equipment reliability directly impacts production volume, product quality, and customer delivery performance. Unplanned downtime or chronic failures in this area carry significant operational and financial consequences. To maintain consistency and ensure critical events are captured for analysis, the following criteria define when a RCFA shall be initiated within Paper Mill Operations.

RCFA shall be initiated when any of the following conditions are met:

1. **Machine Downtime:** an equipment failure resulting in *four hours or more of unplanned machine downtime.*

   Purpose: Ensures that production-interrupting events receive timely investigation to identify and eliminate root causes impacting continuous operation and product delivery.

2. **Repeat Failures:** Any *two repeat equipment failures within a three-month period*, regardless of production loss.

   Purpose: Detects chronic or recuring issues that may indicate systemic mechanical, procedural, or operational deficiencies requiring corrective action beyond repair.

3. **Yield Loss:** An equipment failure resulting in a *yield loss of 250 tons or more within a one-week period*.

   Purpose: Captures events that significantly impact output, waste, or efficiency – focusing on reliability issues that degrade product yield or machine runnability.

4. **Cost Impact:** An equipment failure resulting *in repair or replacement cost of $100,000 or more*.

   Purpose: Ensures that financially significant failures are analyzed to uncover preventable causes, improve asset life, and support more cost-effective maintenance practices.

By defining these triggers, the Paper Mill team can focus on events with the greatest potential for reliability improvement and cost reduction. Consistent use of these criteria promotes a culture of learning, precision maintenance, and operational discipline – ensuring that each RCFA contributes directly to long-term equipment and process stability.

Chapter Two: Facilitator Qualification Process

Definition, Value, and Benefits

The success of a RCFA depends greatly on the capability and mindset of the facilitator. A qualified facilitator ensures that each investigation is performed with structure, objectivity, and discipline – turning data, observations, and team input into actionable knowledge.

An **RCFA Facilitator** is an individual trained to lead the investigative process from event identification through to verified corrective action. They guide cross-functional teams, apply logic-functional teams, apply logic-based analysis methods, and ensure that all findings are supported by evidence and sound engineering judgement. Beyond technical knowledge, a facilitator must demonstrate skills in leadership, communication, and critical thinking to maintain engagement and keep the investigation focused on discovering true root causes – not symptoms or assumptions.

The **Facilitator Qualification Process** establishes the standards for training, experience, and competency needed to effectively lead RCFA's within Sappi operations. It provides a clear path for developing new facilitators while ensuring consistent quality and credibility across all investigations.

The value of having a qualified facilitator includes:

- **Consistency:** Ensures that each investigation follows a standard, repeatable process across departments and mills.
- **Objectivity:** Promotes fact-based analysis and prevent bias, personal opinion, or hierarchy form influencing results.
- **Efficiency:** Reduces investigation time by maintaining focus, clarity, and logical progression from problem to cause.
- **Engagement:** Encourages collaboration and open dialogue across departments, fostering shared ownership of solutions.
- **Credibility:** Builds confidence in finding and correcting actions, ensuring that implemented solutions address the true cause and stand up to scrutiny.

Benefits of the organization:

- Fewer recurring failures and reduced downtime through accurate root cause identification.
- Improved communication and decision-making between operations, maintenance, and engineering.

- Enhanced reliability culture that values learning, prevention, and continuous improvement.

A strong facilitator network is the backbone of an effective RCFA program. By investing in the qualification and development of facilitators, Sappi ensures that every failure investigation leads to meaningful, lasting improvement – transforming problems into opportunities for progress.

Training Material for Qualified RCFA Facilitators

To ensure every RCFA is executed with structure, objectivity, and technical rigor, facilitators must be trained in the fundamental principles of root cause methodology, human performance, and corrective action development. The **Prelical Root Cause Analysis Essentials** training provides the foundation for this qualification process and serves as Sappi's standard course for facilitator development.

This training equips participants with the knowledge, tools, and hands-on experience required to lead RCFA events effectively within industrial operations. The course emphasizes both the technical and human dimensions of problem-solving, ensuring facilitators can guide teams toward meaningful and sustainable corrective actions.

Course Overview: The Prelical RCFA Essentials seminar empowers participants to identify the true underlying causes of failures and incidents, rather than treating symptoms. The program is interactive and designed to blend classroom learning with real-world application, combining presentations, group discussions, and case studies relevant to pulp and paper manufacturing and other heavy industrial environments.

Core Learning Objectives: By the completion of the training, participants will have the ability to:

- **Enhance Problem-Solving Skills:** Apply structured RCFA methodologies to dissect complex technical and process issues.
- **Reduce Downtime and Cost:** Use data-driven analysis to prevent recurrence and improve operational efficiency.
- **Improve Safety and Quality:** Identify and eliminate conditions that lead to incidents and quality deviations.
- **Foster Continuous Improvement:** Integrate RCFA into ongoing reliability and process improvement efforts.

Training Modules: The Prelical curriculum covers a full spectrum of RCFA fundamentals, including:

1. **Introduction to Root Cause Analysis:** Understanding RCFA principles, benefits, and role in proactive reliability.
2. **Defining an Accurate Problem Statement:** Developing clear, evidence-based event definitions.
3. **Data Collection and Analysis:** Gathering and interpreting field data to identify contributing factors.
4. **Assembling a Proper RCFA Team:** Defining facilitator and team member roles for balanced participation.
5. **RCFA Methodologies:** Applying structured tool – Logic Tree
6. **Human and Organizational Performance:** Addressing human error and system deficiencies that influence failures.
7. **Corrective Action Planning:** Developing practical, verifiable actions that eliminate root causes.
8. **RCFA Case Studies:** Applying methods to real industrial failures to build confidence and competence.

Training Format and Expectations: Training is conducted in a workshop-style format that encourages engagement and practical application. Facilitators are expected to bring real Sappi failure events to apply RCFA tools during class exercises, ensuring immediate relevance to mill operations.

Outcome and Certification: Upon successful completion, participants demonstrate the ability to lead investigations, apply logic-tree and cause analysis techniques, and facilitate cross-functional discussions that result in actionable findings. Completion of the Prelical RCFA Essentials course is a prerequisite for designation as a **Qualified RCFA Facilitator** within Sappi's RCFA program.

RACI Matrix for Facilitator Qualification Process

The RCFA Facilitator Qualification Process requires coordination across multiple departments to ensure the mill maintains a full, competent roster of trained RCFA facilitators. The RACI matrix (Responsible, Accountable, Consulted, and Informed) defines clear ownership and communication expectations for each step of the qualification process.

This structure ensures alignment between Operations, Maintenance, and Reliability, while maintaining program continuity and accountability for facilitator development and sustainment.

Facilitator Qualification Process Roles: Key roles in the RCFA Facilitator Qualification Process include:

- **Reliability Manager (R/A):** Accountable for program oversight, maintaining the target number of qualified facilitators, and ensuring training aligns with corporate reliability objectives.
- **Area Maintenance Managers & Site Maintenance Manager (R, C):** Responsible for supporting training coordination and ensuring department participation in the annual facilitator review.
- **Operations Managers and Business Unit Leaders (C, I):** Provide input and visibility to ensure facilitator resources align with operational priorities.
- **Mill Manager (I):** Informed on annual facilitator status and qualification progress to ensure alignment with mill reliability goals.

Key Responsibilities Defined in the RACI-RCFA Qualification Matrix

1. **Maintain a Full Complement of Qualified RCFA Facilitators:**
    a. Responsible: Reliability, Maintenance, and Operations leadership
    b. Accountable: Reliability Manager
    c. Consulted: Site Maintenance, Area Maintenance Managers, BUL's
    d. Informed: OMC, Engineering, and Mill Manager
2. **Annual Review of Qualified Facilitators (Target: 45 Individuals):**
    a. Responsible: Maintenance and Reliability Leadership
    b. Accountable: Reliability Manager

c. Consulted: Site Maintenance Manager

d. Informed: OMC, Operations, and Engineering teams

3. **Coordinate Annual RCFA Training to Qualify Additional Facilitators:**

a. Responsible: Reliability and Maintenance Managers

b. Accountable: Reliability Manager

c. Consulted: Maintenance Managers, Operations Managers, and BUL's

d. Informed: Mill Manager

Program Benefit: Defining RACI ownership ensures the qualification process remains sustainable, transparent, and aligned with Sappi's goal of maintaining at least **45 qualified RCFA facilitators** at Somerset Mill. Clear accountability across departments reinforces a culture of reliability, cross-functional engagement, and continuous improvement.

Chapter Three: Field Investigation Reporting

Definition, Value, and Benefits

The **Field Investigation Report** is the foundation of the RCFA process. It captures the first and most critical information about a failure or incident – directly from the scene, while details are fresh, and evidence is intact. Accurate field reporting transforms isolated events into opportunities for learning and continuous improvement, ensuring that every investigation begins with reliable, fact-based data.

Definition: A **Field Investigation Report** is a structured document used to record the initial facts, observations, and responses surrounding a failure, safety event, environmental incident, or production interruption. The report serves as the formal record of what occurred, when it occurred, and under what conditions, establishing the evidence base for subsequent RCFA review.

The Sappi Failure Report includes key sections that standardize data collection across all departments:

- **Incident Details:** Reporter initiator, date/time, type of incident, and affected process area.
- **Incident Description and Witness Accounts:** Objective summary of the event and immediate conditions observed.
- **Safety, Environmental, and Production Impact:** Documentation of any injuries, environmental releases, downtime, or product loss.
- **Maintenance and Operations Reporting:** Equipment description, failure details, downtime duration, cost impact, and operational condition before failure.
- **Initial Cause Assessment:** Early identification of potential physical, human, or systemic contributors.
- **Photographic Evidence and Supporting Documentation:** Collection of photos, inspection results, and relevant technical references.

Value: The Field Investigation Report ensure that investigations are **rooted in evidence, not assumptions**. By establishing a consistent method of capturing event data, Sappi promotes cross-departmental alignment between Operations, Maintenance, Engineering, Safety, and Reliability.

Key areas of value include:

- **Accuracy:** Records critical event details before information is lost or altered.
- **Accountability:** Defines clear roles for reporting and follow-up within the RCFA workflow.
- **Traceability:** Provides a documented trail of event actions, and conditions that led to the failure.
- **Speed:** Enables faster initiation of RCFA sessions by supplying pre-verified facts and visuals.
- **Integration:** Links with Sappi's Environmental Management System (EMS), SIMS, and SAP systems for unified event tracking.

Benefits: A strong field investigation process strengthens the reliability culture across all operations.

Key benefits include:

- **Improved Investigation Quality:** Facilitators begin RCFA sessions with accurate data, reducing speculation and rework.
- **Enhanced Safety and Environmental Compliance:** Ensures all recordable, first aid, or high-potential incidents are properly logged and escalated.
- **Reduced Recurrence of Failures:** Timely and complete reporting enables more effective root cause identification and corrective action.
- **Faster Learning Cycles:** Capturing data early accelerates the transition from incident to solution, minimizing production losses.
- **Cross-Functional Engagement:** Encourages participation from Operators, Maintenance, and Supervisors, creating shared ownership of reliability outcomes.

RACI Matrix for RCFA Field Incident Report

Sappi uses a RACI matrix to define clear ownership for every task within the reporting process. This structure promotes collaboration between Operations, Maintenance, Engineering, and Reliability, ensuring no step is overlooked and every event meeting RCFA trigger criteria is reported and reviewed effectively.

RCFA Field Incident Report Roles: Key roles in the RCFA Field Reporting Process include:

- **Operations Manager (A/R):** Accountable for ensuring Field Incident Reports (RFIR) are completed, reviewed, and submitted within the prescribed timeline. Provides oversight to guarantee compliance with RCFA reporting standards.
- **Area Shift Supervisor (R):** Responsible for ensuring RFIR's are completed accurately before the end of the shift for any event meeting an RCFA trigger. Leads communication between operators, craftspeople, and reliability personnel during incident documentation.
- **Operator and Craftsperson (C):** Consulted for firsthand details, observations, and evidence collection. They play a crucial role in describing what occurred, how equipment behaved, and what immediate actions were taken.
- **Reliability Manager and Reliability Engineer (I):** Informed of all Field Incident Reports.
- **OMC (A):** Accountable for ensuring accurate reporting, maintaining high-quality reports, and training Area Shift Supervisors to properly report events using the RFIR.

Key Responsibilities Defined in the RACI-RCFA Field Incident Report Matrix

1. **RCFA Field Incident Report Training**
    - **a.** Responsible: OMC and Area Shift Supervisor
    - **b.** Accountable: Ops Manager
    - **c.** Consulted: Reliability Manager and BUL
    - **d.** Informed: Maintenance Managers and Mill Manager
2. **Complete the RFIR Before End of Shift**
    - **a.** Responsible: Area Shift Supervisor
    - **b.** Accountable: Operations Manager, OMC
    - **c.** Consulted: Operators, Craftspeople, Production Engineer
    - **d.** Informed: Maintenance, Reliability, BUL, and Mill Manager
3. **Submit Completed RFIR to OMC**
    - **a.** Responsible: Area Shift Supervisor
    - **b.** Accountable: Operations Manager
    - **c.** Consulted: Production Engineer
    - **d.** Informed: Maintenance, Reliability, OMC, BUL, Mill Manager

"Clarity of responsibility builds consistency – and consistency builds reliability."

Chapter Four: RCFA Identification & Assignment

Definition, Value, and Benefits

Definition: The process ensures that all events meeting established trigger criteria are consistently reviewed, logged, and assigned to a qualified facilitator for formal RCFA. This process provides a disciplined framework for converting field incident data into structured learning opportunities and drives accountability for continuous improvement.

Value: A strong identification and assignment process ensures that Sappi's reliability program remains proactive, data-driven, and focused on what matters most. By using objective criteria and weekly structured review, OMC ensures that:

- No significant event is missed or ignored.
- Facilitator resources are applied to the highest-value investigations.
- Lessons learned from every incident – triggered or not – are captured and communicated.

Each week, the **Operation Maintenance Coordinator (OMC)** reviews RCFA Field Incident Reports (RFIR's), downtime events, and repeat failures to determine which incidents qualify for RCFA. Approved events are assigned to qualified facilitators for investigation and documented in the RCFA Tracking Sheet, while unassigned events are documented in the RCFA Tracking Sheet with clear justification. This ensures transparency, consistency, and a complete record of decision-making.

Benefits: Implementing a structured RCFA Identification and Assignment process ensures:

- **Consistency:** All reported events are evaluated objectively against the same criteria.
- **Transparency:** Decisions to conduct or defer RCFA's are documented and visible.
- **Efficiency:** Resources are focused on high-impact failures for maximum reliability gain.
- **Accountability:** OMC maintains ownership of RCFA initiation, assignment, and progress tracking.
- **Continuous Improvement:** Each review strengthens the mill's ability to prevent recurrence and improve long-term reliability performance.

OMC Review and Decision-Making Process

The OMC is the decision authority for RCFA event identification and assignment. The OMC's weekly review process includes the following activities:

1. **Review Reported Events and RFIR's:** Evaluate all RFIR's, downtime records, and repeated failures to identify events meeting RCFA trigger thresholds (production loss, cost, safety, environmental, or frequency).

2. **Determine RCFA Assignments:** Decide which events will proceed to RCFA and assign each to a qualified facilitator based on experience, workload, and area of responsibility.

3. **Update RCFA Tracking Sheet:** Record all reviewed events, including both triggered and non-triggered cases, and document the reasoning behind each decision.

4. **Coordinate Communication:** Notify Maintenance, Reliability, and Operations teams of assigned facilitators and planned investigations. Ensure assigned events are followed up to completion and closed out within defined timelines.

Chapter Five: RCFA Execution Process

Definition, Value, and Benefits

Definition: The **RCFA Execution Process** defines how Root Cause Failure Analyses are conducted once an event has been assigned to a qualified facilitator. This phase transforms collected evidence and operational data into actionable insights by systematically applying structured analytical tools. The process covers all steps from reviewing the **RCFA Field Incident Report (RFIR)** and preserving evidence, to developing logic trees, validating hypotheses, defining corrective actions, and issuing the final report for approval and distribution.

Value: An effective RCFA execution process ensures that every investigation results in meaningful corrective actions that prevent recurrence. By following a standardized workflow and using digital tools such as EasyRCA and the **Somerset Reliability SharePoint**, Sappi ensures investigations are transparent, data-driven, and verifiable. This disciplined process strengthens communication across Operations, Maintenance, Engineering, and Reliability, while reinforcing Sappi's culture of learning, accountability, and continuous improvement.

Benefits: A standardized RCFA Execution Process delivers measurable benefits to the organization:

- **Consistency:** Every investigation follows a uniform structure and methodology.
- **Traceability:** Documentation and approvals are stored in centralized system (EasyRCA and SharePoint).
- **Quality:** Logic trees and action plans are verified and validated through cross-functional collaboration.
- **Accountability:** Assigned task and due date ensure follow-through and implementation.
- **Sustainability:** A closed-loop process that transforms incidents into long-term reliability improvements.

"Thorough analysis doesn't just fix problems – it prevents them from returning."

Execution Process

Each RCFA follows a consistent series of structured steps designed to produce thorough defensible, and data-backed conclusions:

1. **Event Review and Preparation**
    - **a.** Review the completed RFIR, photos, data, and any available evidence.
    - **b.** Preserve all event information – components, parts, documentation, and relevant logs.
    - **c.** Form the RCFA team (Principal Analyst, Associate Analyst, experts, and vendors as needed).
2. **EasyRCA Setup and Analysis**
    - **a.** Create the investigation in **EasyRCA** select "In Process" and enter event information (title, problem statement, findings).
    - **b.** Add relevant team members, costs, and equipment details.
    - **c.** Develop an event timeline.
    - **d.** Build and verify the logic tree, identifying failure modes, physical hypotheses, and contributing factors.
    - **e.** Use the verification process to confirm physical roots and contributing factors.
3. **Facilitated RCFA Session**
    - **a.** Schedule and conduct the RCFA meeting with the cross-functional team.
    - **b.** Review 1st revision of event report, agree on the human and systemic root causes, and then develop the necessary corrective actions.
    - **c.** Document meeting discussions, agreements, and all assigned tasks with due dates.
4. **Action Implementation and Report Development**
    - **a.** Generate corrective action items "Task" in **EasyRCA** to individuals with expected due dates.
    - **b.** Enter corrective actions in **SAP** with task ownership and deadlines.

c. Finalize the logic tree and generate the **EasyRCA report** for review.

d. Save and format the report in MS Word for inclusion of photos, annotations, and attachments.

e. Upload the completed **RCFA Report** and **RFIR** to the **Somerset Reliability SharePoint** under the "Completed RCFA" folder.

5. **Final Approval and Distribution**

a. Review the final report for accuracy and completeness.

b. Mark investigation status as "Complete" in EasyRCA and SharePoint tracking systems.

c. Distribute the approved report (PDF format) to applicable departments – Operations, Maintenance, Engineering, and Management.

Key Responsibilities Defined in the RACI-RCFA Execution Process

1. **Review Completed RFIR and Preserve Evidence**

a. Responsible/Accountable: RCFA Facilitator

b. Consulted: Operations, Maintenance, Reliability

c. Informed: Maintenance Manager, BUL, Mill Manager

d. Ensures all event data (parts, positions, documentation) are retained for analysis.

2. **Form and Manage the RCFA Team**

a. Responsible/Accountable: RCFA Facilitator

b. Consulted: Operations, Maintenance, Reliability

c. Informed: Maintenance Manager, BUL, Mill Manager

d. Assembles a balanced cross-functional team with appropriate subject matter expertise.

3. **Build and Validate the Logic Tree**

a. Responsible/Accountable: RCFA Facilitator

b. Consulted: Operations, Maintenance, Reliability

c. Informed: Maintenance Manager, BUL, Mill Manager

d. Verifies failure modes and root causes through collaborative review and validation.

4. **Conduct RCFA Meeting and Assign Actions**

    a. Responsible/Accountable: RCFA Facilitator

    b. Consulted: Operations, Maintenance, Reliability

    c. Informed: Maintenance Manager, BUL, Mill Manager

    d. Develops corrective actions, assigns task owners, and establishes due dates.

5. **Finalize and Distribute RCFA Report**

    a. Responsible/Accountable: RCFA Facilitator

    b. Consulted: Operations, Maintenance, Reliability

    c. Informed: Maintenance Manager, BUL, Mill Manager

    d. Ensures final report is uploaded, distributed, and archived properly.

Chapter Six: RCFA Effectiveness & Sustainability

Definition, Value, and Benefits

Definition: The **RCFA Effectiveness and Sustainability** process ensures that the Root Cause Failure Analysis (RCFA) program continues to deliver measurable reliability improvements and long-term value. This process verifies that investigations are not only completed but that their corrective actions are implemented, tracked, and effective. Sustainability is achieved through consistent performance monitoring, periodic reviews, and reinforcement of a culture that values learning, accountability, and reliability excellence.

Value: An RCFA process is only as strong as its follow-through.
Sappi's commitment to effectiveness and sustainability ensures that lessons learned are applied, actions are completed, and improvements are maintained over time. Through continuous measurement and feedback, the organization converts investigations into actionable knowledge – closing the loop between problem identification, corrective action, and long-term prevention. This ongoing review process builds confidence in the RCFA program, enhances cross-functional engagement, and drives the reliability culture forward.

Benefits: Sustaining RCFA effectiveness drives lasting reliability improvements and measurable business outcomes. Key benefits include:

- **Visibility:** Regular KPI tracking provides transparency into RCFA performance and backlog.
- **Accountability:** Defined ownership ensures timely completion of investigations and corrective actions.
- **Continuous Learning:** Ongoing reviews and recognition reinforce a culture of shared improvement.
- **Data Driven Decision Making:** RCFA results and metrics inform reliability strategies and resource allocation.
- **Program Longevity:** Annual reviews keep the RCFA process aligned with evolving mill needs and corporate reliability goals.

"Sustainability in reliability comes from discipline – measuring what we do, learning from it, and improving it every cycle."

Program Monitoring and Performance Reporting

RCFA performance is evaluated through structured reporting, routine tracking, and defined key performance indicators (KPI's). These metrics ensure transparency, consistency, and alignment with mill and corporate reliability goals.

1. **Weekly Downtime Tracking Reports by Area**
    a. Summarizes equipment downtime events and identifies potential RCFA triggers.
    b. Enables OMC and Reliability Engineers to track event trends and recuring issues.
2. **Monthly Reliability Reports by Area**
    a. Consolidates RCFA activity, completed investigations, and open action items.
    b. Highlights progress against reliability objectives and identifies improvement areas.
3. **Key Performance Indicators (KPI) for RCFA Effectiveness**
    a. **% of Triggered Events Receiving RCFA:** Measures discipline in applying RCFA criteria.
    b. **RCFA Cycle Time:** Tracks time from event occurrence to RCFA completion (target ≤ 14 days).
    c. **In-Process RCFA's >30 Days:** Flags overdue investigations for management review.
    d. **Corrective Actions Overdue:** Tracks open or late action items, ensuring closure and accountability.

Governance and Accountability

The RCFA Effectiveness & Sustainability process depends on coordination oversight, clear communication, and defined ownership. The following roles and responsibilities ensure the RCFA performance remains visible and continuously improved:

Operations Maintenance Coordinator (OMC) – R/A

- Accountable for monitoring RCFA KPI's and reporting performance by area.

- Leads weekly and monthly reviews to ensure RCFA progress, compliance, and follow-up.
- Reports results and trends to Mill Leadership Team (MLT).

Reliability Manager and Reliability Engineers – R/C

- Analyze trends, monitor RCFA completion metrics, and provide insights on chronic failures.
- Support data integrity within downtime and reliability reports.

Operations, Maintenance, and Engineering Managers – C/I

- Provide updates on corrective actions, validate effectiveness, and contribute to improvement strategies.

RCFA Facilitators – R

- Ensure corrective actions are closed in a timely manner.
- Provide feedback on recurring issues and participate in lessons-learned review.

Mill Manager and Business Unit Leader (BUL) – I

- Informed of overall program performance and improvement through formal KPI and MLT updates.

Key Responsibilities Defined in the RACI-RCFA Effectiveness & Sustainability

1. **Weekly Downtime Tracking and Monthly Reliability Reporting**
    a. Responsible/Accountable: OMC
    b. Consulted: Maintenance Supervisor, Area Shift Supervisors, Reliability Engineers
    c. Informed: Mill manager
    d. Provides continuous visibility of equipment reliability and RCFA Progress.
2. **RCFA Key Performance Indicator Reporting by Area**
    a. Responsible/Accountable: OMC
    b. Consulted: Reliability and Area Maintenance Managers

c. Informed: Engineering, Operations, and Mill Management

d. Tracks the quality, timeliness, and throughput of RCFA investigations.

3. **RCFA Report-out to MLT (One Area per Week)**

    a. Responsible: OMC

    b. Accountable: Reliability Manager

    c. Consulted: Reliability, Maintenance, and Engineering teams

    d. Informed: Mill Manager

    e. Ensures visibility of progress and celebrates success across all departments.

4. **Annual RCFA Review Meeting**

    a. Responsible: OMC, Reliability and Area Maintenance Managers

    b. Accountable: Reliability Manager

    c. Consulted: BUL and Mill Manager

    d. Recognizes outstanding RCFA's, shares lessons learned and provides feedback for continuous improvement.

5. **Annual RCFA Manual Review for Effectiveness and Sustainability**

    a. Responsible: Reliability Manager

    b. Accountable: Reliability Manager

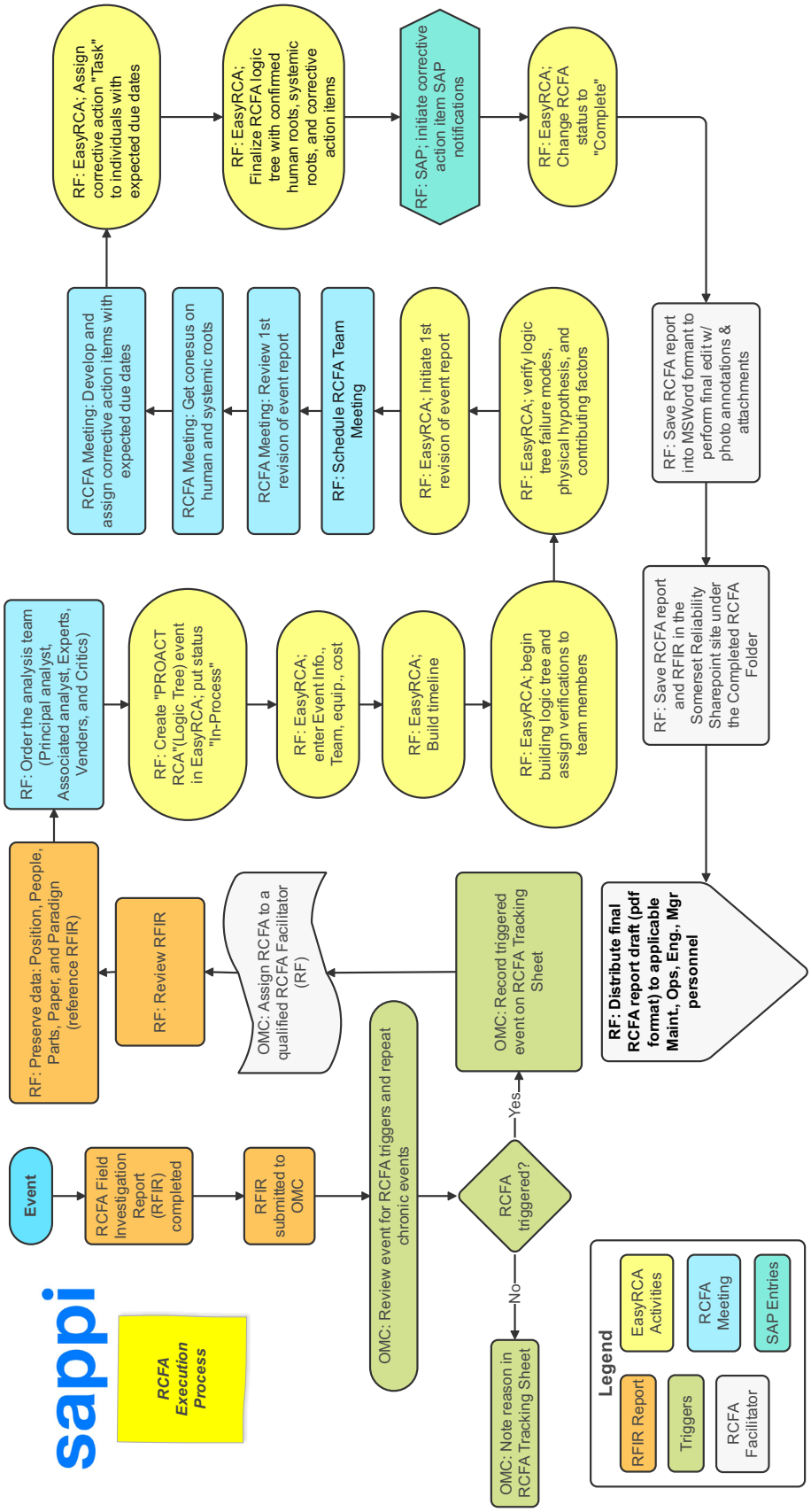
    c. Consulted: OMC, Area Maintenance, Operations, and Engineering

    d. Informed: Mill Manager

    e. Ensures manual updates reflect current practices, tool enhancements, and evolving best practices.

PART II: APPENDIX

RCFA Workflow Process



RCFA Field Incident Report

Triggers	Paper	Pulp & U/R	Woodyard
Health & Safety	Recordable, First Aid, High Potential Near Miss		
Environmental	Recordable event		
Production Loss	4-hours of unscheduled downtime, 250 tons	500 tons	6-hours of unscheduled downtime
Total Cost	$100,000	$100,000	$100,000
Frequency of Failure/Loss	2 repeat equipment failures within a 3-month period		
Customer Complaint	Any customer complaint		

Fill Out this Section for All Potentially Triggered Incidents	1. Report Date:
2. Report Initiator:	5. Incident Date & Time:
3. Type of Incident *(all that apply)* ☐ Health/Safety Recordable or High Priority Near Miss ☐ Environmental Incident ☐ Production Loss or Repair Cost ☐ Customer Service (complaint) ☐ Repeat Failure *Fill out all sections of the report that apply*	6. Incident Description:
4. Witnesses:	

Report for Health, Safety or Environmental Incidents (Reference SIMS Record # as appropriate)	
7. Incident or discharge location:	8. Description of Area Conditions and Activities *(attach pictures as needed):*
10. Did the incident result in an injury or first aid: ☐ Yes ☐ No ***(If Yes, then follow the Supervisor Injury Checklist)***	9. Describe use of Personal Protective Equipment, or other environmental control, safety equipment:
11. Safety Representative Notified: ☐ Yes ☐ No	

Report for Repairs, Customer Service and Production Loss Incidents			
Operations Report	12. Failure Date/Time:		
13. Equipment Description:	14. Functional Location and Location:		
15. Describe Failure: *(attach pictures)*			
16. Maintenance Contacted Date/Time:	17. Consequences of Failure: (Check all that may apply):		
18. Downtime hours until Maintenance starts repair:	☐ Personal Injury	☐ Process Shutdown	☐ Hazardous Spill
19. Operating Condition Before Failure:	☐ Production Loss	☐ Off-Spec. Product	☐ Environmental
20. Total Lost Production:	☐ Lost Time	☐ Fire	☐ Cost Impact
	☐ Explosion	☐ Plant Shutdown	☐ Other
21. Details on Consequences:			
22. Signed & Dated *(Contact Reliability Engineer or Maint. Contact on call):*			

Maintenance Report	23. Work Order Number:	
24. Repair Description: *(attach pictures)*		
25. Delay Reason:	26. Date/Time Repair Begun:	
	27. Delay Repair Hours:	
	28. Maintenance Cost:	
29. Apparent Failure Root Cause: (in depth to follow)		
Physical	Human	Systemic (Latent)
30. Signed & Dated:		

Recommended Checklist pre-RCFA Session

Recommended checklist/assignments prior to conduct the RCFA session

Accountable for investigation items = RCFA Session Leader

Planned RCFA Date: _____

RCFA Leader Assigned: _____

Collected?	Investigation Item	Available (Yes, No, N/A)	Responsible
☐	Witness accounts/statements (What conditions/symptoms led to failure?)		
☐	Maintenance/Technical accounts (What did the initial troubleshooting/repair indicate?)		
☐	Pictures Taken (take pictures of the failure and area conditions as soon as possible)		
☐	Inspection reports		
☐	Drawings		
☐	Technical manual		
☐	Equipment/machine failure history (from SAP)		
☐	Training procedures and SOPs		
☐	Operational procedures (Start-op/Shut-down, running, and operator-driven maintenance)		
☐	Operational Data (PI data, operational indications, power and amp data)		
☐	Maintenance procedures (PM and PdM routines)		
☐	Housekeeping procedures		
☐	Timeline of Events (Can a timeline of events be constructed?)		

Other Observations:

SUPERVISOR INJURY CHECKLIST

sappi

- **All work related injuries must be reported to your supervisor immediately.**
- **Ensure appropriate patient care through Medical,**
- **Notify your supervisor immediately**
- **Ask for support from your safety team lead**

√ EMPLOYEE AND SUPERVISORS NOTIFICATION

	Supervisor name:
	Employee name:
	Time and date of injury:
	Time and date reported to Supervisor:
	Pictures taken and walk-through of scene:

√ Timely and appropriate Medical Attention

	Time and date employee arrived at Medical:
	Employee completes patient care report at Medical
	Union steward offered (If applicable)
	Employee returned to work without restrictions (Form received). Must be cleared before return to work form
	Treatment received (circle): yes/no
	Employee returned to work with restrictions and/or referral (form received)
	First Aid: Supervisor to follow up with employee and Medcor for 3 days

√ Communications

	Supervisor contacted informing of incident

√ FOLLOW UP

	Root cause analysis (RCA) meeting set up if applicable. date/time:
	RCA conducted with employee, Supervisor, Unit Manager, SCM, Safety
	Action Items Closed out and updated in EMS

RCFA Facilitator Qualification Process - Task/Function	OMC	Maint. Planner	Maint. Supv	Operator	Craftsperson	Area Shift Supv	Site Maint Mgr	Area Maint Mgr	Rel. Mgr	Rel. Engineer	Engineering	BUL	Ops Manager	Prod. Engineer	Health & Safety Mgr	Stores/Purch	Mill Manager	RCFA FACILITATOR
Maintain a full complement of qualified RCFA facilitators at Sappi Somerset	I	I	I				C	C	R/A	I		C	I	I			I	
Annual review of qualified facilitators - maintain 45 qualified individuals at Sappi Somerset	I	I	I				C	C	R/A	I		C	I	I			I	
Coordinate Annual RCFA training to qualify additional facilitators	I	I	I				C	C	R/A	I		C	I	I			I	
Qualified RCFA facilitator	R	R	R				C	R	R/A	R	I	C	R	R	R		C	

RACI-RCFA Field Reporting

RCFA Field Incident Reporting - Task/Function	OMC	Maint. Planner	Maint. Supv	Operator	Craftsperson	Area Shift Supv	Site Maint Mgr	Area Maint Mgr	Rel. Mgr	Rel. Engineer	Engineering	BUL	Ops Manager	Prod. Engineer	Health & Safety Mgr	Stores/Purch	Mill Manager	RCFA FACILITATOR
RCFA Field Incident Report Training	R					R	I	I	C			C	A	C			I	
Complete the RCFA Field Incident Report (RFIR) before the end of the shift for any event that hits a RCFA trigger	A	I	I	C	C	R	I	I	I	I		I	R/A	C			I	
Submit completed RCFA Field Incident Reports to OMC	I	I	I			R	I	I	I	I		I	R/A	C			I	

RCFA Identification & Assignment - Task/Function	OMC	Maint. Planner	Maint. Supv	Operator	Craftsperson	Area Shift Supv	Site Maint Mgr	Area Maint Mgr	Rel. Mgr	Rel. Engineer	Engineering	BUL	Ops Manager	Prod. Engineer	Health & Safety Mgr	Stores/Purch	Mill Manager	RCFA FACILITATOR
Record RCFA triggered events in RCFA Tracking Sheet	R/A	C	C				I	I	I	C		I	C	C			I	
Review area downtime events (RFIR's) weekly to identify triggered events requiring an RCFA	R/A	C	C				I	I	I	C		I	C	C			I	
Review repeat events in weekly OMC meeting to identify chronic issues that trigger an RCFA	R/A	C	C				I	I	I	C		I	C	C			I	
Weekly, note reasons on RCFA Tracking Sheet why events did not trigger an RCFA	R/A	C	C				I	I	I	C		I	C	C			I	
Assign triggered events after the weekly OMC meeting to a qualified RCFA facilitator for execution	R/A	C	C				I	I	I	C		I	C	C			I	
Qualified RCFA facilitator	R	R	R				C	R/C	R/A			C	R	R	R		C	

RCFA Execution Process - Task/Function	OMC	Maint. Planner	Maint. Supv	Operator	Craftsperson	Area Shift Supv	Site Maint Mgr	Area Maint Mgr	Rel. Mgr	Rel. Engineer	Engineering	BUL	Ops Manager	Prod. Engineer	Health & Safety Mgr	Stores/Purch	Mill Manager	RCFA FACILITATOR
Review the completed RCFA Field Incident Report (RFIR)	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	I	R/A
Preserve event data: Position, People, Parts, Paper, Paradigms	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Order the Analysis Team: Principal Analyst (PA), Associate Analyst, Experts, Vendors, Critics	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Create a PROACT RCA event in EasyRCA and select the RCA status "In Process"	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Easy RCA - Enter Event Information: Title, Problem Statement, Summary of Findings	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Easy RCA: Enter Event Information	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Easy RCA: Enter Team Members/Equipment/Cost	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Easy RCA: Build timeline	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Easy RCA: Begin building logic tree and assign verifications to team members	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Easy RCA: Verify logic tree failure modes, physical hypothesis, and contributing factors	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Easy RCA: Initiate 1st revision of event report	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Schedule RCA Team Meeting	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
RCFA Meeting: Review 1st revision of event report	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
RCFA Meeting: Get consesus on human and systemic roots	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
RCFA Meeting: Develop and assign corrective action items with expected due dates	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Easy RCA: Finalize RCFA logic tree with confirmed human roots, systemic roots, corrective action items.	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Easy RCA: Assign corrective action items "Task" to individuals with expected due dates	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
SAP: Initiate corrective action item SAP notifications	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Easy RCA: Regenerate RCFA Report	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Save RCFA Report into MSWord format to perform final edit w/ photo annotations and attachments	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Save RCFA Report and Field Incident Report in the Somerset Reliability Sharepoint site under the Completed RCFA folder	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Easy RCA: Change RCFA status to "Complete"	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A
Distribute final RCFA Report draft (pdf format) to applicable Maintenance, Operations, Engineering, Management personnel	C	C	C	C	C	C	I	C	C	C	C	I	C	C	C	C	I	R/A

RCFA Effectiveness/Sustainability - Task/Function	OMC	Maint. Planner	Maint. Supv	Operator	Craftsperson	Area Shift Supv	Site Maint Mgr	Area Maint Mgr	Rel. Mgr	Rel. Engineer	Engineering	BUL	Ops Manager	Prod. Engineer	Health & Safety Mgr	Stores/Purch	Mill Manager	RCFA FACILITATOR
Weekly Downtime Tracking Report by Area	R/A	C	C			C	C	C	C	C	C	C	C	C	C		I	C
Monthly Reliability Report by Area	R/A	C	C			C	C	C	C	C	C	C	C	C	C		I	C
RCFA Key Performance Indicator Reporting by Area	R/A																	
% of triggered events that receive RCFA's	R/A																	
RCFA Cycle Time - time lapse from event to RCFA completion (target 14 days)	R/A																	
Number of RCFA's completed per month	R/A																	
In-process RCFA's > 30 days	R/A																	
Number of corrective action items overdue	R/A																	
RCFA report out to MLT - 1 Area per week, 1 RCFA selected	R	C	C				I	C	A	C	C	I	C	C	C		I	R
Annual RCFA review meeting to celebrate wins, share learnings, provide ongoing education, and give feedback on the RCFA manual revisions.	R	R	R				R	R	R/A	R		C	R	R			C	
Annual RCFA Manual review for effectiveness & sustainability	C	C	C				R	R	R/A	C		C	C	C			I	
Future: Sappi North America Synergy																		

PART III: Sappi Somerset RCFA Examples

ClO2 Plant P-46 Chronic Pump Failures

What Happened?

The ClO2 Solution Transfer Pump failed multiple times over a 3-day period, shutting down ClO2 generation and causing the Bleach Plant to be down.

Why Did It Happen?

Root Cause	Corrective Action(s)
Complacency with repairs	1. Front line leaders perform toolbox meetings and set clear expectation on precision maintenance
Inadequate installation of pump	
Lack of technical support and troubleshooting skills for sustainability	
Like-in-kind PSM process not followed	2. Do we need to check the Stores min/max level for titanium seal or is it purely a situation of chronic failures
Precision maintenance audit and validation process doesn't exist	3. Re-establish thorough precision audit process with RE's evaluating all precision work, even unscheduled
Precision Maintenance knowledge gap; workforce & leadership	4. Develop and implement troubleshooting & precision maintenance training for leadership.
Shaft failed due to rotational bending fatigue w/ a moderate applied load at the time of failure	

Timeline

01/17/2020 12:00	Work Order - P-46 check base & coupling
10/12/2020 00:00	Work Order - MDS 2020 repair pump foot/base
08/23/2021 00:00	Work Order - P-46 NTD align/insp coupling
04/24/2023 00:00	Work Order - P-46 secure/align pump
04/24/2023 00:00	Work Order - P-46 pump vibrating
06/03/2024 00:00	Work Order - P-46 Overhaul base
09/25/2024 00:00	Work Order - Change P-46, bad bearing
12/12/2024 00:00	Work order - P-46 locked up
08/02/2025 16:25	Operators report losing flow from P-46 pump. Shift MW finds pump shaft broken. MW's replaced pump installed with a stainless steel mechanical seal (titanium seal required).
08/03/2025 00:10	P-46 started, MW noted alignment was out of specification due to bolt bound condition on the motor. The bolt bound issue was not addressed.
08/04/2025 07:00	Pump is shutdown to install titanium seal, once it arrives, pump removed and seal replaced. MW's had same bolt bound issue on motor feet during alignment. The bolt bound issue wasn't address.
08/04/2025 12:30	P-46 back in operation
08/05/2025 00:00	Start of Analysis

08/04/2025 20:00	Pump loses flow, Shift MW discovers shaft pump shaft broken again. MW replace the pump shaft and bearing assembly. MW bore the motor feet with a mag base drill to 0.840", achieving an acceptable alignment - No data confirming alignment was acceptable.
08/05/2025 00:00	Event Occurs
08/05/2025 04:15	Pump returned to service
08/05/2025 11:10	Pump loses flow. Pump grid coupling is found broken. Decision made to further correct the alignment conditions. The volute and bearing unit mounting bolts were found loose at the time of failure. Visible pipe strain and improper hardware were also observed.
08/05/2025 13:09	MW installed new coupling to check as found alignment condition. Alignment is found 80 mils out of specification in the vertical direction.
08/05/2025 13:30	PF disconnected pump flanges from the volute. MW rechecked alignment and found it has shifted 30 mils to 50 mils out of specification in the vertical direction.
08/05/2025 20:15	Pump rotating assembly is replaced base mounting hardware is corrected, and motor feet are bored out and slotted (0.875" x 0.350" slot) to reduce the bolt bound condition. Rough alignment is achieved.
08/05/2025 21:02	PF connected pump flanges utilizing screw jack to assist with reducing pipe strain on the pump, which moved the alignment 12 mils out of specification based off the rough alignment. MW realigned the motor and achieved final alignment.

08/05/2025 21:28	Pump started and base line vibration data collected. Pump experienced several periods of cavitation during initial start-up. Axial vibration elevated due to the 12 mil pipe strain condition. Base and pipe modifications are necessary to fix this situation.
09/12/2025 00:00	Expected Completion

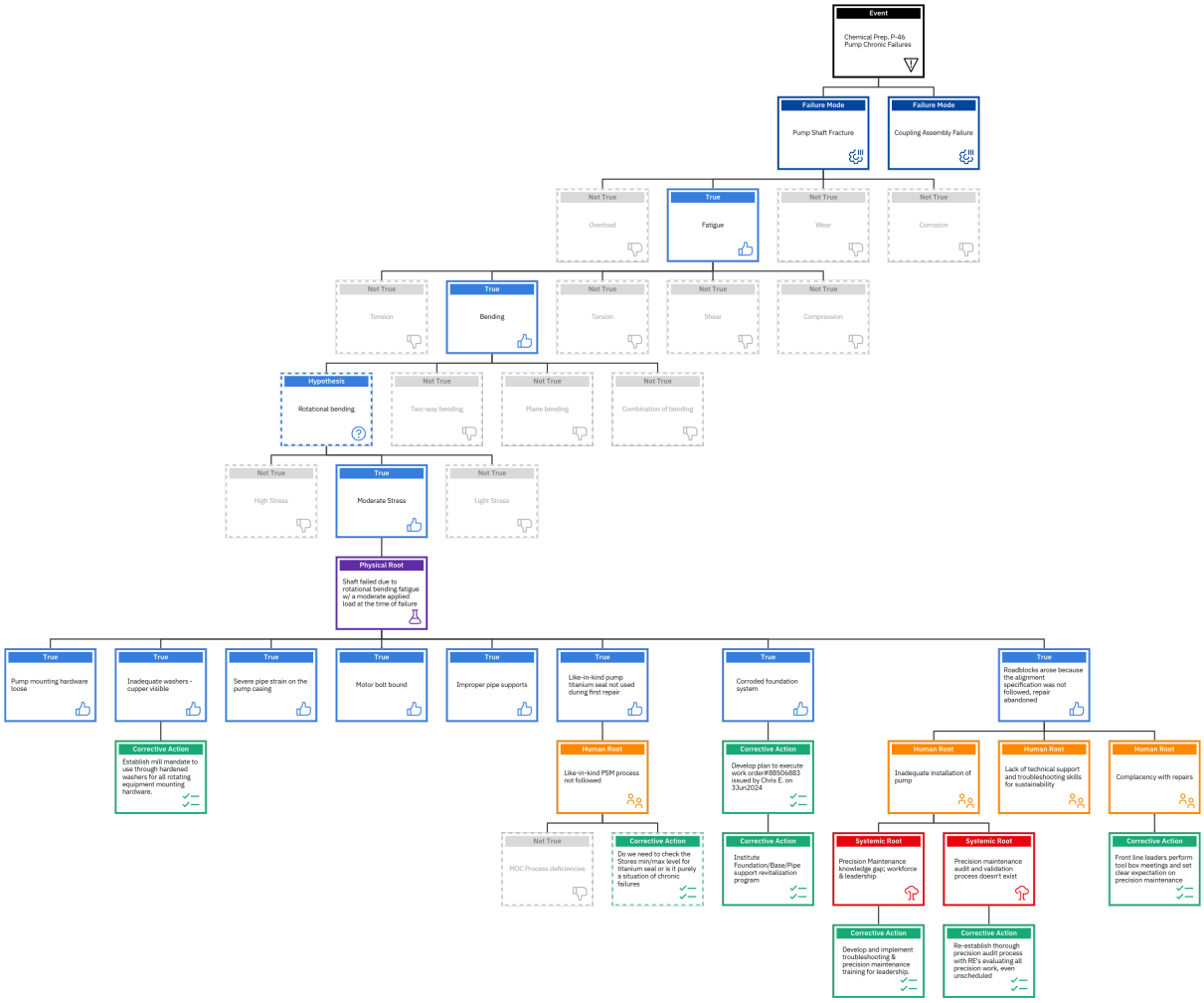
Summary of Findings

Over a 3-day period, the ClO2 Solution Transfer Pump experienced multiple failures, leading to a shutdown of ClO2 generation and downtime in the Bleach Plant. Chronic failures were identified, with specific emphasis on failure modes including Coupling Assembly Failure and Pump Shaft Fracture. Detailed analyses revealed contributory factors such as fatigue, bending, moderate stress, and a lack of adherence to alignment specifications during repairs.

Root causes were categorized into physical, human, and systemic factors. Physically, the shaft's failure was attributed to rotational bending fatigue under moderate load. Human errors included complacency during repairs, inadequate technical support and troubleshooting skills, and improper installation practices. Systemic issues highlighted a gap in precision maintenance auditing, a knowledge gap in the workforce and leadership, and deficiencies in the Management of Change (MOC) process.

To address these failures, corrective actions must include the establishment of a precision maintenance audit and validation process, enhanced training for both workforce and leadership to close the knowledge gaps, and robust adherence to the PSM process during repairs.

Logic Tree


Event
Chemical Prep, P-46 Pump Chronic Failures
Failure Mode
Pump Shaft Fracture
Failure Mode
Coupling Assembly Failure
Not True
Overload
True
Fatigue
Not True
Wear
Not True
Corrosion
Not True
Tension
True
Bending
Not True
Torsion
Not True
Shear
Not True
Compression
Hypothesis
Rotational bending
Not True
Two-way bending
Not True
Plane bending
Not True
Combination of bending
Not True
High Stress
True
Moderate Stress
Not True
Light Stress
Physical Root
Shaft failed due to rotational bending fatigue w/ a moderate applied load at the time of failure
True
Pump mounting hardware loose
True
Inadequate washers - cupper visible
Corrective Action
Establish mill mandate to use through hardened washers for all rotating equipment mounting hardware.
True
Severe pipe strain on the pump casing
True
Motor bolt bound
True
Improper pipe supports
True
Like-in-kind pump titanium seal not used during first repair
Human Root
Like-in-kind PSM process not followed
Not True
MOC Process deficiencies
Corrective Action
Do we need to check the Stores min/max level for titanium seal or is it purely a situation of chronic failures
True
Corroded foundation system
Corrective Action
Develop plan to execute work order#88506883 issued by Chris E. on 3Jun2024
Corrective Action
Institute Foundation/Base/Pipe support revitalization program
True
Roadblocks arose because the alignment specification was not followed, repair abandoned
Human Root
Inadequate installation of pump
Human Root
Lack of technical support and troubleshooting skills for sustainability
Human Root
Complacency with repairs
Systemic Root
Precision Maintenance knowledge gap; workforce & leadership
Systemic Root
Precision maintenance audit and validation process doesn't exist
Corrective Action
Front line leaders perform tool box meetings and set clear expectation on precision maintenance
Corrective Action
Develop and implement troubleshooting & precision maintenance training for leadership.
Corrective Action
Re-establish thorough precision audit process with RE's evaluating all precision work, even unscheduled

Root Causes and Findings

Type	Root Cause	Corrective Actions
PHYSICAL	Shaft failed due to rotational bending fatigue w/ a moderate applied load at the time of failure	
HUMAN	Complacency with repairs	1. Front line leaders perform tool box meetings and set clear expectation on precision maintenance
HUMAN	Inadequate installation of pump	
HUMAN	Lack of technical support and troubleshooting skills for sustainability	
HUMAN	Like-in-kind PSM process not followed	2. Do we need to check the Stores min/max level for titanium seal or is it purely a situation of chronic failures
SYSTEMIC	Precision maintenance audit and validation process doesn't exist	1. Re-establish thorough precision audit process with RE's evaluating all precision work, even unscheduled
SYSTEMIC	Precision Maintenance knowledge gap; workforce & leadership	2. Develop and implement troubleshooting & precision maintenance training for leadership.

ATTACHMENTS – Images

Photo 1 - Pump Shaft Rotational Bending Fatigue Fracture

Photo 2 - Pump Coupling Bending Fracture

Photo 3 - Pump Pedestal Mounting Hardware Discovered Loose

Photo 4 - Pump Valute Mounting Hardware Discovered Loose

Photo - 5 Suction Flange Visibly Misaligned

Photo 6 - Pump Discharge Flange Misalignment

Photo 7 - Pump Discharge Flange Misalignment

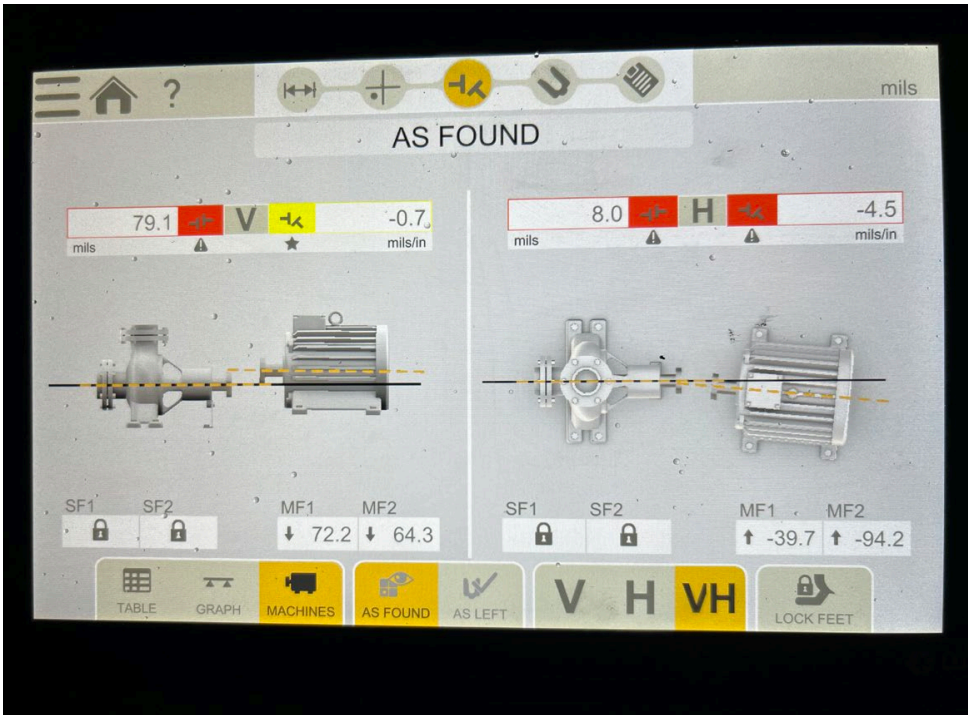


Photo 8 - As Found Misalignment

Photo 9 - Misalignment After Pump Piping Disconnected

Photo 10 - Rough Alignment w/o Pipes Connected

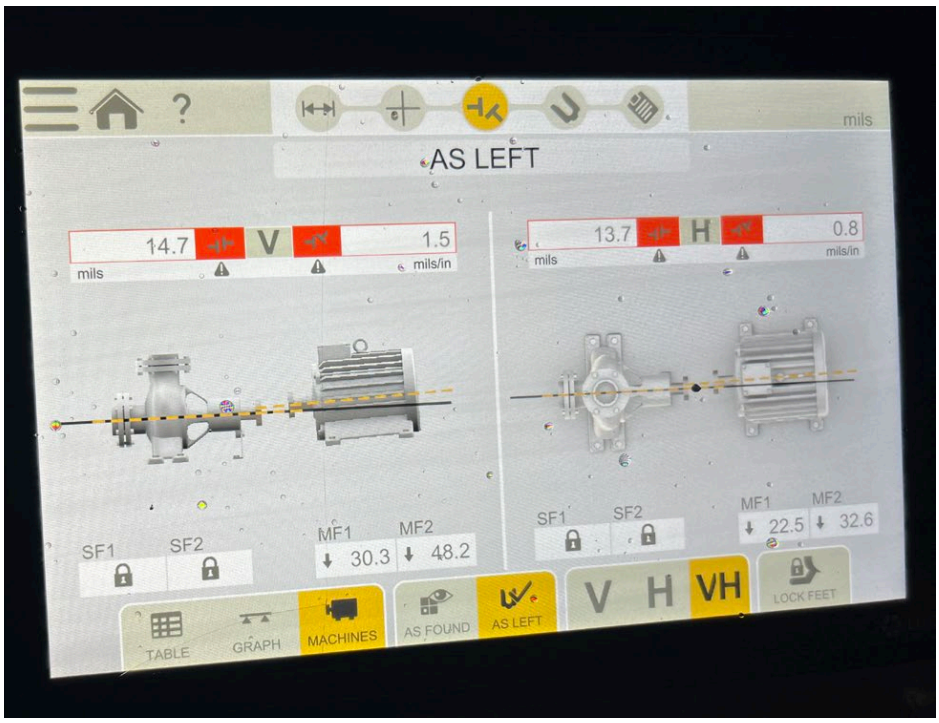


Photo 11 - Alignment Check after Pump Pipes Connected

Photo 12 - Pump Final Alignment

Woodyard Chipper Bearing Failure

What Happened?

The Chipper Rotor has had chronic disc cracks over the last several years. As we've worked to address design flaws in the rotor disc, we've faced issues with high rotor bearing temperatures and low lubricant flow. Despite trying to fix these problems by changing the lubricant oil and filters, we haven't been able to resolve the ongoing lubrication issues.

Why Did It Happen?

Root Cause	Corrective Action(s)
Inadequate cleaning frequency of lube station area	
Inadequate lube deficiency trouble shooting to determine root cause	
Inadequate lubrication practices	1. Audit Pulp/UR/Woodyard Lube and Hydraulic systems for cleanliness and component improvements
Inadequate Oil Flow to the chipper bearing(s) due to a plugged oil circulation flow divider.	
Insufficient policies for contamination control during oil handling	
Lack of assigned subject matter expert to lead reliability efforts	2. MLT training implemented for any Reliability Engineer that is not currently ICML certified 3. Focus to keep Reliability Engineers in their assigned area and not to pull on special projects.
Lack of scheduled maintenance inspection for lube/hydraulic station	4. Daily and Weekly expectation meetings between Lube Technicians and Reliability Engineers 5. Re-institute weekly mill wide Reliability meeting to discuss KPI's (e.g., lube & vibe compliance)
Lack of scheduled operational cleaning of lube/hydraulic stations	6. Implement a scheduled cleaning routine for lube/hydraulic stations w/ Lube PM to minimize contamination
Lack of technical support and troubleshooting skills for sustainability	

Lack of training on lubrication protocols	7. Schedule regular audits on lubrication practices 8. Audit LubeIt lubrication checklist for Lube Techs
No Preventive Maintenance task in SAP & no task in LubeIt	9. PM to replace filter, drain, CLEAN, and fill lube system on every Woodyard outage
Poor documentation of lubrication procedures	
Poor lube fill and drain design	10. Install ISO B connectors and covers to minimize contamination

Timeline

01/01/2017 00:00	Rotor installed in 2017
03/10/2022 00:00	Chipper NDE BRG defect notification written
10/01/2022 00:00	Rotor bearing defect scheduled repair addressed during MSD.
04/11/2023 00:00	Change Chipper Lube system filter
05/23/2023 00:00	High bearing temp notification by C.Enman
06/06/2023 00:00	C.Enman's notification was TECO and new work order generated
06/06/2023 00:00	Chipper lube system oil was drained, flushed, and new oil added, also filter was changed.
08/20/2023 00:00	Chipper Lube system duplex filter system installation/modification notification by J.Murray
04/23/2024 00:00	Chipper Lube system drain and change oil

08/20/2024 00:00	Chipper Lube system duplex filter installation/modification TECO by D. Sinclair. Job was cancelled?? Wasn't done.
03/26/2025 00:00	Chipper Rotor replacement due to chronic disc crack issues, thicker disc with SKF CARB NDE bearing configuration installated.
05/01/2025 11:51	Chipper rotor DE bearing high temp/low flow. Replaced flow divider, both check valves, and lube filter.
08/13/2025 17:27	Notification by D. Sinclair - Loosing oil flow to bearings frequently.
08/18/2025 15:08	The chipper rotor seized due to high temperatures exceeding 175 F. At the time of failure, the flow to the NDE bearing was 0.05 gpm. After loosening the locking nut on the flow control, the flow meter returned to its normal operating range. No adjustments were made. Typically, the Hedland flow meter reads 1.5 gpm, which is equivalent to 0.4 gpm according to the bucket test.
08/18/2025 15:08	Event Occurs
08/18/2025 15:21	Work Order initiated from D. Sinclair's notification on 13Aug2025 to change out pump on NTD. Frequently adjusting the flow control.
08/22/2025 00:00	Start of Analysis
09/05/2025 00:00	Expected Completion

Summary of Findings

A failure occurred with the Sappi Chipper Rotor seizing, which was linked to a bearing failure. Root cause analysis identified inadequate oil flow to the Chipper non-drive end bearing due to a plugged oil circulation flow divider as a significant physical root cause. Additionally, the

lack of technical support and troubleshooting skills, poor lubrication practices, and insufficient cleaning frequency contributed to the event.

The investigation revealed various human and systemic root causes. Human factors included inadequate troubleshooting for lube deficiencies, poor lube fill and drain design, and a lack of technical support. Systemic issues stemmed from a lack of assigned subject matter experts to lead reliability efforts, insufficient policies for contamination control, and poorly documented lubrication procedures, exacerbating the problem.

In response, a range of corrective actions was implemented, including MLT training for Reliability Engineers, regular audits of lubrication practices, and re-establishment of weekly mill-wide reliability meetings to track KPIs. Additionally, a focus on improving cleaning routines for lube/hydraulic stations was instituted, along with a commitment to ensure timely maintenance tasks are scheduled in SAP and LubeIt, thereby fostering a more robust lubrication management system to prevent future failures.

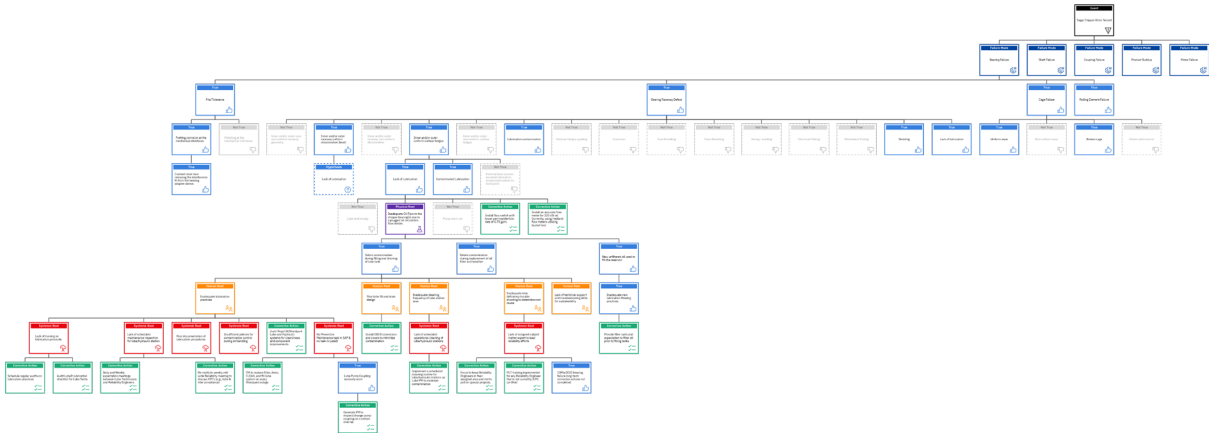
Tasks

Type	Node	Assignee	Task	Due
CA	Lack of Lubrication	Jonah Coffin	**Install Flow Meter w/ flow switch** — Install a flow meter with a lower permissible flow alarm switch to prevent chipper to operate with low lube flow. Set lower limit to 0.75 gpm. Hedland flow meters were installed prior to starting up chipper from failure.	29 Aug 2025
CA	Lack of Lubrication	Jonah Coffin	**Install accurate lube oil flow meter** — Currently, using Hedland flow meter w/ a bucket test to confirm flow accuracy. Install new flow meter that is accurate with 220 cSt oil.	21 Nov 2025

	CA	Lack of training on lubrication protocols	Jonah Coffin, Matt Holman	**Lubrication Practices Quality Control** — Weekly audits of lubrication task by entry level Reliability Engineer for Woodyard/Pulp/U&R. Matt to provide support w/ Mya Eno.	22 Sep 2025
	CA	Lack of scheduled maintenance inspection for lube/hydraulic station	Jonah Coffin	**Implementation of Regular Alignment Meetings between Lubrication Team and Reliability Engineers** — Conduct daily and weekly alignment meetings to ensure that lubrication practices are consistently followed and to foster open communication regarding lubrication system performance and maintenance needs.	08 Sep 2025
	CA	Lack of scheduled maintenance inspection for lube/hydraulic station	Preston Maheu, Matt Holman	**Mill Wide Reliability Meeting** — Re-institute weekly mill wide Reliability Meeting to discuss KPI's (e.g., lube & vibe compliance)	29 Aug 2025
	CA	Inadequate lubrication practices	Jonah Coffin, Matt Holman	**Pulp/UR/Wdy Lube Assessment** — Perform a lube assessment of all lube/hydraulic systems. Inspection to include cleanliness, breathers, level, filters, and other accessories as done for chipper lube system. Audit also needs to verify if task are in LubeIt and SAP (PM's on interval). Jonah will be assigned to task, but will require additional RE support.	31 Oct 2025
	CA	No Preventive Maintenance task in SAP & no task in LubeIt	Jonah Coffin, seth.washburn@sappi.com	**Wdy Chipper Lube System PM** — SAP PM to replace filter, drain, clean, and fill lube system on every outage. Need to have a detailed procedure to include cleaning area first after shutdown, draining lube, old breather and filters, cleaning tank, installing new filtered oil every 6 weeks. This task also needs to be listed in LubeIt	12 Sep 2025

CA	Inadequate new lubrication filtering practices	Jonah Coffin	**Filter Cart Schedule** — Develop a filter cart schedule for WDY/Pulp/UR within LubeIT and execute when filter carts are purchased.	Sep 2025	26
CA	Lack of assigned subject matter expert to lead reliability efforts	Matt Holman	**MLT Lube Training** — Develop plan to send RE's to MLT training (ICML certified). Who is not ICML certified, When will they be sent to training?	Sep 2025	30
CA	Poor lube fill and drain design	Preston Maheu	**Chipper Lube System - Install ISO B connectors** — Install ISO B connectors on inlet and drain lines for lube system to minimize contamination.	Aug 2025	29
CA	Lube Pump Coupling severally worn	Jonah Coffin, seth.washburn@sappi.com	**WDY Lube System Pump Cplg Insert PM** — Generate a SAP PM to replace the insert on the Chipper Lube sytem pump coupling once a year.	Sep 2025	12
CA	Inadequate new lubrication filtering practices	Jonah Coffin	**Filter Cart Survey & Purchase** — Identify WDY/Pulp/UR areas where filter carts are required and purchase.	Sep 2025	19
V	Inadequate new lubrication filtering practices	Jonah Coffin, Preston Maheu	**Woodyard New Lubrication Filter Practices** — Investigate the filtering practices in PULP/UR/Woodyard areas. Are we performing this task? If not, why? Do we have the proper filter carts to filter new oil prior to filling? Jonah has confirmed we are not filtering oil before putting it in the lube tank.	Sep 2025	12

Logic Tree



Root Causes and Findings

Type		Root Cause	Corrective Actions
PHYSICAL		Inadequate Oil Flow to the chipper bearing(s) due to a plugged oil circulation flow divider.	
	FINDINGS	Jesse Gove was called to adjust lube flow after the Chipper rotor seized. Seth Ames and Jesse Grove observed the Chipper Rotor NDE bearing lube flow to be 0.05 gpm. The flow jumped back to 1.5 gpm on the Hedland flow meter after the flow control valve locking nut was loosened. No adjustment of flow was initiated to create the change.	
	NOTE	Andritz's recommendation for oil flow to each of the Chipper rotor bearings is approximately 1 gpm.	
	FINDINGS	Bucket flow test were conducted for the DE and NDE Chipper rotor bearings after the rotor was removed from service. The test was performed without adjusting the flow control valve to determine the flow rates to the bearings. Results: Average flow was 0.4 gpm while the Hedland flow meters read 1.5 gpm. Futher investigation revealed the Hedland flow meters viscosity upper permissible limit for accuracy is 109 cSt, while the lube oil for the bearings is 220 cSt. The thickner viscosity reduced the accuracy of the readout.	
	NOTE	Furthermore, the Chipper Rotor DE bearing did not lose all its oil flow, which confirms that the blockage must have occurred at the flow divider.	
HUMAN		Inadequate cleaning frequency of lube station area	
	NOTE	The lube station was coated in chip fines when the Chipper Rotor failed. It took a few tries to clean the area before we could troubleshoot the system. Bad housekeeping makes it more likely that lubrication will get contaminated.	

HUMAN		Inadequate lube deficiency trouble shooting to determine root cause	
	FINDINGS	Over the last few years, several work orders have reported low oil flow to the Chipper Rotor bearings. The usual fix was to flush the oil, refill it, and replace the filter. However, no further investigation was done in any of these cases, according to the SAP work order history.	
HUMAN		Inadequate lubrication practices	1. Audit Pulp/UR/Woodyard Lube and Hydraulic systems for cleanliness and component improvements
	NOTE	Poor lubrication technician work performance has been observed in this area.	
	NOTE	Lack of Lube Technician accountability	
HUMAN		Lack of technical support and troubleshooting skills for sustainability	
	NOTE	The Woodyard area is missing the technical support and leadership it needs to follow proper lubrication practices and troubleshoot problems.	
HUMAN		Poor lube fill and drain design	2. Install ISO B connectors and covers to minimize contamination
	NOTE	The oil and fill lines should have ISO B connectors with caps to reduce the potential of debris contamination.	
	NOTE	Lube technicians receive training to identify and address deficiencies. Leadership must set clear expectations and regularly audit performance to prevent chronic failures from occurring.	
SYSTEMIC		Insufficient policies for contamination control during oil handling	
SYSTEMIC		Lack of assigned subject matter expert to lead reliability efforts	1. MLT training implemented for any Reliability Engineer that is not currently ICML certified 2. Focus to keep Reliability Engineers in their assigned area and not to pull on special projects.
	NOTE	Attached work order history reveals history of inadequate solutions to lube system problems.	
SYSTEMIC		Lack of scheduled maintenance inspection for lube/hydraulic station	3. Daily and Weekly expectation meetings between Lube Technicians and Reliability Engineers 4. Re-institute weekly mill wide Reliability meeting to discuss KPI's (e.g., lube & vibe compliance)
SYSTEMIC		Lack of scheduled operational cleaning of lube/hydraulic stations	5. Implement a scheduled cleaning routine for lube/hydraulic stations w/ Lube PM to minimize contamination
SYSTEMIC		Lack of training on lubrication protocols	6. Schedule regular audits on lubrication practices 7. Audit LubeIt lubrication checklist for Lube Techs

SYSTEMIC	No Preventive Maintenance task in SAP & no task in LubeIt	8. PM to replace filter, drain, CLEAN, and fill lube system on every Woodyard outage
SYSTEMIC	Poor documentation of lubrication procedures	

ATTACHMENTS – Images

Photo 13 - Chipper Rotor NDE BRG Inner Race

Photo 14 - Chipper Rotor NDE BRG Adapter Sleeve

Photo 15 - Chipper Rotor NDE BRG Outer Race - Raceway

Photo 16 - NDE BRG Raceway w/ Bronze Cage Adhesion

Photo 17 - Chipper Lube Tank Bottom - As Found Condition

Photo 18 - Chipper Lube Tank Top - As Found Condition

Photo 19 - Chipper Lube Tank Inlet Connection - Contamination

Photo 20 - Chipper Lube Oil Circulation Block Contamination

Photo 21 - Chipper Lube System Pump Coupling Damage