PLC and Industrial Automation Systems Root Cause Analysis Workbook - Recurring Fault After Repair

PLC and Industrial Automation Systems | Recurring Fault After Repair | Asset ID FIX-09-06-10

Safety gate: Stop, isolate and verify before exposure to hazardous energy. Lockout/Tagout and live testing require the applicable site procedure, authorised controls and a qualified person. Never bypass a guard, interlock or protective device to complete this workbook.

How to use this field resource

This is an equipment-agnostic documentation workbook for plc and industrial automation systems. It helps a trained team trace input, logic, interlock, output and field response without bypassing protections. It does not identify a fault by itself and does not replace the equipment-specific OEM manual, drawings, limits, permits or a qualified technician's judgement.

Intake field	Record
Asset or equipment ID	_____
Site and location	_____
Reported by / time	_____
Fault situation	Recurring Fault After Repair
Operating state	Stopped / standby / starting / running / loaded
Safety owner	_____
OEM reference used	Document number and revision: _____

Evidence areas for this system

For a recurring fault after repair, focus on evidence that can be dated, repeated and handed to another technician. Capture the as-found state before clearing alarms, changing settings or disturbing connections.

#	Evidence area	First record
1	Machine state and sequence step	As-found note: _____
2	Input status	As-found note: _____
3	Interlock and permissive state	As-found note: _____
4	Logic command	As-found note: _____
5	Output status	As-found note: _____
6	Field-device response	As-found note: _____

Root Cause Analysis Workbook

Use this section to compare the new event with the original evidence and the completed repair record. Record what changed, what stayed the same and how long the repair held before choosing the next action.

Branch	Confirmed fact	Cause hypothesis	Discriminating evidence
0	Observed fact: _____	Possible link to machine state and sequence step	Evidence needed: _____
1	Observed fact: _____	Possible link to input status	Evidence needed: _____
2	Observed fact: _____	Possible link to interlock and permissive state	Evidence needed: _____
3	Observed fact: _____	Possible link to logic command	Evidence needed: _____
4	Observed fact: _____	Possible link to output status	Evidence needed: _____
5	Observed fact: _____	Possible link to field-device response	Evidence needed: _____

Root-cause standard

- A replaced part is not automatically the root cause.
- Name the physical or process mechanism that produced the failure.
- Explain why the evidence rules out the closest alternative.
- Identify the condition that allowed the cause to persist.
- Define a verification that would fail if the diagnosis were wrong.

PLC and Industrial Automation Systems Evidence Map

Evidence first: Preserve alarms, event history, settings, trends and the as-found physical state before reset, disconnection or adjustment. If safe access is uncertain, stop and refer the task to the authorised person.

#	System area	Evidence action	Trace	Record
1	Machine state and sequence step	Observe and identify	Evidence ID: _____	Finding: _____
2	Input status	Record source and time	Evidence ID: _____	Finding: _____
3	Interlock and permissive state	Compare with reference	Evidence ID: _____	Finding: _____
4	Logic command	State what it supports	Evidence ID: _____	Finding: _____
5	Output status	State what it rules out	Evidence ID: _____	Finding: _____
6	Field-device response	Choose the least invasive next check	Evidence ID: _____	Finding: _____

Scenario boundary

For this recurring fault after repair, reopen the diagnosis instead of repeating the same replacement without evidence. Write the boundary before testing so urgency does not quietly change the rules.

Boundary	Definition
Known good condition	_____
Known failed condition	_____
Difference between them	_____
First missing evidence	_____
Stop-work threshold	_____
Escalation owner	_____

Evidence labels

- FACT - directly observed and traceable.
- REPORT - supplied by another person; source recorded.
- INFERENCE - reasonable explanation that still needs a test.
- UNKNOWN - important gap that must not be filled by assumption.
- LIMIT - OEM, engineering or site acceptance value.

Recurring Fault After Repair Condition Workbook

The goal is to compare the new event with the original evidence and the completed repair record. Describe the failed state narrowly enough that another trained person could look for the same thing without being told your suspected cause.

Question	Boundary prompt	Record
What changed?	Function, output, indication or behaviour	_____
Where?	Asset, side, circuit, zone or process stage	_____
When?	Sequence step, runtime, load or environment	_____
How often?	Every cycle, random, once, or after delay	_____
What restores it?	Nothing, time, reset, cooling or load change	_____
What stays normal?	Unaffected systems or functions	_____
What changed recently?	Work, software, settings, parts or operating duty	_____

Controlled reproduction plan

Plan field	Record
Safe starting state	_____
One condition to vary	_____
Conditions held constant	_____
Evidence captured	What changed, what stayed the same and how long the repair held
Maximum attempts	_____
Immediate stop signal	_____
Authorising person	_____

Attempt notes

Attempt	Starting condition	Result	Decision
1	State: _____	Observed: _____	Next decision: _____
2	State: _____	Observed: _____	Next decision: _____
3	State: _____	Observed: _____	Next decision: _____
4	State: _____	Observed: _____	Next decision: _____

Measurement and Evidence Register

Measurement boundary: This page records an approved test; it does not authorise one. A qualified person must choose the method, instrument category, connection points, isolation state and protective controls from the applicable procedure.

ID	Evidence area	Traceable source	Result	When
1	Machine state and sequence step	Method / source: _____	Value / state: _____	Time: _____
2	Input status	Method / source: _____	Value / state: _____	Time: _____
3	Interlock and permissive state	Method / source: _____	Value / state: _____	Time: _____
4	Logic command	Method / source: _____	Value / state: _____	Time: _____
5	Output status	Method / source: _____	Value / state: _____	Time: _____
6	Field-device response	Method / source: _____	Value / state: _____	Time: _____

Instrument and reference record

Control	Record
Instrument or data source	_____
Identifier and range	_____
Calibration / validation status	_____
OEM or engineering reference	Document and revision: _____
Equipment operating state	_____
Uncertainty or limitation	_____

Before using a value

- Check units, scale, timestamp and source identity.
- Keep raw evidence where practical; do not retain only a conclusion.
- Record values that disagree with the current theory.
- Compare only like operating conditions.
- Treat a single normal reading as one data point, not proof that an intermittent fault is absent.

Cause and Evidence Matrix

List competing explanations before the team settles on one. A good next check separates hypotheses; a poor check produces the same answer no matter which cause is true.

#	Hypothesis	Supporting	Contradicting	Discriminating check
1	Machine state and sequence step hypothesis	For: _____	Against: _____	Next evidence: _____
2	Input status hypothesis	For: _____	Against: _____	Next evidence: _____
3	Interlock and permissive state hypothesis	For: _____	Against: _____	Next evidence: _____
4	Logic command hypothesis	For: _____	Against: _____	Next evidence: _____
5	Output status hypothesis	For: _____	Against: _____	Next evidence: _____
6	Field-device response hypothesis	For: _____	Against: _____	Next evidence: _____

Five-why chain with evidence

Level	Explanation	Proof or gap
Problem	Recurring Fault After Repair	Evidence ID: _____
Why 1	_____	Evidence: _____
Why 2	_____	Evidence: _____
Why 3	_____	Evidence: _____
Why 4	_____	Evidence: _____
Why 5	_____	Evidence: _____

Cause confidence

- Confirmed - reproduced or directly measured against a valid reference.
- Probable - best fit, but one meaningful alternative remains.
- Possible - plausible and worth a safe test.
- Unrelated - contradicted by the evidence.
- Unknown - evidence is missing or unreliable.

Repair Decision and Return-to-Service Gate

Release authority: Completion of a repair is not permission to energise or operate. Restore energy and return equipment to service only through the site's authorised process, with guards and protective functions reinstated.

Decision field	Record
Confirmed problem	_____
Evidence-supported cause	_____
Approved repair reference	Document and revision: _____
Work completed	_____
Parts / settings changed	_____
Residual defect or restriction	_____
Person completing / checking	_____

Controlled verification

Verification	Acceptance basis	Status
As-found symptom	Recurring Fault After Repair	Absent / present / not tested
Primary function	Machine state and sequence step	Pass / fail / not tested
Related function	Input status	Pass / fail / not tested
Protection and alarms	Normal protective state retained	Pass / fail / not tested
Leak, heat, noise or damage	No new adverse condition	Pass / fail / not tested
Recorded operating condition	Load / mode / duration: _____	Accepted / restricted

Release signatures

- Technical check by: _____ Date/time: _____
- Operations acceptance by: _____ Date/time: _____
- Safety or permit close-out by: _____ Date/time: _____
- Follow-up owner and due date: _____

Handover, Follow-Up and Prevention Plan

Close the record so the next shift can understand the recurring fault after repair, the evidence, the repair decision and any remaining restriction without relying on memory.

Handover field	Record
Current equipment state	_____
What was confirmed	_____
What remains unknown	_____
Operating restriction	_____
Evidence location	Log / work order / folder: _____
Next owner and action	_____
Escalation trigger	_____

Follow-up schedule

When	Review	Record
Next shift	Confirm state and restriction	Owner: _____ Result: _____
24 hours	Review machine state and sequence step	Owner: _____ Result: _____
7 days	Check for repeat events under comparable duty	Owner: _____ Result: _____
30 days	Review effectiveness and maintenance action	Owner: _____ Result: _____

Prevention decision

- Update the task, limit, drawing or training only when the cause supports it.
- Remove any temporary control by its approved expiry point.
- Share the lesson without exposing private, security-sensitive or proprietary data.
- Record whether the action reduced repeat faults, downtime or diagnostic effort.
- Reopen the analysis if the symptom returns under the same conditions.

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