AI-04712 Fault Tree Analysis Employment Delete

#cmp

Perform a Fault Tree Analysis of a new hire Samsung Employee not lasting 1 year as CMP Equipment Technician 2.

Fault Tree Analysis (FTA)

New Hire Samsung Employee — CMP Equipment Technician 2 Does Not Last One Year

Analysis scope: A newly hired **CMP Equipment Technician 2** at Samsung Austin Semiconductor leaves the company, fails probation/performance expectations, transfers out, or otherwise does not remain employed through the first 12 months.

Top event:

> 🔴 **NEW HIRE DOES NOT COMPLETE 12 MONTHS AS A CMP EQUIPMENT TECHNICIAN 2**

This FTA is designed as a **practical workforce-retention and training diagnostic**, not as an assessment of any individual employee. It examines how technical, organizational, personal, and operational conditions can combine to produce early attrition.

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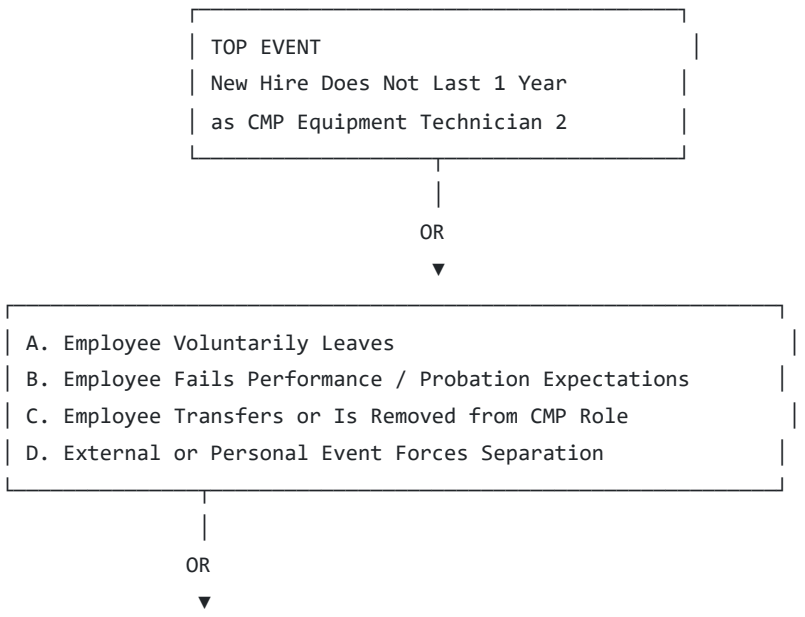
1. Top-Level Fault Tree



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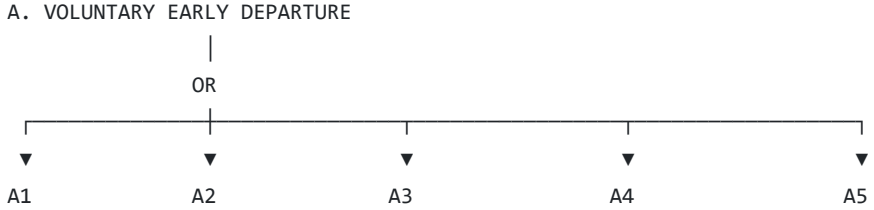
2. Primary Branch A — Employee Voluntarily Leaves



```
Job          Work          Poor          Better          Personal
Mismatch     Conditions    Support       Opportunity      Strain
```

A1. Job Expectations Do Not Match Reality

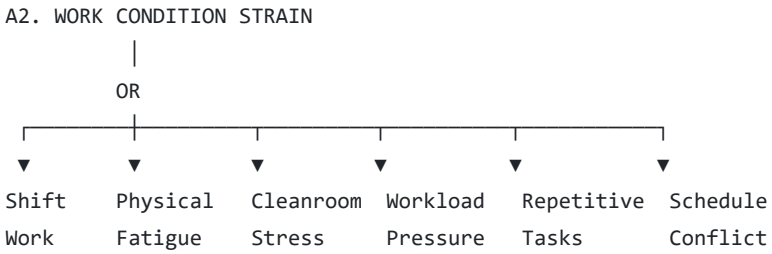
Potential basic events:

- Expected a primarily technical role but encounters extensive routine maintenance.
- Underestimates the complexity of semiconductor manufacturing.
- Expected daytime work but struggles with rotating shifts, nights, weekends, or overtime.
- Did not understand cleanroom requirements and restrictions.
- Expected immediate independent work but discovers a lengthy qualification process.
- Expected equipment repair to be straightforward but encounters complex, interdependent systems.
- Finds the CMP environment less interesting than expected.
- Feels the actual Technician 2 responsibilities differ from the recruiting description.

Failure mechanism:

> **Expectation gap → disappointment → disengagement → resignation**

A2. Work Conditions Become Intolerable



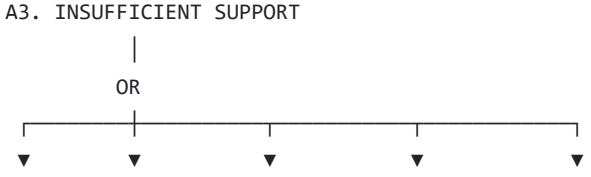
Potential basic events:

- Difficulty adapting to 12-hour or rotating shifts.
- Insufficient recovery between shifts.
- Standing, walking, climbing, bending, or working in constrained areas becomes difficult.
- Cleanroom garments, PPE, temperature, or environmental restrictions create discomfort.
- Frequent urgent equipment calls interrupt planned work.
- Chronic overtime or insufficient staffing increases fatigue.
- Work feels repetitive without visible skill progression.
- Schedule conflicts with family, transportation, or outside obligations.

Failure mechanism:

> **Sustained operational strain → reduced quality of life → job dissatisfaction → voluntary exit**

A3. Poor Supervisor, Mentor, or Team Support



```
Weak      Poor        No Clear     Unsafe        Interpersonal
Onboarding Mentoring Feedback     Questions     Conflict
```

Potential basic events:

- No clearly assigned mentor or training owner.
- Training depends on whoever happens to be available.
- New hire is told to “watch and learn” without a structured progression.
- Inconsistent instructions from different technicians.
- Questions are interpreted as incompetence rather than learning.
- New employee fears asking for help.
- Supervisor feedback is vague, delayed, or primarily negative.
- Team culture is dismissive, territorial, or hostile.
- New hire is left alone before being adequately qualified.
- Training documentation is incomplete or difficult to access.

Failure mechanism:

> **Low psychological safety + unclear support → avoidable errors and frustration → loss of confidence → departure**

A4. Better External Opportunity

Potential basic events:

- Receives a higher-paying offer.
- Finds a position with a more predictable schedule.
- Obtains a role closer to home.
- Receives an offer from another semiconductor company.
- Finds a position with clearer advancement opportunities.
- Moves into an engineering, automation, facilities, or controls role.
- Employer offers better benefits, relocation support, or work-life balance.
- New hire views the Samsung role as a temporary stepping stone.

Failure mechanism:

> **Perceived opportunity elsewhere exceeds perceived value of staying → resignation**

A5. Personal or Financial Strain

Potential basic events:

- Commute becomes unsustainable.
- Transportation reliability is poor.
- Childcare or family responsibilities conflict with shifts.
- Housing costs exceed practical affordability.
- Financial pressure requires immediate higher income.
- Personal relationship or family circumstances change.
- Physical or mental fatigue affects ability to maintain the schedule.
- Employee cannot sustain the demands of the role alongside personal obligations.

Failure mechanism:

> **Personal constraint + demanding work schedule → inability to continue employment**

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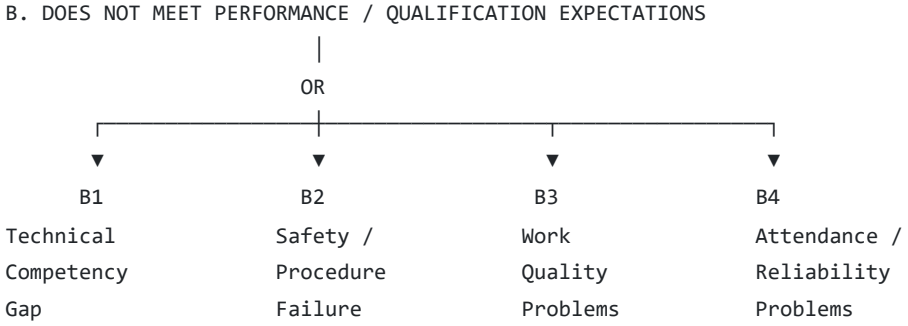
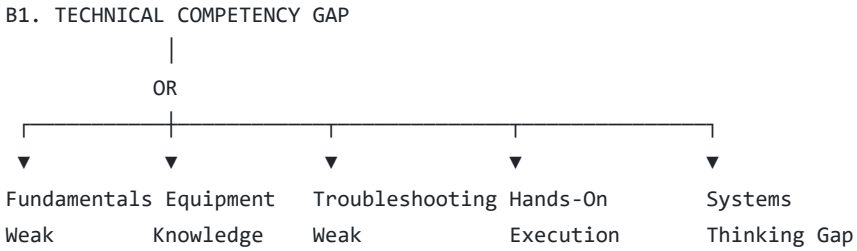
3. Primary Branch B — Performance or Qualification Failure



B1. Technical Competency Gap



Potential basic events

- Weak understanding of electrical fundamentals.
- Weak mechanical troubleshooting skills.
- Insufficient knowledge of pneumatics, hydraulics, vacuum, or fluid systems.
- Limited familiarity with sensors, actuators, motors, valves, and interlocks.
- Cannot interpret schematics, wiring diagrams, P&IDs, or equipment documentation.
- Limited understanding of PLC, HMI, or equipment-control concepts.
- Weak understanding of preventive maintenance principles.
- Does not understand CMP process fundamentals.
- Cannot connect equipment symptoms to likely failure modes.
- Replaces components without isolating root cause.
- Troubleshooting is based on guessing rather than a systematic process.
- Does not recognize interactions between mechanical, electrical, chemical, and process subsystems.
- Lacks confidence using required tools, meters, test equipment, or diagnostic software.

CMP-specific competency areas

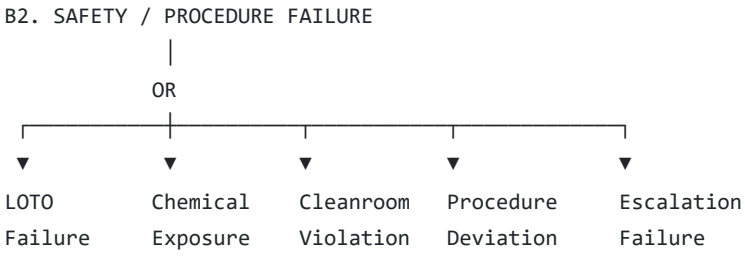
A CMP Equipment Technician 2 may need to develop working knowledge of equipment systems such as:

- Wafer handling and robotic transfer.
- Slurry delivery and distribution.
- Slurry pumps, valves, filters, and flow control.
- Polishing head and carrier systems.
- Retaining rings and consumable-related mechanisms.
- Platen and pad-related systems.
- Conditioning systems.

- Chemical delivery and chemical safety.
- DI water and utility systems.
- Vacuum and pneumatic systems.
- Equipment sensors and interlocks.
- Equipment alarms and fault codes.
- Preventive maintenance procedures.
- Equipment recovery and qualification procedures.
- Contamination-control practices.
- Process/equipment interaction.

Important: The exact equipment, tools, and qualification requirements depend on the Samsung facility, assigned module, and specific toolset.

B2. Safety, Procedure, or Compliance Failure



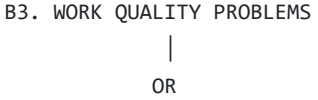
Potential basic events

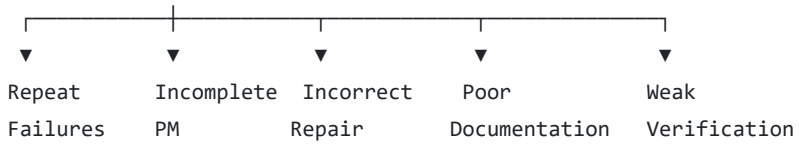
- Does not consistently follow lockout/tagout requirements.
- Fails to recognize hazardous energy sources.
- Mishandles chemicals or chemical-delivery systems.
- Fails to use required PPE.
- Violates cleanroom or contamination-control procedures.
- Bypasses an interlock or protective mechanism improperly.
- Performs work without required authorization or qualification.
- Fails to follow maintenance procedures.
- Skips verification steps after repair.
- Does not properly document work performed.
- Fails to escalate unsafe or abnormal conditions.
- Takes shortcuts under production pressure.
- Does not understand the consequences of procedural deviation.

Failure mechanism:

> **Procedure deviation → safety, equipment, or production risk → disciplinary action, removal from qualification, or termination**

B3. Work Quality and Troubleshooting Problems





Potential basic events

- Same equipment failure recurs after repair.
- PM tasks are incomplete or performed incorrectly.
- Incorrect part or consumable is installed.
- Repair introduces a secondary fault.
- Technician does not verify equipment functionality after repair.
- Equipment is returned to production prematurely.
- Troubleshooting notes lack useful detail.
- Shift handoff information is incomplete.
- Technician cannot distinguish symptom from root cause.
- Excessive dependence on more experienced technicians.
- Work takes significantly longer than expected without improvement.
- Failure to recognize when escalation is necessary.

Failure mechanism:

> **Repeated quality problems → loss of trust → poor performance evaluation → failed qualification or termination**

B4. Attendance, Reliability, or Schedule Performance

Potential basic events:

- Frequent tardiness.
- Absenteeism during training or qualification.
- Difficulty maintaining rotating shift attendance.
- Missed mandatory training.
- Inability to report reliably for scheduled work.
- Excessive unscheduled leave.
- Failure to follow call-in procedures.
- Fatigue contributes to attendance or performance problems.
- Transportation issues repeatedly affect punctuality.
- Schedule expectations were not understood before hiring.

Failure mechanism:

> **Unreliable attendance → training delays and staffing impact → corrective action → separation**

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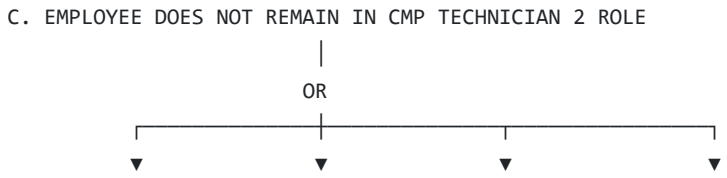
4. Primary Branch C — Transfer, Removal, or Role Displacement



```
   C1          C2          C3          C4
Internal    Qualification  Workforce   Role /
Transfer    Not Completed  Restructuring  Assignment Change
```

C1. Internal Transfer

- Employee transfers to another department.
- Employee moves to facilities, engineering, automation, or another manufacturing area.
- Employee accepts a role with a more desirable schedule.
- Employee is reassigned due to staffing needs.
- Employee pursues a career path outside CMP.

C2. Qualification Not Completed

- Required qualification milestones are not met.
- Training progression stalls.
- Employee cannot demonstrate safe independent work.
- Technical evaluations remain below expectations.
- Remediation is unsuccessful.
- Qualification deadlines are missed.
- Training requirements are unclear or inconsistent.

C3. Workforce or Organizational Changes

- Headcount reduction.
- Hiring plan changes.
- Organizational restructuring.
- Module consolidation.
- Shift or assignment elimination.
- Business conditions alter staffing requirements.

C4. Role or Assignment Change

- New hire is placed in a different role.
- Assignment is changed before the employee establishes proficiency.
- Job expectations change substantially after onboarding.
- Employee no longer has a clear path to complete Technician 2 qualification.

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5. Primary Branch D — External or Personal Separation Event

```
D. EXTERNAL / PERSONAL SEPARATION
              |
             OR
  ┌──────────┬┴──────────┬──────────┐
  ▼          ▼           ▼          ▼
D1          D2          D3         D4
Health /    Family      Relocation Legal /
Injury      Emergency   or Move    Other Event
```

Potential basic events:

- Serious illness or injury.
- Work-related injury.
- Family emergency requiring relocation.
- Spouse or family member relocation.
- Employee moves out of the region.
- Immigration, legal, or work-authorization issue.
- Major personal crisis.
- Other event unrelated to job satisfaction or performance.

These events may be **independent of the quality of the Samsung training or work environment**.

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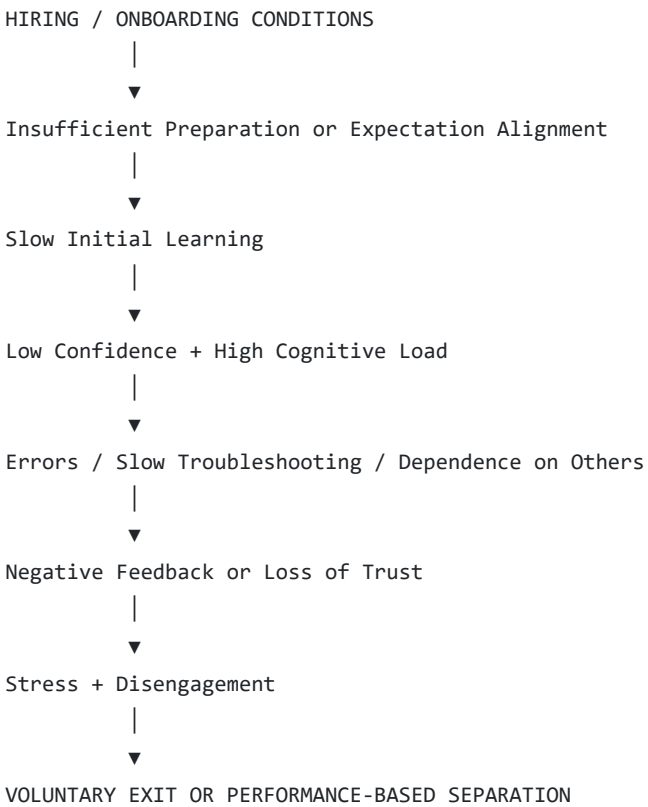
6. Detailed Causal Tree — Why a New Hire Fails to Become Productive

Early attrition is often not caused by one event. A more realistic model is a chain:



Contributing factors that can amplify the chain

- No structured 30/60/90-day plan.
- No competency matrix.
- Training is not matched to the employee's starting skill level.
- Too much information introduced at once.
- No controlled progression from observation → assisted work → supervised work → independent work.
- No objective definition of “ready.”
- Feedback is focused on errors rather than improvement.
- Training time competes with production demands.

- New hire is assigned difficult tools or shifts too early.
- Experienced technicians are too busy to coach.
- The employee does not understand how success is measured.

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7. AND-Gate Scenarios — Combinations That Can Cause Early Attrition

Fault Tree Analysis becomes more useful when we identify **combinations of conditions**, rather than treating every problem as an isolated OR event.

Scenario 1 — Expectation Gap + Shift Stress + Weak Support

```
Expectation Gap
      AND
Shift / Schedule Strain
      AND
Insufficient Mentoring
      │
      ▼
High Frustration + Low Confidence
      │
      ▼
VOLUNTARY RESIGNATION
```

Example: The employee expected a predictable technical role, struggles with rotating shifts, and has no consistent mentor to help navigate the first difficult months.

Scenario 2 — Technical Gap + Inadequate Training + Production Pressure

```
Technical Knowledge Gap
          AND
Insufficient Structured Training
          AND
High Production Pressure
          │
          ▼
Repeated Troubleshooting Errors
          │
          ▼
Performance Concerns
          │
          ▼
FAILED QUALIFICATION / SEPARATION
```

Scenario 3 — Fatigue + Shift Work + Safety-Critical Task

```
Accumulated Fatigue
       AND
Difficult Shift Schedule
       AND
Safety-Critical Maintenance Task
       │
       ▼
Reduced Attention / Procedural Error
       │
       ▼
Safety or Compliance Violation
       │
       ▼
DISCIPLINARY ACTION / SEPARATION
```

Scenario 4 — Poor Feedback + No Career Path + Better Opportunity

```
Unclear Performance Feedback
          AND
No Visible Advancement Path
          AND
External Job Opportunity
          │
          ▼
Low Perceived Future Value
          │
          ▼
VOLUNTARY DEPARTURE
```

Scenario 5 — Personal Constraint + Inflexible Schedule

```
Family / Transportation Constraint
              AND
Inflexible Shift Requirement
              AND
Insufficient Schedule Accommodation
              │
              ▼
Unable to Sustain Attendance
              │
              ▼
VOLUNTARY OR INVOLUNTARY SEPARATION
```

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8. Root Cause Categories

Root Cause Category	Typical Root Causes	Observable Symptoms

Person–Job Fit	Expectations differ from actual work	Disengagement, complaints about role
Technical Readiness	Weak fundamentals or equipment knowledge	Slow troubleshooting, repeated errors
Training System	No structured qualification path	Unclear progress, inconsistent skills
Leadership	Poor coaching or unclear expectations	Fear of asking questions, frustration
Team Culture	Blame, exclusion, poor communication	Isolation, low psychological safety
Workload / Staffing	Overtime, insufficient coverage	Fatigue, rushed work, burnout
Shift / Schedule	Rotating shifts, night work, schedule conflict	Tardiness, absenteeism, resignation
Safety / Compliance	Poor procedure discipline	Near misses, deviations, corrective action
Career Development	No visible growth path	External job search, disengagement
Personal / External	Family, health, transportation, relocation	Attendance issues, sudden departure

9. Leading Indicators — Detect Risk Before the Employee Leaves

The goal is to identify **weak signals**, not to label an employee prematurely.

Training and technical indicators

- Qualification milestones repeatedly missed.
- Same technical concept requires repeated retraining.
- Increasing dependence on one mentor.
- Cannot explain the purpose of a maintenance procedure.
- Troubleshooting sequence is inconsistent.
- Repeated documentation omissions.
- Hesitates to perform tasks even after adequate instruction.
- Avoids asking questions due to fear of criticism.
- PM completion quality is inconsistent.

Engagement and work-environment indicators

- Stops asking questions or participating in training.
- Frequently expresses surprise about schedule or job expectations.
- Reports feeling unsupported.
- Increasing frustration with shift assignments.
- Withdraws from team communication.
- Expresses that the job is not what was promised.
- Mentions actively looking for other opportunities.

Reliability and safety indicators

- Repeated tardiness or attendance issues.
- Fatigue-related mistakes.
- Missed training sessions.

- Repeated procedural deviations.
- Fails to escalate abnormal conditions.
- Work quality declines under pressure.

Important: These are **risk indicators**, not proof of likely resignation or incompetence. They should trigger supportive investigation, not automatic punishment.

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10. Preventive Controls and Mitigation Plan

The strongest prevention strategy is to control the **system**, not merely tell the employee to "try harder."

A. Before Day 1 — Hiring and Expectation Alignment

Control	Purpose
Realistic job preview	Show actual shift, cleanroom, PM, troubleshooting, and physical demands
Technical baseline assessment	Identify electrical, mechanical, vacuum, fluid, and controls gaps
Shift expectation confirmation	Confirm employee understands schedule requirements
Clear Technician 2 role definition	Define expected responsibilities and qualification timeline
Career-path discussion	Explain Technician 2 → Technician 3 → senior/lead/engineering pathways
Transportation and schedule discussion	Identify foreseeable practical barriers

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B. Days 1–30 — Foundation and Safety

Objective: Build a safe, supported, and technically grounded employee.

- Assign a named mentor or training owner.
- Provide a written training roadmap.
- Complete safety and cleanroom qualification.
- Introduce CMP process fundamentals.
- Teach equipment architecture and major subsystems.
- Establish tool, documentation, and escalation procedures.
- Confirm understanding of hazardous energy and chemical safety.
- Use supervised observation and low-risk hands-on activities.
- Conduct weekly check-ins.
- Establish a psychologically safe environment for questions.

Control objective:

> **No new hire should be forced to guess when safety, equipment integrity, or product quality is at risk.**

C. Days 31–60 — Guided Technical Development

Objective: Transition from knowledge acquisition to structured execution.

- Begin supervised PM tasks.

- Practice fault isolation using real or simulated examples.
- Teach alarm interpretation and troubleshooting logic.
- Review electrical, mechanical, pneumatic, vacuum, and fluid systems.
- Introduce equipment-specific documentation.
- Use a competency checklist.
- Review completed work with the mentor.
- Conduct short technical assessments.
- Provide immediate, specific feedback.
- Adjust training based on demonstrated gaps.

D. Days 61–90 — Controlled Independence

Objective: Demonstrate safe, repeatable performance.

- Perform selected maintenance tasks under supervision.
- Demonstrate correct escalation decisions.
- Complete troubleshooting exercises.
- Demonstrate accurate documentation and shift handoff.
- Verify repairs using defined acceptance criteria.
- Evaluate quality, safety, efficiency, and judgment.
- Identify remaining qualification gaps.
- Create a remediation plan if needed.

E. Months 4–12 — Qualification and Retention

Objective: Convert initial training into sustainable competence and career commitment.

- Maintain a documented qualification matrix.
- Assign progressively more complex tasks.
- Conduct monthly development discussions.
- Provide cross-training across equipment subsystems.
- Recognize measurable progress.
- Discuss career progression and future opportunities.
- Monitor workload and shift fatigue.
- Provide refresher training after errors.
- Avoid assigning independent work beyond demonstrated competence.
- Conduct a structured 6-month and 9-month retention check.
- Confirm the employee sees a future in the role.

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11. Control Matrix — Failure Mode to Countermeasure

Failure Mode	Early Detection	Preventive / Corrective Control	Owner
Unrealistic job expectations	New hire expresses surprise or dissatisfaction	Realistic job preview and expectation confirmation	Hiring Manager / HR

Weak electrical fundamentals	Poor assessment or troubleshooting performance	Foundational technical training	Training Lead
Weak CMP equipment knowledge	Cannot explain subsystem functions	Equipment architecture curriculum	Module Trainer
Poor troubleshooting	Repeated part swapping or recurring failures	Structured fault-isolation training	Mentor / Supervisor
Safety procedure deviation	Observation or audit finding	Requalification, coaching, procedural reinforcement	EHS / Supervisor
Shift fatigue	Attendance issues, fatigue complaints	Schedule review, fatigue management, staffing review	Supervisor
Lack of mentoring	New hire reports unclear support	Named mentor with scheduled check-ins	Area Manager
Poor team integration	Isolation, reluctance to ask questions	Buddy system, team inclusion, psychological safety	Supervisor / Team
Qualification delay	Missed milestones	Individual training recovery plan	Training Lead
Career stagnation	Disengagement, external job interest	Career-path and development discussion	Supervisor / HR
Personal constraints	Attendance or schedule difficulty	Early supportive discussion and available resources	Supervisor / HR

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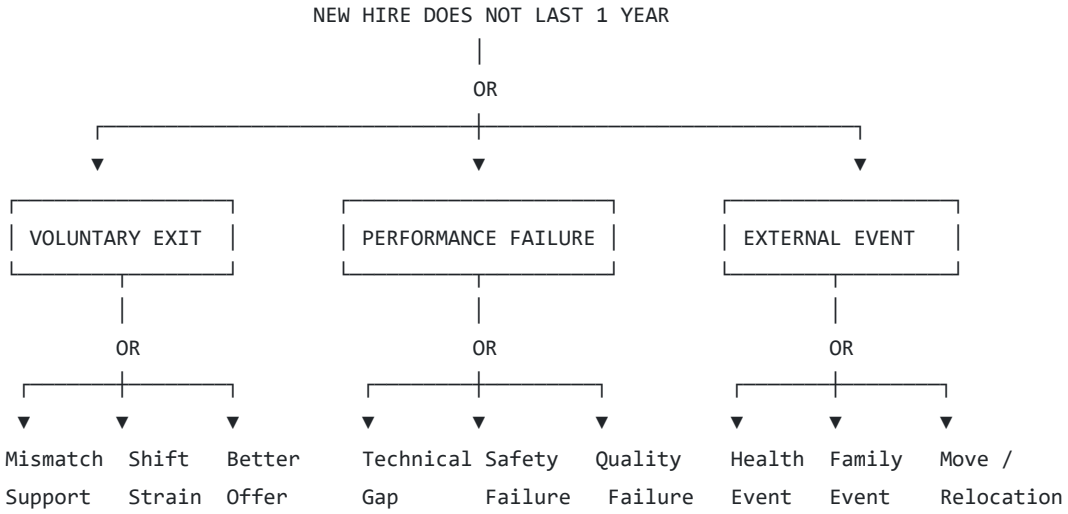
12. Suggested 30/60/90-Day Retention Dashboard

A simple dashboard can detect risk without turning the process into surveillance.

Metric	**Day 30**	**Day 60**	**Day 90**	**Desired Condition**
Safety / cleanroom qualification	Complete	Maintained	Maintained	No unresolved gaps
Training plan completion	≥90%	≥90%	≥90%	On track
Technical competency assessment	Baseline	Improving	Meets stage target	Progressive improvement
PM task proficiency	Observe / assist	Supervised	Controlled execution	Safe and repeatable
Troubleshooting proficiency	Fundamentals	Guided	Demonstrated logic	Evidence-based
Mentor check-ins	Weekly	Weekly	Weekly	Consistent
Attendance reliability	Baseline	Stable	Stable	Meets expectations
Employee confidence	Establish baseline	Improving	Positive	Can ask for help
Manager feedback	Initial	Midpoint	Formal review	Clear and actionable

Career-path understanding	Discussed	Reviewed	Confirmed	Sees next step

13. FTA Summary — Most Important Failure Paths



Final Assessment

The most controllable causes of a new CMP Equipment Technician 2 failing to last one year are usually found in the intersection of:

> **Expectation Alignment + Technical Readiness + Structured Qualification + Supervisor Support + Shift Sustainability**

A new hire does not necessarily fail because the person lacks ability. The employee may fail because the **training system, work conditions, expectations, or support structure do not provide a realistic path to competence and confidence**.

Highest-value prevention principle

> **Make the first year a managed qualification journey—not a survival test.**

A well-designed system should answer five questions continuously:

1. **What must the technician learn?**
2. **How will competency be demonstrated?**
3. **Who is responsible for developing it?**
4. **What happens when the technician struggles?**
5. **Why should the technician want to remain after becoming competent?**