WHY DOES THIS BSL-3 KEEP GOING INTO ALARM?

Diagnostic Guide
GD-007

A technical diagnostic guide to recurring alarms, nuisance conditions, control instability, and alarm normalization

A practical guide to distinguishing meaningful containment alarms from instrumentation failures, poorly configured thresholds, recurring disturbances, and control problems.

DIAGNOSTIC GUIDE

HOW TO USE THIS GUIDE

A RECURRING ALARM IS INFORMATION — EVEN IF THE SYSTEM RECOVERS.

This guide was created for laboratories where alarms occur frequently enough that operators, maintenance personnel, or management have begun to treat them as normal.

Why we developed it

High-containment laboratories depend on alarms to make loss of control visible. Pressure deviations, fan failures, filter conditions, door states, interlock failures, and control-system problems can all generate alarms.

When an alarm repeats, the response can shift from investigation to simple acknowledgement: silence it, reset it, widen the threshold, increase the delay, or accept that "that room always does that."

The purpose of this guide is to prevent that normalization by helping technical teams distinguish the alarm signal from the system condition that generated it.

Who can use it

The guide is intended for operators, facility managers, biosafety personnel, engineers, controls specialists, maintenance teams, and institutional authorities responsible for BSL-3 operation.

It may be used for a recurring alarm, a group of alarms, or a broader review of whether the laboratory's alarm strategy remains technically useful.

HOW TO USE IT IN PRACTICE

Identify exactly which alarm occurred, confirm whether the underlying condition was real, reconstruct the event from trends and operating history, determine why the condition occurred, and evaluate whether the alarm threshold, delay, and escalation path remain appropriate.

The objective is not to eliminate alarms. It is to eliminate unexplained recurrence and preserve the alarms operators need to trust.

01 IDENTIFY

02 CONFIRM

03 DIAGNOSE

04 RESPOND

HOW THIS GUIDE MAY BE USED — AND WHAT IT DOES NOT AUTHORIZE

This guide is a general diagnostic-orientation tool. It is designed to help structure technical questions, organize evidence, and define what requires more specific evaluation.

Acceptable use

It may be used to:

- structure preliminary technical investigations;
- prepare internal reviews and multidisciplinary discussions;
- identify missing information, measurements, and documentation;
- support definition of the scope of a subsequent evaluation;
- serve as educational and internal technical reference material.

It does not constitute

This guide does not constitute a specific alarm-response procedure, acceptance criterion, certification, compliance determination, authorization to operate, or site-specific recommendation.

Technical and operational decisions

No decision regarding alarm acknowledgement or reset, modification of thresholds or delays, control intervention, continued operation, or return to service should be based solely on this guide.

Applicable technical basis

The content should be interpreted together with the risk assessment, approved control sequences, commissioning criteria, alarm-response procedures, regulatory requirements, manufacturer instructions, and other site-specific documentation.

Competent personnel

Changes to alarms, sensors, control logic, or containment-critical setpoints should be performed or reviewed by appropriately qualified personnel and verified against the intended function.

Responsibility

BioLab Solutions assumes no responsibility for decisions, modifications, interventions, or actions carried out outside a site-specific evaluation and without review by competent personnel.

First published: October 2026
Current version: October 2026 | v1.0

COPYRIGHT AND PERMITTED USE

© 2026 Biological Laboratory Solutions S.A.S. de C.V. All rights reserved.

This publication may be downloaded, retained, and used internally for educational, technical, and reference purposes.

It may not be reproduced, redistributed, modified, sold, or incorporated, in whole or in part, into commercial materials, courses, procedures, specifications, reports, or third-party publications without prior written authorization from BioLab Solutions.

Brief excerpts may be quoted with full attribution to BioLab Solutions and reference to the corresponding Diagnostic Guide.

01 Identify exactly which alarm occurred

"The laboratory went into alarm" is too broad to diagnose.

Begin with the specific monitored variable, the trigger condition, and the affected system.

Pressure

- low or high differential;
- cascade reversal;
- loss of reference;
- sensor failure.

Air systems

- fan failure;
- low airflow;
- VFD failure;
- damper failure;
- loss of redundancy.

Doors / interlocks

- door held open;
- simultaneous opening;
- interlock failure;
- door-position switch problem.

Filtration / controls

- high filter DP;
- sensor out of range;
- communication loss;
- PLC/BMS failure;
- electrical event.

Record: alarm name, timestamp, duration, value at trigger, affected room/system, associated alarms, operator action, and recovery condition.

02 Confirm whether the alarm represented a real condition

Alarm logic may function correctly even when the signal that triggered it does not represent the real physical condition.

Verify the measurement

- compare BMS and local indication;
- use calibrated independent measurement where appropriate;
- review sensor calibration;
- inspect reference tubing and ports;
- review communication status.

Two different questions

Did the alarm logic function?
The control system correctly generated an alarm from the input it received.

Was the monitored condition real?
The underlying physical condition actually crossed the defined limit.

Both questions must be answered.

DO NOT CORRECT A SENSOR PROBLEM WITH AIRFLOW — OR A REAL CONTAINMENT PROBLEM WITH A NEW ALARM LIMIT.

03 Reconstruct the event, not only the alarm

The sequence before and after the trigger often reveals the cause.

Trend data should be read as a timeline of interacting system conditions.

Observe	What it may reveal
Pressure trend	Gradual drift, sudden collapse, oscillation, slow recovery, or reference instability.
Door status	Whether the event followed an opening, prolonged opening, or interlock conflict.
Fan / VFD trend	Loss of the operating fan, increasing speed, transition to standby equipment, or control hunting.
Damper position	Whether controls reached a limit or repeatedly corrected.
Filter DP	Increasing system resistance or a sudden measurement anomaly.
Power / controls	Utility disturbance, transfer event, PLC restart, or communication loss.
Adjacent rooms	Whether the alarm originated from a change elsewhere in the pressure cascade.

04 Distinguish nuisance alarms from meaningful recurrence

"Nuisance" should describe an alarm-design problem, not an unexplained event.

A recurring alarm may result from an inappropriate threshold or delay. It may also be the earliest evidence of a system operating too close to its limit.

A genuinely poorly configured alarm may have

- a threshold within normal operating variability;
- no appropriate delay for expected transients;
- duplicate notifications;
- an incorrect sensor range;
- poor priority classification.

A meaningful recurring alarm may indicate

- loss of control margin;
- filter loading;
- envelope leakage;
- control-loop instability;
- door behavior outside assumptions;
- sensor deterioration;
- operational change.

DO NOT CLASSIFY A RECURRING ALARM AS "NUISANCE" UNTIL THE CONDITION GENERATING IT HAS BEEN UNDERSTOOD.

05 Look for alarm normalization

Repeated alarms can change operator behavior before the system changes again.

Repeated acknowledgement

The same alarm is routinely silenced without documented investigation.

Threshold drift

Alarm limits are repeatedly widened to reduce frequency rather than correct the condition.

Delay drift

Delays are extended until a recurring excursion no longer produces an alarm.

Permanent bypass

An interlock, alarm, or sensor remains in override because it is operationally inconvenient.

Improvised local workaround

Operators change door behavior, hold a door open, adjust a setpoint, or modify workflow to avoid triggering the alarm.

Loss of trust

Operators stop distinguishing meaningful alarms because too many alerts have become routine.

> Alarm fatigue is not only a human-factors problem. In containment systems, it can remove the operational visibility the alarms were intended to provide.

06 Review whether the alarm signals loss of system margin

The laboratory may continue recovering while becoming progressively less resilient.

Recurring alarms during ordinary disturbances may show that the system is operating closer to its limits than the accepted condition assumed.

Fan authority

Is the exhaust fan operating at progressively higher speeds simply to maintain normal pressure?

Filter resistance

Has increasing filter differential pressure reduced available capacity?

Envelope condition

Has leakage increased, requiring more airflow to maintain the same differential?

Door recovery

Does the system take longer to recover after normal door operation?

Control saturation

Do dampers or VFDs regularly reach their minimum or maximum positions?

Interaction with adjacent zones

Does another room or shared-system event now trigger the alarm?

THE SYSTEM DOES NOT HAVE TO FAIL COMPLETELY FOR RECURRING ALARMS TO BECOME TECHNICALLY IMPORTANT.

ALARM-PATTERN MATRIX

WHAT THE RECURRENCE PATTERN MAY BE INDICATING

Pattern	Possible causes
Alarm every time a door opens	Threshold/delay mismatch, insufficient recovery, excessive leakage, change in door behavior, or low control margin.
Alarm at the same time every day	Schedule change, HVAC mode transition, adjacent-system operation, environmental load, or automatic control sequence.
Alarm frequency increases over months	Filter loading, fan degradation, increasing leakage, sensor drift, or cumulative configuration change.
Several rooms alarm together	Common fan, electrical event, shared control system, pressure-reference problem, or central-system disturbance.
Alarm immediately after maintenance	Sensor problem, altered setpoint, changed damper position, filter replacement, control change, or incomplete restoration.
High/low alarms alternate rapidly	Control-loop instability, supply/exhaust hunting, or unstable sensor signal.
Alarm appears without physical change	Sensor/reference failure, communication problem, scaling error, or BMS logic problem.

> Patterns narrow the diagnostic field. They do not replace independent verification.

ALARM STRATEGY

IS THE ALARM CONFIGURATION STILL APPROPRIATE?

Threshold

Does the trigger correspond to a technically meaningful deviation from the accepted operating condition?

Delay

Does the delay distinguish expected brief transients from sustained loss of control without hiding a meaningful event?

Priority

Can operators distinguish advisory, maintenance, and containment-critical alarms?

Notification

Who sees the alarm locally, through the BMS, and outside normal operating hours?

Required response

Is the expected operator action defined, realistic, and linked to the consequence of the alarm?

Reset / acknowledgement

Does acknowledgement only silence the notification, or is there a risk that it is confused with resolution of the condition?

> **AN ALARM SHOULD BE ACTIONABLE, TRACEABLE, AND PROPORTIONAL TO THE CONDITION IT REPRESENTS.**

WHAT NOT TO DO

DO NOT MANAGE RECURRENCE BY MAKING THE ALARM LESS VISIBLE

Do not widen thresholds first

Determine why the system crosses the existing threshold before changing what is considered acceptable.

Do not extend delays first

A longer delay can hide a real sustained deviation just as easily as it can filter a transient.

Do not disable the alarm

If a function is genuinely no longer required, remove or modify it through a controlled and documented technical change rather than maintaining a permanent override.

Do not treat reset as correction

Resetting the alarm does not establish why it occurred or whether the underlying condition was restored.

Do not blame “user error” without evidence

Repeated door or workflow alarms may reveal that the system does not support normal operation as designed.

Do not investigate alarms in isolation

Related alarms and trends may reveal a common upstream cause.

DIAGNOSTIC SEQUENCE

WHY DOES THIS ALARM KEEP COMING BACK?

01

Are the exact alarm and trigger condition known?

No → identify the monitored variable, threshold, delay, priority, and affected system.
Yes → continue.

02

Was the underlying physical condition real?

No or uncertain → investigate sensor, reference, communication, and calibration.
Yes → continue.

03

Is the event associated with a repeatable operating condition?

Yes → reconstruct the sequence and evaluate system response.
No → continue reviewing trends and events.

04

Is the system losing margin or showing drift?

Yes → investigate capacity, resistance, leakage, controls, and recent changes.
No → continue.

05

Is the alarm threshold/delay technically appropriate?

No → revise it only through controlled technical review and verification.
Yes → continue.

06

Was the cause corrected and the alarm function retested?

No → the recurrence remains unresolved.
Yes → document the restored condition and retain the event history.

WHAT TO GATHER BEFORE CHANGING THE ALARM

Alarm configuration

- tag/name;
- threshold;
- delay;
- priority;
- notification path;
- reset logic.

Event record

- timestamp;
- duration;
- value at trigger;
- related alarms;
- operator action;
- recovery.

System data

- pressure trends;
- airflow;
- fan/VFD;
- damper positions;
- filter DP;
- door status.

History

- maintenance;
- calibration;
- setpoint changes;
- software changes;
- operational changes;
- previous investigations.

Investigation objective: establish whether the alarm reveals a real system condition, an instrumentation problem, inappropriate alarm configuration, or a combination of these factors.

RETURN TO NORMAL OPERATION

CORRECT THE CAUSE. THEN VERIFY THE ALARM.

A recurring-alarm investigation should conclude with two demonstrations: that the system condition has been restored and that the alarm still performs its intended protective function.

System restoration may require

- sensor calibration;
- airflow correction;
- filter replacement;
- envelope repair;
- control adjustment;
- door adjustment;
- restoration of redundancy;
- operational change.

Alarm verification may require

- controlled testing of the alarm function;
- confirmation of threshold and delay;
- local and remote notification;
- event logging;
- operator response;
- reset/recovery behavior.

THE SUCCESSFUL OUTCOME IS NOT “THERE ARE NO MORE ALARMS.” IT IS A STABLE SYSTEM WITH ALARMS THAT STILL MEAN SOMETHING.

08 Review the alarm philosophy, not only the individual threshold

A technically correct alarm can become ineffective if priority, delay, acknowledgement, and escalation are poorly designed.

Purpose

What condition is the alarm intended to make visible, and what operator action is expected?

Priority

Does its priority reflect the containment consequence, or are critical and advisory conditions presented similarly?

Delay / persistence

Is the delay linked to an accepted transient, or was it added simply to reduce alarm frequency?

Acknowledgement

Does acknowledgement silence the notification while keeping the active condition visible until it actually clears?

Escalation

Who must be notified when an alarm persists, recurs, or occurs while redundancy is degraded?

Suppression / override

Are inhibited, shelved, or overridden alarms visible, authorized, time-limited, and reviewed?

Diagnostic warning: an alarm parameter should not be changed until the institution can explain what transient is acceptable, for how long, and why the revised setting still protects the intended containment function.

EVENT RECONSTRUCTION

WHEN MANY ALARMS OCCUR, FIND THE FIRST TECHNICAL EVENT

A single disturbance can create a cascade of alarms. Treating each signal as an independent failure may hide the initiating condition.

Build a sequence of events

- synchronize clocks across PLC/BMS/independent devices where possible;
- identify the first change of state rather than the first alarm someone noticed;
- compare pressure, fan, damper, door, interlock, and power events;
- record acknowledgement, reset, and manual-intervention times;
- distinguish primary alarms from consequential alarms.

Alarm flood

During a real disturbance, dozens of alarms may appear within seconds. The diagnostic record is most useful when it shows the causal order.

A fan failure may produce room-pressure, cascade, airflow, and downstream-equipment alarms. Correcting each threshold individually would treat the consequences rather than the initiating event.

The event record should therefore preserve temporal resolution appropriate to the system being diagnosed.

> **THE MOST IMPORTANT ALARM MAY BE THE ONE THAT EXPLAINS WHY THE OTHERS FOLLOWED.**

BEFORE WIDENING A THRESHOLD, INCREASING A DELAY, OR NORMALIZING THE ALARM

Use this checklist as a diagnostic-support tool. A checked item does not constitute acceptance; each element must be interpreted against the risk basis, facility configuration, and applicable criteria.

□ Identify the exact alarm, point of origin, threshold, delay, priority, and required operator response.

□ Confirm whether the alarm represents a real process deviation, an instrumentation/reference problem, a communication problem, or a configuration problem.

□ Review event history and trends around the alarm rather than relying only on the value currently displayed.

□ Determine the first technical change of state in a group of alarms and distinguish initiating alarms from consequential alarms.

□ Review sensor location, reference point, calibration status, signal damping/averaging, and trend-sampling interval.

□ Review door events, fan transitions, maintenance, filter loading, schedule changes, and other repeatable disturbances associated with the alarm.

□ Confirm whether the control loop is stable and whether actuators, dampers, or VFDs operate near their available limits.

□ Verify that alarm suppression, override, or delay changes have not reduced visibility of a containment-relevant condition.

□ Define what evidence would demonstrate that the underlying cause was corrected rather than merely acknowledged.

□ Document corrective action, repeat testing, residual limitations, and the authority to return the alarm strategy to normal operation.

> **Technical-use note:** This review checklist is a diagnostic-support tool. It does not establish site-specific acceptance criteria, replace risk assessment or professional judgment, constitute certification, or authorize operation or return to service.

If the review identifies a condition requiring site-specific evaluation, BioLab Solutions can support technical assessment, verification, and definition of the required evidence.

RELATED BIOLAB RESOURCES

EXPLORE PRESSURE, CONTROLS, VERIFICATION, AND LIFECYCLE DRIFT IN GREATER DEPTH

NT-010–013
Directional airflow, pressure cascades, ACH, and pressure-control failure modes

NT-014–017
HVAC integration, exhaust authority, redundancy, and control hierarchy

NT-032–035
Commissioning, functional testing, authority, and documentation

NT-036
Operation as a continuous containment activity

NT-037
Maintenance as a containment-risk domain

NT-039
Lifecycle drift in containment systems

BIOLAB DIAGNOSTIC GUIDES

Short technical resources organized around real containment problems rather than individual disciplines.

Series concept: symptom → system → evidence → restoration.

CLOSING DIAGNOSTIC PRINCIPLE

AN ALARM SHOULD MAKE LOSS OF CONTROL VISIBLE — NOT BECOME PART OF THE BACKGROUND NOISE.

Recurring alarms deserve investigation because they reveal either a recurring system condition or a recurring problem in how that condition is measured and communicated.

In both cases, repetition matters. A system that repeatedly crosses a limit may be losing margin. A sensor that repeatedly generates false conditions erodes operator trust. An alarm configured so tightly that normal operation continuously triggers it is poorly matched to the system it monitors.

The objective is to preserve a clear relationship between physical condition, alarm logic, and required response so that a containment alarm remains technically meaningful when it occurs.

BIOLAB SOLUTIONS

Independent technical support for planning, design, commissioning, assessment, and lifecycle management of high-containment laboratories.

For site-specific evaluation, BioLab Solutions can support technical review, verification, and definition of evidence requirements.

ALARM → CONDITION → CAUSE → RESPONSE