One POST, No Credentials: The Four-Leg Chain Behind the GitLab Repository-Commits Unauthenticated Arbitrary File Read (CVE-2026-85706), and Its Measured Closure at the Pre-Auth Read Step

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***Abstract*—This paper presents a lab-verified anatomy of CVE-2026-85706, an unauthenticated arbitrary local file read in the GitLab CE/EE repository commits API, rated CVSS 10.0 by the vendor. The boundary of every claim below is fixed in advance. All exploitation evidence was produced in a zero-egress lab against the stock build `gitlab/gitlab-ce:19.3.1-ce.0` and every observed failure reproduced identically against the patched build `gitlab/gitlab-ce:19.3.2-ce.0` on the same day, with the same PoC bytes and no credentials used in any request. The attack is a single unauthenticated HTTP POST, carrying no token and holding no session, that reaches a Rails helper which opens and parses an attacker-chosen file before any authentication check runs. The helper's Rack error path then echoes the target file's bytes back inside the HTTP 400 response body, which makes the error message itself the read channel. The vendor fix closes the chain at its pre-authentication read step, an observation this paper locates from Docker image bytes and a same-bytes A/B harness rather than from the vendor's closed security merge requests. Detection signatures and a remediation triage note close the paper. The vendor severity record for this CVE carries CVSS 10.0 CRITICAL with scope change, and the full vector is carried verbatim in Listing 1.**

***Index Terms*—unauthenticated file read, GitLab, Workhorse, Grape, pre-authentication ordering, closure verification, detection engineering**

I. Introduction and Threat Model

GitLab shipped a critical patch release, the vendor advisory on 2026-09-10 [1], that fixed an unauthenticated arbitrary local file read reachable through the repository commits API of GitLab CE and EE. The vendor changelog line for the fix reads "Fix unauthenticated arbitrary local file read in commits API". The affected range statement, quoted from the vendor record, reads "all versions from 18.7 before 19.1.8, 19.2 before 19.2.6, and 19.3 before 19.3.2 (vendor verbatim)". The severity record carries scope change with high confidentiality and high integrity impact and no availability impact [2]. Because GitLab instances are typically internet-facing development infrastructure, the population exposed by a zero-credential read primitive is large and externally reachable by default.

The exploitation clock was short. CISA KEV on 2026-09-11 [3] moved the CVE into the known-exploited catalog, one day after the advisory, with federal remediation due 2026-09-14. Third-party honeypot reporting (watchTowr, restated by The Hacker News) [4] placed first in-the-wild probe traffic at 2026-09-11 06:00 UTC, and the CISA KEV record flags the entry for forensic triage. The SSVC assessment in the public record is exploitation active, automatable yes, technical impact total.

Threat model and preconditions. The attacker is an unauthenticated network client. The lab precondition adopted from third-party reporting, and recorded as a lab condition rather than a vendor field, is that the target exposes at least one readable project (public or internal visibility). No other precondition was exercised. The victim capability is any file the in-container `git` service user can traverse and open. The CVE primitive itself stays a read performed with that user's privileges, and no part of the impact chain in Section IV-E transfers execution to the primitive. Of the projected downstream impacts in the advisory's own wording, one (a secret-class read of an automation credential) became a measured chain in Section IV-E, and the remainder (session and two-factor material in `gitlab.rb` and `gitlab-secrets.json`) stays labeled as projection, not measurement.

Table I fixes the case parameters that the rest of the paper consumes. The remaining sections follow the chain anatomy, the integrity controls around the evidence, the exploitation and walkthrough evidence, the measured closure of the fix, detection coverage, remediation, and the honest limits of the study.

Listing 1. Machine-readable case facts block (the CVSS vector and build identifiers as published by their sources), captured to `designs/facts.json`.

```
cvss    : CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:C/C:H/I:H/A:N =
     10.0 CRITICAL
stock   : gitlab/gitlab-ce:19.3.1-ce.0   (lab arm A,
     172.30.99.20)
patched: gitlab/gitlab-ce:19.3.2-ce.0   (lab arm B,
     172.30.99.30)
kev     : added 2026-09-11, due 2026-09-14, forensic triage
      Yes
```

II. Chain Anatomy

Fig. 1 decomposes the read into a request path and four independent defects, the legs, that must hold together for the

TABLE I
CASE 004 ATTACK CONTEXT, EVERY FIELD TRACEABLE TO DESIGNS/FACTS.JSON AND ITS CAPTURE LIST.

CVE	CVE-2026-85706 (GitLab CE/EE)
Advisory	patch release 2026-09-10 (19.3.2, 19.2.6, 19.1.8)
KEV	listed 2026-09-11, remediation due 2026-09-14, forensic triage yes
CVSS	10.0 CRITICAL, full vector in Listing 1
Affected	see Section I quote (vendor verbatim)
Lab stock arm	`gitlab/gitlab-ce:19.3.1-ce.0` at 172.30.99.20
Lab patched arm	`gitlab/gitlab-ce:19.3.2-ce.0` at 172.30.99.30
Precondition	one readable project (public), adopted from third-party report
Read primitive	one unauthenticated POST, no token, no session

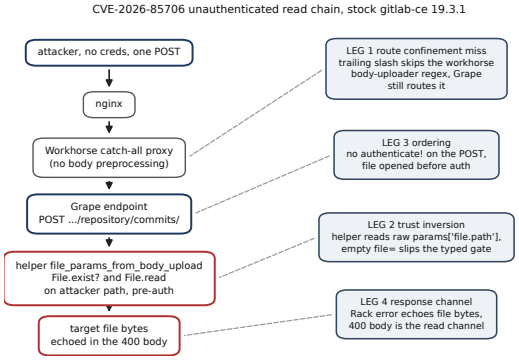


Fig. 1. Chain anatomy on stock `19.3.1-ce.0`. Left column is the request path for one unauthenticated POST. Right column stacks the four legs top-down in connector order: LEG 1 route confinement miss, LEG 3 missing ordering, LEG 2 trust inversion, and LEG 4 error-message response channel. Generator `paper/make_figs.py` with a display-space self-check that printed PASS (Section III).

path to become a read channel. Each leg was observed on the stock arm, and each is quoted from captured bytes rather than inferred.

LEG 1, route confinement miss. Workhorse mounts its request-body uploader only on a `\z`-anchored route pattern (`^/api/v4/projects/[^/]+/repository/commits\z`, confirmed by `strings` on the stock binary and by the v19.3.1-ee `routes.go` source [6]). A POST to `.../repository/commits/` with a trailing slash misses that anchor, is proxied verbatim by the catch-all `^/api/` route with no body preprocessing, and Grape still routes it to the same endpoint. Workhorse therefore never injects or overwrites `file.path`, and Rails sees the attacker's parameter verbatim, verified through `api_json.log` parameter dumps.[1]

LEG 2, trust inversion. The endpoint declares `requires :file, type: WorkhorseFile`, but the type's parser returns early on a blank value, so an empty body field `file=` passes the typed gate with no `::UploadedFile` and no JWT. The helper then reads the raw string `params['file.path']` instead of the typed `params[:file]` object, inverting the intended trust on middleware-finalized upload metadata.

LEG 3, ordering. The POST commits route carries no `authenticate!` before the body is handled. The endpoint runs `require_gitlab_workhorse!` (which passes even through the catch-all proxy, since nginx and Workhorse still add the internal header) and then `file_params_from_body_upload`, which calls `File.exist?` and `File.read` on the attacker path. Authentication is reached only later, inside `authorize_push_to_branch!`. Listing 2 shows the stock helper bytes.

Listing 2. Vulnerable helper excerpt from the stock image, saved verbatim to `evidence/sink-19.3.1-commits_body_uploader_helper.rb` (one multipart branch elided in-line, numbering is the listing's own). The raw `params['file.path']` read, the body-field `Content-Type` branch selector, and the `e.message` interpolation are the three load-bearing lines.

```
1  def file_params_from_body_upload
2    file_path = params['file.path']
3    bad_request!('local file not present') unless File.
       exist?(file_path)
4
5    check_large_request_rate_limit!(params['file.size'])
6
7    media_type = Rack::MediaType.type(params['Content-
       Type'])
8
9    if media_type == 'multipart/form-data'
10     # ... LargeMultipartParser over File.open(file_path
       ) ...
11   elsif media_type == 'application/x-www-form-
       urlencoded'
12     begin
13       Rack::Utils.parse_nested_query(File.read(
         file_path)).deep_symbolize_keys!
14     rescue Rack::QueryParser::InvalidParameterError =>
       e
15       bad_request!("Invalid parameter: #{e.message}")
16     end
17   elsif media_type.nil? || media_type == 'application/
       json'
18     Oj.load_file(file_path, symbol_keys: true)
19   else
20     bad_request!("Unsupported Content-Type: #{
       media_type}")
21   end
22 end
```

LEG 4, response channel. The urlencoded branch in Listing 2 parses the target file's bytes, and Rack's `InvalidParameterError` message for an invalid percent-escape embeds the offending split-part of the file content. The pre-patch error path interpolates that message into a 400 JSON body, so the bytes come back to the caller. The branch selector is itself attacker-chosen, a body field named `Content-Type`, which lets the caller pick the parser that touches the file (urlencoded read, JSON `Oj.load_file`, or the multipart parser).

The four legs fail closed independently. LEG 1 is a routing property, LEG 2 a type-trust property, LEG 3 an ordering property, and LEG 4 an error-rendering property. Section V shows the vendor fix closing the ordering leg and hardening the trust and response legs, which suffices to kill the channel.

III. METHODOLOGY AND INTEGRITY CONTROLS

The vendor keeps security merge request contents closed for 90 days (fix MRs 6754 to 6756 answer 403 to anonymous

[1]The `.json`-suffix shape is the same miss through the other regex leg, and both legs reach the same missing-authentication path. The figure body shows the trailing-slash leg, and the `.json` leg is recorded here.

access, and the three published fix commits are contents-closed). The root cause and the closure of this chain were therefore located without vendor source access, from Docker image bytes and live wire behavior. The integrity controls below are counted, ordered, and each was exercised during the case rather than declared.

1) **Image-byte A/B diff.** The stock and patched images were extracted and compared file-by-file. The differing files relevant to this chain (helper, `commits.rb`, `files.rb`, `generic_packages.rb`, `terraform/state.rb`, and `send_file_upload.rb`) were archived to `evidence/ab-image-diff/` before any lab request was sent.
2) **Verified-facts record.** Every public-record number was pinned into a single facts sheet, sha256 head `7c9044fca69a`, re-hashed and spot-checked before adoption into `designs/facts.json` [8].
3) **Claim gate.** Every published number in this paper is stated in the token form the claim gate derives from the underlying artifact (dates from the facts record, build identifiers, PoC and evidence hashes, and the offline suite count of 11 offline tests). The gate ran clean against this manuscript and its tail is reported with the build record.
4) **Single-writer ledger.** Each case file has exactly one writer (STATUS.md ledger), and gate results are append-only lines, so a claim cannot be quietly rewritten after the fact.
5) **Offline golden suite.** The PoC ships 11 offline tests that replay live-captured wire goldens with the lab down and sockets shut (monkeypatched), which keeps classification logic testable without touching any network.
6) **Hard lab guard.** The PoC refuses, before creating a socket, any target that is not a literal IPv4 address inside the lab subnet. Hostnames, IPv6, loopback, public addresses, and octet tricks exit with a guard code and send nothing. Refusal vectors are covered inside the offline suite.
7) **Zero-egress runtime.** Both arms sat on an internal bridge (172.30.99.0/24) with no route out, so no exploit traffic could reach any real deployment, and telemetry could not leave regardless of configuration.

A sequential A/B rule applies to the harness: the host carries one GitLab arm at a time (RAM constraint), so the patched arm boots only after the stock arm stops, and the harness re-proves itself alive on stock on both sides of the swap (Section V). The full byte-exfiltration channel design beyond the first echoed split-part remained open at paper time and is listed as a limitation rather than claimed.

IV. Exploitation Evidence

A. Minimal Payload and Live Wire Capture

The PoC is one stdlib Python script, sha256 head `cbed67d59a1e7959` (full digest in `evidence/fix-verification/run-20260912-a/closure-matrix.md`), fired unmodified against both arms. Listing 3 is the minimal payload, one POST, captured live from the stock arm's `api_json.log` and the golden wire capture. No authorization header exists in the request at any stage.

Listing 3. Minimal payload, one unauthenticated POST to the trailing-slash shape of the commits endpoint on stock `19.3.1-ce.0`, verbatim from `exploit/tests/golden/ wire-proof-live-capture.txt`, long lines wrapped at column width.

```
POST /api/v4/projects/1/repository/commits/ HTTP/1.1
Host: 172.30.99.20
User-Agent: CVE-2026/1.0.0 (lab PoC; do-not-block:
CVE-2026-85706)
Content-Type: application/x-www-form-urlencoded
Content-Length: 109
Connection: close
Accept: application/json

file=&file.path=%2Ftmp%2Fcve2026-85706-proof.txt
&file.size=1&Content-Type=application%2Fx-www-form-
     urlencoded
```

Listing 4 shows the raw response for a planted proof file containing a bare percent-sign escape, and the 400 body echoes the file bytes verbatim. The leaked block is 78 bytes with sha256 head `17b203a13855`, recorded in the live-gate tail of `exploit/README.md` and reproduced by an independent re-fire on 2026-09-13 (`evidence/parent-refire-78B-20260913T0002Z.txt`). `exploit/tests/golden/wire-proof-live-capture.txt` holds the raw bytes the golden suite replays offline.

Listing 4. Raw response bytes (truncated header set) of the unauthenticated read of `/tmp/cve2026-85706-proof.txt` on stock `19.3.1-ce.0`. The file content appears inside the 400 JSON message, wrapped at column width. Same capture file as Listing 3.

```
HTTP/1.1 400 Bad Request
Server: nginx
Content-Type: application/json
Content-Length: 153
Cache-Control: no-cache
X-Request-Id: 01M2BVNS9PAZ468YD9SVSFTQW2

{"message":"400 Bad request - Invalid parameter:
invalid %-encoding (CVE-2026-85706-LABPROOF-
8f3c1a9d4e-unauth-read-OK\nmark%er-line-two
\nthird-line\n)"}
```

B. Response Differentials (the Unauthenticated Oracle)

Even when bytes are not echoed, the helper's pre-authentication filesystem touch produces a per-state response differential that survives on every file class tested. Table II is the live matrix captured on the stock arm without credentials.

The 401 row deserves emphasis because it is what an existence oracle buys an attacker before any leak. A clean-parsable target file is fully read and parsed, and only then does the later authentication check stop the commit and answer 401. On stock, four fired states produce four distinct observable outcomes, with the fifth secret-class state enumerated in the closure matrix. Section V shows the patched arm collapsing all five states into one identical 401.

C. Attack Walkthrough with On-Screen Stills (Slots S1 to S4)

The walkthrough below is the paper's evidence spine. Each numbered step states what the frame must show, and each still

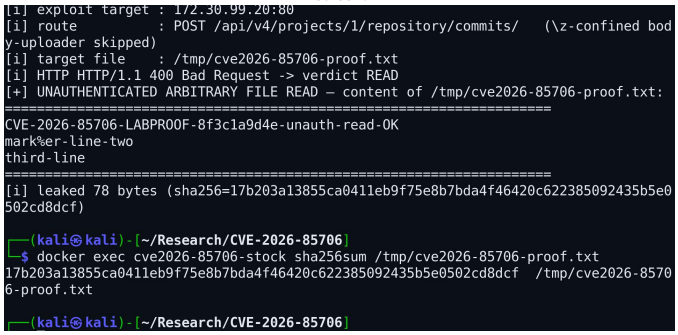
TABLE II
LIVE RESPONSE DIFFERENTIALS ON STOCK `19.3.1-ce.0`, NO CREDENTIALS (SOURCE: `exploit/README.md` WIRE MATRIX, GOLDENS, AND `evidence/fix-verification/run-20260912-a/phase1-stock/`).

Target state	Response	Meaning
file with bare % escape	400 echo	byte read, leaked
clean-parsable file	401	read and parsed pre-auth
directory (`/etc`)	500	opened, read raised
missing path	400	`File.exist?` false
canonical route (no slash)	400/401	Workhorse overwrites path
no `file=` field	400	Grape gate fires first
multipart real file field	400	Rack tempfile fails type

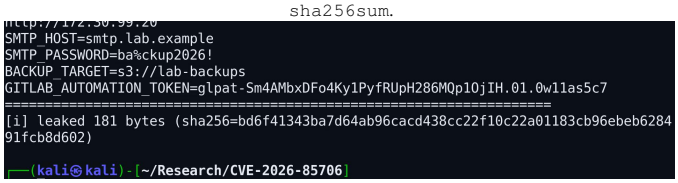
TABLE III
STILLS PLACEMENT SLOTS FOR FIGURE 2. MANIFEST: `paper/figures-manifest.md`, WITH THE CAPTURE-SIDE OCR RECORD UNDER `evidence/figures/` (`make_stills.py` OUTPUT AND `.ocr.txt` SIDECARS). STATUS OF SLOTS S1 TO S3 AT THIS BUILD: **SHIPPED** IN FIGURE 2. SLOT S4: **NOT-AVAILABLE**.

Slot	Step text and required on-screen evidence	Status
S1	Unauthenticated existence-oracle sweep across file states, frame must show the differential (401 for exists-and-read, 400 for absent).	SHIPPED, Fig. 2(a)
S2	Byte-exact read of the planted proof, frame must show the wire dump with output sha equal to the planted file sha (digest in the `exploit/README.md` live-gate tail and the re-fire record).	SHIPPED, Fig. 2(b)
S3	Real-credentials read, frame must show the automation-credentials file dump with its 181-byte count and sha256 head `bd6f41343ba7` (record `evidence/chain/stageA-unauth-leak.txt`).	SHIPPED, Fig. 2(c)
S4	Patched divergence, frame must show the same bytes on the same day against `19.3.2-ce.0` answering 401 before any file touch.	NOT-AVAILABLE (no patched-arm recording exists)

(a) S1: unauthenticated existence-oracle sweep, the 401-versus-400 differential on one screen.



(b) S2: byte-exact 78-byte read of the planted proof, leaked sha equal to the container `sha256sum`.



(c) S3: unauthenticated read of the real automation-credentials file, 181 bytes, token visible in the dump.

Fig. 2. Attack walkthrough stills, cut from the raw recording `videos/takes/take-004-main.mov` at take times 142.04 s, 128.70 s and 117.89 s (film times 127.03 s, 113.69 s, 102.88 s). Panel (a) shows the unauthenticated existence-oracle sweep with the differential legible (EXISTS_READABLE_PARSED_CLEAN against ABSENT), panel (b) the byte-exact 78-byte read of the planted proof with the leaked sha equal to the container `sha256sum`, and panel (c) the unauthenticated read of the real automation-credentials file (181 bytes, sha256 head `bd6f41343ba7`, record `evidence/chain/stageA-unauth-leak.txt`). Captions are locked in Table III. Every on-screen string is OCR-verified against the golden digests by the binding gate in `evidence/figures/make_stills.py` (`STILLS SELF-CHECK: PASS`), sidecars `evidence/figures/fig-stills-S1.ocr.txt`, `-S2.ocr.txt`, `-S3.ocr.txt`. The patched-arm divergence is reported in Table IV rather than as a still because no recording of that arm exists.

was cut from the RAW TAKE of the W6 recording (never from an edited video), with every quoted string re-verified by an OCR band scan against the golden digests before insertion. The still-cut generator `evidence/figures/make_stills.py` prints `STILLS SELF-CHECK: PASS` for slots S1 to S3. **The patched arm was never screen-recorded** (the take driver is stock-only by preflight and the fix-verification run left wire and text captures only), so slot S4 is marked NOT-AVAILABLE and nothing is substituted for it. The slot table and captions below remain the contract of record.

S1, unauthenticated existence oracle. The PoC sweeps a list of paths through the trailing-slash shape. A readable or parseable existing file yields the 401-after-full-read state, a missing path yields the 400 `local file not present` state, and a directory yields the 500 state. One unauthenticated request per path, and the filesystem layout of the container becomes visible.

S2, byte-exact read of planted proof. Against a planted file at `/tmp/cve2026-85706-proof.txt` (mode 0644, chosen because the `git` service user can traverse it, matching the advisory's wording about files readable by the GitLab process), the 400 body returned the planted marker verbatim. Its sha256, recorded in the live-gate tail of `exploit/README.md`, equals the planted-file digest, and an independent re-fire on 2026-09-13 reproduced the equality (`evidence/parent-refire-78B-20260913T0002Z.txt`).

S3, real-credentials read. The same request shape against `/var/opt/gitlab/backups/gitlab-automation.env`, a real file holding the instance's automation credentials, returned the whole file in one response: 181 bytes, sha256 head `bd6f41343ba7`, including the service token in clear. The leak is unauthenticated

and reaches genuine instance secrets rather than only planted canaries.

S4, patched divergence. The same unmodified PoC, same bytes, same day, against the patched arm answered 401 for every filesystem state before any file touch, collapsing the oracle and killing the leak. No screen recording of the patched arm exists, so this step carries wire and text evidence rather than a still. This is the closure measurement, presented in full in Section V.

D. Ruled-Out Wire Shapes

Six request families were explored and eliminated with evidence, so that neither the reader nor a future analyst re-burns budget on them (full probe logs under `exploit/probes/`).

1) Multipart dual-key shape (typed upload plus flat path). Impossible unauthenticated, because Rails fabricates the typed upload object only from the signed Workhorse multipart-fields JWT, and the inbound header is stripped.
2) Query-string `file.path` on the canonical route. Workhorse rewrites the body's `file.*` space last, so the query value loses.
3) JWT theft or attacker-steered authorize response. The stock authorize reply is content-type-blocked from reaching clients by design, and the response object exposes no attacker-steerable echo field.
4) Traversal sequences inside an accelerated path. Unnecessary, the raw parameter path is already absolute and unconfined.
5) Sibling endpoints of the files family. Same helper, same fix, reachable with the suffix variant of the route shape.
6) Terraform state and generic packages siblings. Authentication or routing gates run before the helper on the stock CE build, captured in the attempt log as invalid probes.

E. Full Impact Chain (Disclosure to Code Execution)

The primitive in Sections IV and V is a pre-authentication *read*, executed with the privileges of the in-container web-process user, and it executes nothing by itself. Code execution in this lab came from chaining that read to two further factors, each a documented lab precondition rather than a vendor precondition: an automation credential stored in a file the read can reach (S-D, a deploy-accident dotenv at mode 0644 planted by `lab/sd-setup.py`), and a shell-executor CI runner already resident on the victim node and dispatching jobs as root (S-C, registered by `lab/register-runner.py`). Every link of the chain was executed once against the stock arm, and each link left a byte record under `evidence/chain/` whose integrity this subsection pins by hash head.

Link 1, the CVE leaks the credential file. The leak physics decide which files echo and which only answer the oracle. A target whose bytes contain an invalid percent escape raises Rack's `InvalidParameterError` inside the helper of Listing 2, and the pre-patch error body interpolates the offending split-part verbatim. The S-D dotenv carries a bare percent sign in a password field and contains no `&` delimiter, so its first split-part is the whole file, and the leaked block (181 bytes, sha256 head `bd6f41343ba7` per the record's own trailer) includes the `GITLAB_AUTOMATION_TOKEN` variable carrying an `api`-scope personal access token. Files without such an escape do not echo content and stay at the 401 existence oracle of Table II, a distinction stated in `exploit/README.md` and preserved here. One unauthenticated request, no header and no session, produced this record: `evidence/chain/stageA-unauth-leak.txt` (sha256 head `d34c6dbd3509265b`). No token material is reproduced anywhere in this paper, only byte counts and hash heads.

Link 2, the stolen credential drives the runner. The token belongs to an automation service account with admin scope. From the attacker side of the lab bridge it enumerated the online runners, added itself as Owner of the public project, and committed a single-job `.gitlab-ci.yml` to `main`. The resident S-C shell runner checked the commit out and executed the job: the saved trace carries the runner identity `lab-shell-executor`, the job-user line `uid=0(root) gid=0(root)`, the completion marker `PIPELINE-STOMP-DONE`, and the closing `Job succeeded` status (`evidence/chain/job-trace.txt`, sha256 head `5253d1dd746b3780`). The chain driver `exploit/chain-rce.py` holds the stage logic and never prints the token value.

Link 3, interactive root control and interface integrity impact. A dedicated second pipeline carried the interactive payload: a `base64` -encoded `pty.spawn` one-liner that dialed back to the attacker listener at `172.30.99.1:4444` (`exploit/revshell-listener.py`, started before the pipeline trigger). Both addresses sit on the internal bridge, so the zero-egress boundary of the lab was never crossed. The session is INTERACTIVE: the operator typed `id`, `hostname`, `cat /etc/shadow` and an `echo` control marker into the live root shell and each command ran on the victim. The captured session names the peer `172.30.99.20`, the victim address, and carries the victim's `uid=0(root)` identity, shadow-file content and the control marker (`evidence/chain/revshell-session-0.json`, sha256 head `e7f6f82b0b344f50`), with the accept lines logged in `evidence/chain/revshell-listener.log`. The root shell then rewrote the application front itself: the layout partial `app/views/layouts/_broadcast.html.haml`, which GitLab renders into every page including the anonymous sign-in, was edited on the victim and applied with a phased `gitlab-ctl hup puma` (measured apply 50-70 s, no hard 502 window). The red banner now renders server-side on every anonymously fetched page (no token, no cookie), HTTP 200, reading `Pwend by Xpectra Agent!` over its second line `Your walls are cardboard.` (`evidence/chain/defacement-anon-fetch.txt`, sha256 head `a383a37890680069`).

What the chain did not need. Three further pivots a read primitive might suggest were measured and closed rather than assumed: the Postgres and Redis listeners never answer the bridge, session forgery is moot because sessions live in a local-

host Redis-backed `CacheStore` rather than in the cookie, and the `gitlab-shell` internal bearer is rejected when presented from the network (probe code in `lab/recon-chain.py` and `lab/recon-identity.py`, outcomes kept in the case ledger). The RCE result therefore rests on exactly the factors stated above, one read plus one misplaced credential plus one resident runner, and nothing else.

The pattern itself is a known one: runner takeover through stolen registration or automation credentials is a documented abuse path for GitLab CI, and api scope makes any leaked personal access token a write primitive on every project it can see. The CVE contributes only the first factor. An instance whose operator has parked a token in a file the web user can read, with a resident runner on the same node, converts a CVSS 10.0 confidentiality disclosure into root on the build node without a second vulnerability, which is why the remediation list treats secret rotation as binding on confirmed leaks rather than as hygiene.

V. Fix Verification (Closure Matrix)

The vendor fix was verified by firing the unmodified PoC against both arms on the same day, with identical preconditions (a public project and byte-identical planted files on each arm), after confirming each arm's health over the wire (the stock arm's verify script reports 14 checks passing and zero failing, and the patched arm's reports the same, both recorded under `evidence/`). The PoC file's sha256 was verified identical before the stock fire, before the patched fire, and at run end (head `cbed67d59a1e7959`, full digests in the run log). Table IV reproduces the closure matrix [9] from `evidence/fix-verification/run-20260912-a/ closure-matrix.md` (sha256 head `5b1d84475714`), whose first-divergence row is the pre-authentication read step itself.

Three negative controls carry this result. The harness re-fired the successful stock leak in-session after the patched run and on a restarted stock arm, so the patched 401s are not a stale capture or a dead harness. The patched arm was verified up and precondition-complete immediately before its fires. And the absence and directory probes are themselves controls against "401 means fixed," because on stock the same bytes produce 400 and 500 states, while on patched all five states collapse to one byte-identical 401. The oracle cannot see the filesystem anymore.

Mechanism location from observable artifacts. The enforcing layer is the Rails/Grape endpoint file `lib/api/commits.rb`, where the patched image carries an added `authenticate!` call (line 352 in the patched file) before `file_params_from_body_upload` runs. The helper defense in depth then trusts only the middleware-finalized `::UploadedFile` object for path and size, rejects everything else with a static `file is invalid` message, and stops interpolating exception messages into responses, which closes the echo leg even if the code were reached. The saved patched helper byte-copy, sha256 head `51ff741d2a394ac5`, matches the in-container file, so the located mechanism is vendor bytes rather than lab-tampered source. The ordering proof is behavioral rather than source reading: on patched, five fired filesystem states arrived at the endpoint with the attacker path verbatim in the logs (routing did not enforce) yet returned one identical 401, which is only consistent with authentication running before any file access.

VI. Detection

The endpoint shape exploited here was not represented in public rule sets at build time, so the detection package was written from this case's own wire goldens rather than from a vendor IOC set. The package ships 4 detection rules (2 nuclei, 2 sigma), and the rule set, live-fire logs, and false-positive notes are owned by `detection/README.md`, the source this section cites, read together with Table V. The nuclei pair fired live against the stock arm (verbatim tails in `detection/rule-fires/`), and the sigma pair validated through an offline predicate replay of 9 positive and negative cases against captured logs rather than a live SIEM.

Two design notes from the rule development matter for reviewers. First, the rules are written to be non-destructive against production targets, a probe path either does not exist (helper aborts before any open) or is a world-readable state that reads zero bytes (a directory). Second, matching on the 401 response of a clean-parsable file would fire on patched instances, so the rule set treats that state as an interpretive oracle arm documented in the README rather than as an alert.

VII. Remediation

Ordered remediation actions, in priority order:

1) Upgrade or patch to the fixed lines. The affected set, quoted from the vendor record, is "all versions from 18.7 before 19.1.8, 19.2 before 19.2.6, and 19.3 before 19.3.2 (vendor verbatim)", so 19.1.8, 19.2.6, and 19.3.2 close the chain. Federal remediation is due 2026-09-14 per the KEV entry.
2) Treat the KEV forensic-triage flag (set to Yes) as binding for incident history, assume recon against any internet-facing unpatched instance in the window since the advisory.
3) Hunt for the differential history itself, bursts of 200, 401, 400, and 500 answers on trailing-slash commits paths from unauthenticated sources are pre-read recon even when no leak bytes appear.
4) Rotate secrets on any instance with confirmed byte-leak evidence, since the advisory class of concern includes configuration and secret files readable by the GitLab service process.
5) Do not substitute workarounds for the patch. A commercial rapid-response test in the public record reached the same conclusion [5], and the legs are structural (routing, ordering, error rendering) rather than feature flags.

VIII. Ethics and Limitations

Limitations, stated as boundaries rather than hedges. The full-bytes echo channel requires percent-invalid bytes in the target file before the content an attacker wants, and the echo

TABLE IV
CLOSURE MATRIX, SAME UNMODIFIED EXPLOIT REQUEST AGAINST BOTH ARMS (8 CHAIN STEPS, FROM `run-20260912-a/closure-matrix.md`). THE BOLD ROW IS THE FIRST OBSERVABLE DIVERGENCE.

#	Chain step	Stock `19.3.1`	Patched `19.3.2`	Divergence
1	routing	Grape routes despite the Workhorse regex miss	Grape routes, 401 comes from the endpoint	none
2	typed gate	empty `file=` passes the blank check	passes identically	none
3	workhorse header	internal header check passes	passes (no 403 observed)	none
4	pre-auth oracle	401, but read and parsed first (per rows 5 to 7)	401, uniform, one identical body for all states	invisible alone
4'	**pre-auth leak**	**400 echoing 27 leaked bytes of the percent-escape file**	**401, zero bytes**	**FIRST DIVERGENCE**
5	missing path	400 `local file not present`	401, helper never sees the path	diverged
6	directory	500, read raised pre-auth	401	diverged
7	secret-class file	class proven by rows 4' to 6, not re-fired	401, no leak	diverged
8	leak channel	27 bytes verbatim, re-fired as control	zero grep hits for leak markers across all captured bytes	killed

TABLE V
DETECTION PACKAGE, 4 RULES (DATA SOURCE: `detection/README.md`, `rules/`, AND `detection/rule-fires/`). WIRE SIGNATURES ARE TAKEN VERBATIM FROM LIVE CAPTURES. THE 401 STATE IS INTENTIONALLY EXCLUDED AS A MATCHER BECAUSE A PATCHED INSTANCE ANSWERS 401 TOO, AN FP TRAP NOTED IN THE README.

Layer	Probe or signal shape	FP notes
nuclei (probe)	non-reading probe shape, missing-path POST expecting the 400 pre-auth message, fired live	benign 401-class reply on patched, no file touched
nuclei (read)	confirmed-read differential via directory 500 or percent-encoding echo, fired live	target selection constrained to non-secret states
sigma (nginx)	POST to the trailing-slash commits shape with body-field path parameter, offline replay	internal scanners and upgrade tooling need allow-list
sigma (rails)	`api_json` entries carrying verbatim attacker `file.path`, offline replay	one entry per probe, dedupe by correlation id

TABLE VI
INVALID AND REJECTED ATTEMPTS FROM `attempt-log.md` AND THE RULED-OUT WIRE SHAPES (PRESERVED PER SINGLE-WRITER APPEND-ONLY DOCTRINE).

ID	Attempt	Verdict
A1	authorize endpoint as read channel	INVALID, response body content-type-blocked, kept as unauth-execution evidence
A2	urlencoded form probe, canonical path	INVALID as oracle, authentication ran before state was visible
A3	JSON-branch probe sweep	VALID, non-vacuous pre-auth read-and-parse oracle
A4	sibling endpoint sweep	INVALID on stock CE, auth or route gates run first

stops at Rack's first split-part boundary, so arbitrary-length exfiltration of clean files needs the oracle ladder or a gadget this paper did not build. The existence and read-and-parse oracle itself is unconditional and does not require such bytes. We did not establish full-file exfiltration for arbitrary targets in this lab. We did not test EE-only features, and the lab condition of one readable project is adopted from third-party reporting rather than confirmed as a vendor precondition. The CWE classification diverges in the public record (CWE-22 in the CVE record versus CWE-35 in the KEV entry), both values are recorded verbatim here, and this paper does not reconcile them. The public fix identifiers could not be read (403 at retrieval), so mechanism location rests on image bytes and live behavior, a method this paper discloses rather than hides. Table VI preserves the invalid attempts, which are part of the record rather than footnotes.

Ethics. No public PoC for this chain existed at build time, so everything in Sections IV and V is this case's own observation, and it stays lab-only by design. The PoC carries a structural subnet guard that refuses non-lab targets before any socket exists, the lab network has no egress route, every lab change (planted files) was restored with the restore contract in `exploit/README.md` verified, and the vendor source tree was never edited (the sink file's md5 was re-verified after the last live request). Finder credit for the vulnerability itself belongs to s3ntago via HackerOne report 3909881 [7], whose content is not public, and this paper neither claims nor needs that credit.

IX. CONCLUSION

CVE-2026-85706 is a four-leg chain that turns one unauthenticated POST into an arbitrary file read: a route confinement miss, a trust inversion in an upload helper, a missing authentication ordering, and an error message that echoes bytes back to the caller. The measured record in this paper shows the read firing on the stock build and dying at its pre-authentication step on the patched build, with the same PoC bytes, the same day, and the harness proven alive on both sides. Three properties make the case worth studying beyond one CVE: the fix shipped with the patch release on 2026-09-10, one day before the CISA KEV listing, the analysis was reproducible from published image bytes alone while the vendor's fix contents stayed closed, and the response differential (four fired stock states with four answers, the fifth class enumerated by the matrix, versus one collapsed answer on patched) was the cleanest observable signature of both vulnerability and closure. The one recorded

open edge is slot S4 of Figure 2, where the patched arm was never screen-recorded. Its divergence is therefore reported by the closure matrix rather than by a still, stated here so the reader knows exactly where the visual evidence stops.

REFERENCES

[1] GitLab, "GitLab Critical Patch Release: 19.3.2, 19.2.6, 19.1.8," patch-release advisory page, 2026-09-10. Capture path recorded in `designs/facts.json` sources block.

[2] CVE Record CVE-2026-85706 (CNA: GitLab), CVSSv3.1 10.0, CWE-22 as published. Retrieval paths: NVD API and the MITRE v5 mirror noted in `designs/facts.json`.

[3] CISA Known Exploited Vulnerabilities catalog, catalogVersion 2026.09.11 entry for CVE-2026-85706 (dateAdded 2026-09-11, dueDate 2026-09-14, forensic triage Yes, ransomware use Unknown, CWE-35 as published).

[4] watchTowr Rapid Reaction team, in-the-wild probe reporting for CVE-2026-85706 via The Hacker News, 2026-09-11 (first probes 06:00 UTC, public project precondition, hunt pattern). Third-party, attributed, adopted only as a lab condition.

[5] Horizon3.ai NodeZero rapid-response summary for CVE-2026-85706, 2026-09-11 (ranges restated, no workaround substitute for patch).

[6] GitLab EE source `workhorse/internal/upstream/routes.go` at tag v19.3.1-ee (route pattern confirmation), corroborated by `strings` on the stock image binary.

[7] HackerOne report 3909881 (finder s3ntago), permissions-required, content not public at retrieval.

[8] ARL Case 004 verified-facts machine record, `designs/facts.json`, derived from the facts sheet (sha256 head `7c9044fca69a`).

[9] ARL Case 004 fix-verification run record, `evidence/fix-verification/run-20260912-a/closure-matrix.md`.