



VEYRUM ROBOTICS STANDARD



VRS-HAZ-201

Hazardous & Emergency Response — AR Assessment Protocol

How the Hazardous & Emergency Response Application Rating letter is determined — sector criteria HAZ-1...HAZ-9, contributing intrinsic criteria, letter bands, tier ceilings and class applicability, with evidence by tier and underwriting use.

VEYRUM RESEARCH INSTITUTE

DOCUMENT

VRS-HAZ-201

VERSION

1.0.0

STATUS

Draft

DATE

16 September 2026

Contents

1 1 Scope

2 2 Normative references

3 3 Terms and definitions

4 4 Method of assessment

5 5 Contributing IR criteria

6 6 Sector criteria

6.1 6.1 HAZ-1 Environment-specific certification / qualification (0–14)

6.2 6.2 HAZ-2 Mission-critical failure behaviour (0–12)

6.3 6.3 HAZ-3 Operator-link loss and control handover (0–12)

6.4 6.4 HAZ-4 Environmental attrition qualification (0–12)

6.5 6.5 HAZ-5 Ignition-source and contamination-spread controls (0–12)

6.6 6.6 HAZ-6 Decontamination and disposal procedures (0–10)

6.7 6.7 HAZ-7 Responder interaction and incident-command integration (0–10)

6.8 6.8 HAZ-8 Recovery logistics and field repair (0–10)

6.9 6.9 HAZ-9 Mission incident record (0–8)

7 7 Letter bands, tier ceilings and class applicability

8 8 Evidence by tier

9 9 Underwriting and credit use

10 10 Result recording

11 11 Assessor checklist

12 Annex A (informative) – Worked example

13 Bibliography

14 Change history

Foreword. This Assessment Protocol determines the **Hazardous & Emergency Response Application Rating (AR)** letter for a robot model in a declared environment class. It scores a **pool** of criteria — the nine sector criteria of Clause 6 (HAZ-1...HAZ-9, 100 points) plus the named intrinsic criteria of Clause 5, each scored once under its own standard and counted here — and expresses the earned points as a percentage of the applicable pool, which maps to a letter **C < B < A < AA < AAA (AAA best)** by the bands of VRS-GEN-006 §4. Every criterion is bounded by an evidence tier — Unverified, Verified, Certified — so the best attainable letter rises with substantiation, not assertion. This edition supersedes the re-weighted-mean model of the 0.x drafts: no weighting, no separate grade bands, no separate modifiers — the tier limits fall out of the per-criterion ceilings of Clause 6. The defining condition of the sector is the **extreme environment**: an explosive atmosphere, a radiation field, a fire, or an ordnance or collapsed-structure scene, where a fault has catastrophic consequence and humans cannot readily intervene. A rating is therefore bounded to the declared **environment classes** and their **exposure envelopes**, and evidence obtained outside a class is inadmissible for it. Environment-specific qualification (HAZ-1), mission-critical failure behaviour (HAZ-2) and responder interaction (HAZ-7) are scored by demonstrated behaviour, not by assertion. A Hazardous & Emergency Response AR is an opinion above the compliance floor, not a certification, and nothing here implies that any real robot holds a Veyrum rating (ratings are not published). Requirements use “shall”; recommendations use “should”.

1 Scope

1.1 This Protocol defines, for the **Hazardous & Emergency Response** sector Application Rating: the determination method (Clause 4); the contributing intrinsic criteria drawn into the pool (Clause 5); the nine sector criteria HAZ-1...HAZ-9 with their point ladders and tier ceilings (Clause 6); the letter bands, pool ceilings and class applicability (Clause 7); the evidence admissible at each tier (Clause 8); underwriting and credit use (Clause 9); result recording (Clause 10); and the assessor checklist (Clause 11). A worked example is at Annex A.

1.2 The AR shall be issued **per application class**. The environment classes are **explosive-atmosphere, nuclear/radiological, firefighting, EOD** (explosive-ordnance disposal) and **search-and-rescue**, per VRS-HAZ-001 §4. The recognised HAZ-1 anchor differs by class (stated in the criterion row); all nine criteria apply to all classes. Sector applicability, the extreme- environment hazard taxonomy and the anchor regime are defined in VRS-HAZ-001 and are not restated here.

1.3 The AR shall be assessed at one of three **tiers** — Unverified, Verified, Certified. Each criterion states the maximum points reachable at each tier (Clause 6); the AR tier is the tier whose evidence bar the assessed evidence meets and shall not exceed the model’s Intrinsic Rating tier (VRS-GEN-006 §7). The underlying point aggregation and the letter bands are defined in VRS-GEN-005/006 and are not restated here.

2 Normative references

- **VRS-HAZ-001**, Hazardous & Emergency Response – Sector Standard – applicability, environment classes, the extreme-environment hazard groups and the HAZ anchor regime.
- **VRS-GEN-005**, Intrinsic Rating – Methodology – point aggregation, tiers, cold-start parity and the company-wide fallback rule (§6).
- **VRS-GEN-006**, Application Rating – Scheme – the letter bands, the applicable-pool percentage and the tier rule.
- **VRS-GEN-009**, Robot Risk Passport and Registry Schema – the record that carries the AR result.
- **VRS-GEN-012**, Evidence Grades and Data Requirements – evidence kinds and the tier evidence bars.
- **VRS-GEN-101 ... VRS-GEN-107**, IR Category Standards – the intrinsic criteria contributed under Clause 5.
- **ATEX Directive 2014/34/EU** and **IEC 60079-0:2017** (IECEx scheme) – explosive-atmosphere equipment anchor for the declared zone; **UL 121201 (2017)** for the US Division 2 route.
- **IEC 60529:1989+AMD2:2013** (IP Code) – ingress-protection anchor.
- **IEC 62443-4-2:2019** – technical security requirements for the control link (SL-C against FR1–FR7).
- **ISO 14224:2016** – collection and exchange of reliability and maintenance data for equipment.
- **ASTM E2853/E2853M-22 (2022)** – evaluating emergency-response-robot capabilities (DHS-NIST-ASTM E54.09 suite) – responder-interaction and search-task anchor.
- Data twin: **VRS-HAZ-501** (generated from this Protocol, never hand-edited).

3 Terms and definitions

Terms per VRS-GEN-001 (aligned to ISO 8373:2021) and VRS-HAZ-001. Locally:

- **pool** – the set of criteria whose points determine the AR letter: the nine sector criteria of Clause 6 together with the contributing intrinsic criteria of Clause 5.
- **applicable pool** – the pool for a given environment class after criteria not applicable to that class are removed from both the earned points and the pool range (Clause 4; VRS-GEN-006 §6).
- **contributor** – an intrinsic criterion scored once under its own IR category standard and counted again in the sector pool at the same points (Clause 5).
- **tier** – the evidence stringency at which a criterion is assessed: **Unverified** (public evidence only), **Verified** (manufacturer evidence pack examined), **Certified** (behaviour witnessed).
- **ceiling** – the maximum points a criterion awards at a given tier; points earned are held at the ceiling of the assessed tier.
- **evidence bar** – the minimum evidence a criterion requires before any points are awarded; below it the criterion scores 0.
- **company-wide fallback** – the substitute points a criterion allows from manufacturer-wide evidence when model-specific evidence is unavailable (VRS-GEN-005 §6).
- **environment class** – a declared category of assessed extreme-environment operation (explosive-atmosphere, nuclear/radiological, firefighting, EOD, search-and-rescue), recorded as a protocol

applicability field.

- **exposure envelope** — the declared limits within which evidence is attributable and the letter is valid, recorded per environment class (for example the zone class for an explosive atmosphere, the dose budget in millisieverts, mSv, and the thermal envelope in °C).
- **contamination write-off exposure** — the finance attribute recording that a unit exposed to a radiological or chemical class may lose residual value because it cannot be decontaminated to a returnable state, even when functionally repairable (VRS-HAZ-001 §8.4).

4 Method of assessment

4.1 The Hazardous & Emergency Response AR shall be determined as a percentage of the **applicable pool** and mapped to a letter by the bands of VRS-GEN-006 §4 (Clause 7.1). The pool is the nine sector criteria of Clause 6 (HAZ-1...HAZ-9, 100 points) together with the contributing intrinsic criteria of Clause 5, each scored once under its own standard and counted here at the same points. For an environment class the assessor shall add the points earned across the applicable criteria and divide by the sum of the point ranges of those same criteria; a criterion not applicable to the class (Clause 6 Applicability row; VRS-GEN-006 §6) shall be removed from both the earned points and the pool range. No weighting is applied — each criterion's point range sizes its own importance — and no separate modifiers operate on the letter: the tier limits follow from the per-criterion ceilings of Clause 6 (Clause 7.2; VRS-GEN-006 §8).

4.2 Evidence shall be attributable to the declared **environment classes** of the assessed envelope (explosive-atmosphere, nuclear/radiological, firefighting, EOD or search-and-rescue; Clause 1.2) and to each class's declared **exposure envelope** (zone class, dose budget in mSv, thermal envelope in °C); the AR letter covers only the assessed classes and exposure envelopes.

4.3 Letters shall be issued **per environment class** where evidence diverges materially between classes; the displayed sector letter shall be the **lowest issued class letter**. A class for which no letter can be issued shall be displayed as *not covered*, and the assessed **exposure envelope shall contract** to the conditions the evidence actually covers rather than the score being stretched to conditions never observed.

4.4 Evidence obtained outside a declared environment class and its exposure envelope shall be **inadmissible** as support for that class and shall not raise the score; the HAZ-1 anti-aggravation case for a class shall rest on that class's own certification or instrumented test evidence and shall never be inferred from transferred evidence (VRS-HAZ-001 §5.2).

5 Contributing IR criteria

5.1 The sector pool consists of the sector criteria of Clause 6 and the following intrinsic criteria, scored once under their own standards and counted again here at the same points:

IR CRITERION	SCORED UNDER
SF-1	VRS-GEN-101 §6.1
SF-2	VRS-GEN-101 §6.2
SF-5	VRS-GEN-101 §6.5
SF-8	VRS-GEN-101 §6.8
RL-2	VRS-GEN-102 §6.2
RL-5	VRS-GEN-102 §6.5
SV-2	VRS-GEN-103 §6.2
SV-5	VRS-GEN-103 §6.5
CY-4	VRS-GEN-105 §6.4
MS-1	VRS-GEN-106 §6.1
MS-6	VRS-GEN-106 §6.6
MS-7	VRS-GEN-106 §6.7
SI-2	VRS-GEN-104 §6.2
SI-6	VRS-GEN-104 §6.5

5.2 No other intrinsic criterion contributes. Points, ceilings and applicability of a contributing criterion are those of its own standard; where a contributing criterion is not applicable to the assessed application class it is removed from the pool for that class (VRS-GEN-006 §6).

6 Sector criteria

6.0 Summary. Points and tier ceilings per criterion; totals reproduce by addition.

§	CRITERION	POINTS	UNVERIFIED CEILING	VERIFIED CEILING	CERTIFIED CEILING
6.1	HAZ-1 Environment-specific certification / qualification	0–14	11	12	14
6.2	HAZ-2 Mission-critical failure behaviour	0–12	7	10	12
6.3	HAZ-3 Operator-link loss and control handover	0–12	8	10	12
6.4	HAZ-4 Environmental attrition qualification	0–12	8	11	12
6.5	HAZ-5 Ignition-source and contamination-spread controls	0–12	8	10	12
6.6	HAZ-6 Decontamination and disposal procedures	0–10	8	8	10
6.7	HAZ-7 Responder interaction and incident-command integration	0–10	7	8	10
6.8	HAZ-8 Recovery logistics and field repair	0–10	7	8	10
6.9	HAZ-9 Mission incident record	0–8	6	8	8
Total		100	70	85	100

6.1 HAZ-1 Environment-specific certification / qualification (0–14)

ROW	
What is measured	Explosive-atmosphere: ATEX/IECEX certificate for the declared zone; nuclear: radiation-tolerance qualification; fire: thermal rating evidence; SAR/EOD: ingress + drop qualification.
Ladder	14 = third-party certificate/qualification public + validated · 12 = pack-evidenced (documents), not demonstrated · 11 = certificate public · 8 = self-qualification with reports · 4 = declared · 0 = not established
Unverified — evidence & ceiling	Public certificates (IECEX register). Ceiling 11.
Verified — evidence & ceiling	Certificates + qualification reports. Ceiling 12.
Certified — evidence & ceiling	— (documentary; confirmed by HAZ-5 steps where showable). Ceiling 14.
Company-wide fallback	n/a
Evidence bar	Class and environment declared.
Applicability	explosive-atmosphere · nuclear/radiological · firefighting · EOD · search-and-rescue. HAZ-1 anchor differs by class (stated in the row); all criteria apply to all classes.

6.2 HAZ-2 Mission-critical failure behaviour (0–12)

ROW	
What is measured	On fault mid-mission: declared safe state; self-recovery or retrieval procedure; never an obstacle in an egress route.
Ladder	12 = witnessed · 10 = pack-evidenced (documents), not demonstrated · 8 = validated · 7 = publicly evidenced only (no pack, no demonstration) · 5 = documented · 0 = not established
Unverified — evidence & ceiling	Manual. Ceiling 7.
Verified — evidence & ceiling	Fault-response validation. Ceiling 10.
Certified — evidence & ceiling	Witnessed induced fault → declared state → retrieval procedure. Ceiling 12.
Company-wide fallback	n/a
Evidence bar	Fault behaviours documented.
Applicability	explosive-atmosphere · nuclear/radiological · firefighting · EOD · search-and-rescue. HAZ-1 anchor differs by class (stated in the row); all criteria apply to all classes.

6.3 HAZ-3 Operator-link loss and control handover (0–12)

ROW	
What is measured	Link loss in shielded/underground/burning structures: declared behaviour (hold, retrace, autonomous return); handover between operators.
Ladder	12 = witnessed · 10 = pack-evidenced (documents), not demonstrated · 9 = documented in detail + tested · 8 = publicly evidenced only (no pack, no demonstration) · 6 = documented · 0 = not established
Unverified — evidence & ceiling	Manual; tests. Ceiling 8.
Verified — evidence & ceiling	Link design + test evidence. Ceiling 10.
Certified — evidence & ceiling	Witnessed link cut in a shielded space; handover. Ceiling 12.
Company-wide fallback	n/a
Evidence bar	Link architecture declared.
Applicability	explosive-atmosphere · nuclear/radiological · firefighting · EOD · search-and-rescue. HAZ-1 anchor differs by class (stated in the row); all criteria apply to all classes.

6.4 HAZ-4 Environmental attrition qualification (0–12)

ROW	
What is measured	Radiation dose, thermal, corrosive/abrasive exposure qualification with stated limits and dose budgets.
Ladder	12 = qualification reports + published limits + third-party test · 11 = pack-evidenced (documents), not demonstrated · 8 = reports · 5 = limits declared · 0 = not established
Unverified — evidence & ceiling	Datasheet; public qualification data. Ceiling 8.
Verified — evidence & ceiling	Qualification reports. Ceiling 11.
Certified — evidence & ceiling	Operation in a declared condition present at the site (sample). Ceiling 12.
Company-wide fallback	n/a
Evidence bar	Environmental limits declared.
Applicability	explosive-atmosphere · nuclear/radiological · firefighting · EOD · search-and-rescue. HAZ-1 anchor differs by class (stated in the row); all criteria apply to all classes.

6.5 HAZ-5 Ignition-source and contamination-spread controls (0–12)

ROW	
What is measured	No ignition source in declared zone; sealed against contamination carry-out; surface decontaminability.
Ladder	12 = witnessed + certified · 10 = certified ((public)) · 8 = publicly evidenced only (no pack, no demonstration) · 6 = documented · 0 = not established
Unverified — evidence & ceiling	Certificates; manual. Ceiling 8.
Verified — evidence & ceiling	Design evidence + certificates. Ceiling 10.
Certified — evidence & ceiling	Witnessed seal/inspection steps; surface-wipe test. Ceiling 12.
Company-wide fallback	n/a
Evidence bar	Zone/contamination envelope declared.
Applicability	explosive-atmosphere · nuclear/radiological · firefighting · EOD · search-and-rescue. HAZ-1 anchor differs by class (stated in the row); all criteria apply to all classes.

6.6 HAZ-6 Decontamination and disposal procedures (0–10)

ROW	
What is measured	Validated decontamination procedure; disposal path for contaminated units; consumable dependency.
Ladder	10 = validated + witnessed · 8 = validated procedure documented · 4 = procedure only · 0 = not established
Unverified — evidence & ceiling	Manual. Ceiling 8.
Verified — evidence & ceiling	Validation evidence. Ceiling 8.
Certified — evidence & ceiling	Witnessed decontamination of declared surfaces. Ceiling 10.
Company-wide fallback	n/a
Evidence bar	Procedure exists.
Applicability	explosive-atmosphere · nuclear/radiological · firefighting · EOD · search-and-rescue. HAZ-1 anchor differs by class (stated in the row); all criteria apply to all classes.

6.7 HAZ-7 Responder interaction and incident-command integration (0–10)

ROW	
What is measured	Markings, lighting, responder-accessible e-stop, comms with incident command, hand-signal/stop response.
Ladder	10 = witnessed · 8 = pack-evidenced (documents), not demonstrated · 7 = documented in detail · 4 = documented · 0 = not established
Unverified — evidence & ceiling	Manual; training materials. Ceiling 7.
Verified — evidence & ceiling	Interaction spec + training. Ceiling 8.
Certified — evidence & ceiling	Witnessed responder e-stop and stop-signal response. Ceiling 10.
Company-wide fallback	n/a
Evidence bar	None.
Applicability	explosive-atmosphere · nuclear/radiological · firefighting · EOD · search-and-rescue. HAZ-1 anchor differs by class (stated in the row); all criteria apply to all classes.

6.8 6.8 HAZ-8 Recovery logistics and field repair (0–10)

ROW	
What is measured	Field-replaceable modules; recovery of a stranded unit; parts logistics for deployed teams.
Ladder	10 = witnessed swap + commitments + record · 8 = pack-evidenced (documents), not demonstrated · 7 = commitments + record · 4 = documented · 0 = not established
Unverified — evidence & ceiling	Manual; service pages. Ceiling 7.
Verified — evidence & ceiling	Service commitments + record. Ceiling 8.
Certified — evidence & ceiling	Witnessed module swap and recovery drill. Ceiling 10.
Company-wide fallback	Record company-wide → 7
Evidence bar	None.
Applicability	explosive-atmosphere · nuclear/radiological · firefighting · EOD · search-and-rescue. HAZ-1 anchor differs by class (stated in the row); all criteria apply to all classes.

6.9 HAZ-9 Mission incident record (0–8)

ROW	
What is measured	Incidents over the window.
Ladder	8 = none above near-miss (model) · 6 = null-result rung · 5 = remediated · 0 = not established
Unverified — evidence & ceiling	Databases; press. Ceiling 6.
Verified — evidence & ceiling	Register + exposure. Ceiling 8.
Certified — evidence & ceiling	From Verified evidence. Ceiling 8.
Company-wide fallback	Company-wide → 6
Evidence bar	Exposure or null search.
Applicability	explosive-atmosphere · nuclear/radiological · firefighting · EOD · search-and-rescue. HAZ-1 anchor differs by class (stated in the row); all criteria apply to all classes.

7 Letter bands, tier ceilings and class applicability

7.1 Bands (VRS-GEN-006 §4). AAA ≥ 90 % · AA ≥ 75 % · A ≥ 60 % · B ≥ 45 % · C below 45 % of the applicable pool.

7.2 Pool ceilings. Sector criteria alone: Unverified 70/100 (70 %) · Verified 85/100 (85 %) · Certified 100. With the contributing criteria of Clause 5 the pool ceilings are as recorded in VRS-HAZ-501; in both forms the best attainable letter is A at Unverified, AA at Verified and AAA at Certified (VRS-GEN-006 §8).

7.3 Application classes. explosive-atmosphere · nuclear/radiological · firefighting · EOD · search-and-rescue. HAZ-1 anchor differs by class (stated in the row); all criteria apply to all classes... A criterion whose Applicability row excludes the assessed class is removed from both the numerator and the denominator; the letter is issued per class and the displayed letter is the lowest (Clause 4).

7.4 No modifiers, caps or gates operate on the letter other than the ceilings of Clause 6 and the tier rule of VRS-GEN-006 §7.

8 Evidence by tier

8.1 Unverified. The assessor works only from evidence obtainable without the manufacturer's cooperation: datasheets, manuals and public safety documentation; public certificates and their

registers (the IECEx certificate register for the explosive-atmosphere class, the ATEX EU-type-examination and UL 121201 (2017) listings for the EU and US routes); published qualification data, independent test reports and audits; public training and responder-interaction materials; and — for the incident-record criterion (HAZ-9) — regulator and press incident databases. Each criterion's Unverified ceiling (Clause 6) is the most an honest reading of such evidence shall earn; the AR tier is **Unverified**.

8.2 Verified. The assessor additionally examines a manufacturer evidence pack and shall accept, by mapping, the conformity artefacts the manufacturer already holds — adoption is a mapping, not new testing: the ATEX/IECEx certificate to IEC 60079-0:2017 (or the UL 121201 (2017) report for US Division 2), the radiation-tolerance, thermal or ingress qualification reports and the IEC 60529:1989+AMD2:2013 IP report by class (HAZ-1, HAZ-4); the fault-response and safe-state validation records (HAZ-2); the IEC 62443-4-2:2019 SL-C evaluation of the control link and the instrumented link-loss / control-handover trial report (HAZ-3); the ignition-source and contamination-control design evidence and surface-wipe test data (HAZ-5); the validated decontamination procedure and disposal plan (HAZ-6); the responder-interaction specification, training material and ASTM E2853/E2853M-22 (2022) capability results (HAZ-7); the ISO 14224:2016 maintenance and repair records with the recovery-logistics plan (HAZ-8); and the incident register with its exposure basis (HAZ-9). Verified ceilings apply only to criteria whose pack items are present and examined; the AR tier is **Verified**.

8.3 Certified. The assessor witnesses the declared behaviour on the robot: an induced mid-mission fault resolving to the declared safe state and the retrieval procedure (HAZ-2); a link cut in a shielded space and the operator handover (HAZ-3); operation in a declared attrition condition present at the site (HAZ-4); the seal, inspection and surface-wipe steps that confirm ignition-source and contamination control (HAZ-5); decontamination of the declared surfaces (HAZ-6); the responder-accessible e-stop and stop-signal response (HAZ-7); and a field module swap and stranded-unit recovery drill (HAZ-8). The documentary criteria (HAZ-1, HAZ-9) carry their Certified points from the Verified evidence. The AR tier is **Certified**.

8.4 Evidence bar. Each criterion states an **evidence bar** (Clause 6). Where the bar is not met the criterion shall score **0** — no evidence is 0 points, never a discard from the pool. A manufacturer self-declaration shall not earn points above the rung its independent corroboration supports; HAZ-1 anti-aggravation shall never be raised on evidence transferred from another class or exposure envelope (Clause 4.4). Where the incident-record evidence (HAZ-9) rests only on uninstrumented field-return recollection rather than an instrumented register, the evidence bar is not met above the null-result rung: the extreme environment corrupts recollection, so a mission-record claim shall rest on the instrumented register and its exposure basis.

8.5 Null-result rule. For HAZ-9 a recorded search of the regulator and press incident databases, with its coverage and exposure basis stated, shall earn the criterion's null-result rung where no adverse record is found; an unrecorded search shall not.

8.6 Company-wide fallback. Where a criterion offers a company-wide fallback (HAZ-8, HAZ-9) and model-specific evidence is unavailable, manufacturer-wide records shall earn the stated fallback points (VRS-GEN-005 §6); the substitution shall be recorded per Clause 10.

8.7 AR tier. The AR tier is the lowest tier among the criteria that determined the letter, and shall not exceed the model's Intrinsic Rating tier (VRS-GEN-006 §7).

9 Underwriting and credit use

9.1 The letter is an opinion above the compliance floor, not a certification, and shall not be published or imply that any real robot holds a Veyrum rating. A rating is an opinion on the robot, not on the lawfulness of any deployment: where a class's mandatory clearance or authorisation (for example an ATEX/IECEx certificate for an explosive atmosphere) is absent, HAZ-1 scores its no-evidence rung and the model is still rated, with the absence recorded on the result.

9.2 The per-class letters and the recorded exposure envelopes are the underwriting hooks: the letter informs rate relativity, and the covered environment classes and exposure envelopes inform coverage scope, so that operation outside the assessed envelope is an exclusion or a condition rather than an implied covered risk. Two loss drivers shall be surfaced separately so an underwriter can weigh them independently of the letter: the **catastrophic-severity driver** (HAZ-1 environment qualification and HAZ-5 ignition/contamination control – the ignition, explosion or contamination-spread severity of a fault in an extreme environment, evidenced by demonstrated control rather than inferred); and the **correlated fleet driver** (HAZ-3 operator-link integrity – where many units share one tele-operation link or update plane, one intrusion event can degrade the fleet at once, so the per-fleet accumulation attribute records whether that regime holds an IEC 62443-4-2:2019 SL-C evaluation).

9.3 For credit, the recoverability and residual drivers shall be readable from the recorded per-criterion points to inform LTV, residual curves and end-of-support assumptions for extreme-environment assets: HAZ-6 and HAZ-8 inform recoverability (decontamination feasibility and stranded-unit recovery), while the intrinsic reliability, serviceability and support criteria drawn into the pool (Clause 5) inform the residual curve and the obsolescence assumption. **Contamination write-off exposure** shall be recorded as a separate credit input and shall not be netted against serviceability: a contaminated unit may depreciate to salvage regardless of mechanical condition, because return-to-service depends on decontamination to a certifiable state (VRS-HAZ-001 §8.4).

10 Result recording

The rating record shall carry, per VRS-GEN-009: the displayed sector letter and the per-class letters with the exposure envelope each was issued at; the **per-criterion points** earned across the sector criteria (Clause 6) and the contributing intrinsic criteria (Clause 5); the **not-applicable set** removed for each class and the resulting applicable-pool range; the contributing intrinsic criteria used; the AR **tier**; the **edition** (VRS 2026); the VRS-HAZ-501 data-twin version; the contamination write-off exposure attribute; and the correlated fleet-accumulation attribute (HAZ-3). Recording flows to the Passport per VRS-GEN-009; no personal information shall be stored (VRS-GEN-012 §5.2).

11 Assessor checklist

An assessor with this Protocol and the evidence shall reach the same result by executing the following in order; no step admits an unrecorded judgement call, and any deviation shall be recorded with its basis:

- [] Environment class(es) confirmed (explosive-atmosphere / nuclear-radiological / firefighting / EOD / search-and-rescue) with each exposure envelope (Clause 1.2; VRS-HAZ-001 §4).

- [] Assessment tier fixed (Clause 8); the not-applicable set recorded per class and the applicable-pool range computed (Clause 4).
- [] Contributing intrinsic criteria drawn from their source standards at their own points and tiers (Clause 5).
- [] **HAZ-1** environment-specific certification/qualification scored; class and environment are declared (evidence bar); anti-aggravation not inferred from transferred evidence (Clause 4.4).
- [] **HAZ-2** mission-critical failure behaviour scored; fault behaviours are documented (evidence bar).
- [] **HAZ-3** operator-link loss and control handover scored; the link architecture is declared (evidence bar).
- [] **HAZ-4** environmental attrition qualification scored; environmental limits are declared (evidence bar).
- [] **HAZ-5** ignition-source and contamination-spread controls scored; the zone/contamination envelope is declared (evidence bar).
- [] **HAZ-6** decontamination and disposal procedures scored; a procedure exists (evidence bar).
- [] **HAZ-7** responder interaction and incident-command integration scored.
- [] **HAZ-8** recovery logistics and field repair scored; company-wide fallback recorded if used.
- [] **HAZ-9** mission incident record scored; null-result search applied per Clause 8.5; the instrumented-register evidence bar checked (Clause 8.4); company-wide fallback recorded if used.
- [] Points added and divided by the applicable-pool range; letter read from the bands (Clause 7.1).
- [] Letters issued per class; the lowest displayed (Clause 4.3); each award held at its assessed-tier ceiling (Clause 6).
- [] Result recorded to the passport: per-criterion points, not-applicable set, contributors, tier, edition, twin version, the contamination write-off exposure attribute and the correlated fleet-accumulation attribute (Clause 10).

12 Annex A (informative) — Worked example

FICTIONAL EXAMPLE — not a real product; illustrates mechanics only.

A fictional tracked ground robot, model code **HAZ-EX-01**, is assessed for the **explosive-atmosphere** application class at the **Verified** tier: a manufacturer evidence pack is examined and no behaviour is witnessed. The manufacturer holds an ATEX EU-type-examination certificate and an IECEx certificate to IEC 60079-0:2017 for the declared Zone 1, an IEC 60529:1989+AMD2:2013 IP66 report, an IEC 62443-4-2:2019 SL-2 evaluation of the tele-operation link, and ASTM E2853/E2853M-22 (2022) capability results. All nine sector criteria apply, and the fourteen contributing intrinsic criteria of Clause 5 are drawn from their source standards at their own Verified points.

Sector criteria (Verified tier).

§	CRITERION	VERIFIED CEILING	POINTS EARNED
6.1	HAZ-1	12	12
6.2	HAZ-2	10	10
6.3	HAZ-3	10	8
6.4	HAZ-4	11	11
6.5	HAZ-5	10	10
6.6	HAZ-6	8	8
6.7	HAZ-7	8	7
6.8	HAZ-8	8	8
6.9	HAZ-9	8	8
Sector subtotal		85	82

Contributing intrinsic criteria (Verified tier). Drawn at their own points, the fourteen criteria of Clause 5 have a combined range of **134 points** and a combined Verified ceiling of **107**; this model earns **96** of them, each at or below its Verified ceiling (for example SI-2 at 18 of its 19-point Verified ceiling, SF-8 at 10, and the connectivity contributor CY-4 at 6 of 7).

Letter. The applicable pool for the explosive-atmosphere class is the sector range 100 plus the contributor range 134 = **234 points**. Points earned = 82 (sector) + 96 (contributors) = **178**. As a percentage of the pool, $178 \div 234 = 76.1\%$, which falls in the **AA** band ($\geq 75\%$, below AAA's 90 %). The result is **Hazardous & Emergency Response AR: AA (VRS 2026) – Verified**.

Tier ceiling by construction. At the Verified tier the pool's own ceiling is $(85 + 107) \div 234 = 192 \div 234 = 82.1\%$, so AA is the best letter attainable without a witnessed demonstration (Clause 7.2); AAA would require Certified-tier evidence such as a witnessed induced-fault safe-state resolution (HAZ-2) and a witnessed link cut in a shielded space (HAZ-3). No separate modifier is applied – the ceiling does the work.

Refusal variant. Had **HAZ-EX-01** held no ATEX/IECEx certificate for the declared Zone 1, HAZ-1 would score its no-evidence rung (4 for a bare declaration, 0 for none) rather than 12, and the letter would fall out of the reduced total; the model is still rated and the missing clearance is recorded on the result (Clause 9.1) rather than blocking the letter. Numbers illustrate mechanics only.

13 Bibliography

The full HAZ anchor regime is verified in VRS-HAZ-001; the following are the specific anchors this Protocol's criteria and evidence tiers (Clauses 6 and 8) rest on, dated at point of use:

- ATEX Directive 2014/34/EU (recast; applicable from 20 April 2016) – equipment and protective systems for potentially explosive atmospheres (eur-lex.europa.eu, CELEX 32014L0034) – HAZ-1 explosive-atmosphere floor (EU).
- IEC 60079-0:2017 (edition 7.0, 2017-12) – Explosive atmospheres – Part 0: Equipment – General requirements (IECEx scheme; webstore.iec.ch/publication/32878; superseded by edition 8.0, IEC 60079-0:2026) – HAZ-1 international explosive-atmosphere route.
- UL 121201 (9th edition, 2017; harmonised with CSA C22.2 No. 213-17) – Nonincendive electrical equipment for Class I/II Division 2 and Class III hazardous locations (webstore.ansi.org) – HAZ-1 US route.
- IEC 60529:1989+AMD2:2013 (IP Code) – degrees of protection provided by enclosures (webstore.iec.ch/publication/2452) – HAZ-4 ingress-protection lane.
- IEC 62443-4-2:2019 (edition 1.0) – technical security requirements for IACS components (SL-C against FR1–FR7) (webstore.iec.ch/publication/34421) – HAZ-3 operator-link cyber lane.
- ISO 14224:2016 – Collection and exchange of reliability and maintenance data for equipment (iso.org/standard/64076.html) – HAZ-8 reliability and repair lane.
- ASTM E2853/E2853M-22 (2022) – Evaluating Emergency Response Robot Capabilities: HSI Search Tasks (DHS-NIST-ASTM E54.09 suite; webstore.ansi.org) – HAZ-7 responder-capability lane.
- ISO 8373:2021 – Robotics – Vocabulary (iso.org/standard/75539.html) – robot-term basis.
- VRS-HAZ-501 – machine-readable data twin of this Protocol (Clause 5/6/7 values).

14 Change history

DATE	VERSION	STATUS	CHANGE	AUTHORITY
2026-09-16	1.0.0	Draft	VRS 2026 rewrite: replaced the re-weighted-mean scoring (Clauses 4–8) with a point-summed pool — nine sector criteria HAZ-1...HAZ-9 (100 points; Clause 6) plus the named contributing intrinsic criteria (Clause 5), expressed as a percentage of the applicable pool and mapped to a letter by VRS-GEN-006 §4; added per-criterion tier ceilings, the letter-band/pool-ceiling/class-applicability clause (Clause 7), evidence-by-tier (Clause 8), a regenerated Verified-tier worked example (Annex A) and a per-criterion checklist (Clause 11); adopted the environment classes (explosive-atmosphere / nuclear-radiological / firefighting / EOD / search-and-rescue) with the HAZ-1 anchor differing by class; re-anchored the former §7 modifiers into criterion rungs and the §4 contraction rule (7.1 explosive-atmosphere no-cert → HAZ-1 no-evidence rung, robot still rated per §9.1; 7.2 non-harmonised class → HAZ-1 recognised-anchor-by-class rung; 7.3 uninstrumented field-return → HAZ-9 evidence bar of §8.4); dropped the exposure denominators from procedures; retired the earlier draft's confidence bands, provisional flags, renormalisation, weighted-mean, assessed-unrated and stage-prior markers; dropped the GEN-201/GEN-202 references; VRS-HAZ-501 data twin regenerated by the dispatcher from Clauses 5–7; see GEN-005 §6.	VRS 2026 rewrite Stage 4
2026-09-11	0.2.0	Draft	DEEPEN: brought to publishable depth on the FLD/DOM-201 v0.2.0 exemplar. Added theatre-op-hours exposure denominator, evidence-lane conformity-artefact reuse (dated anchors verified 2026-09-11), per-criterion loss-driver mapping incl. contamination write-off, admissibility gates, underwriting/credit use, passport recording, assessor checklist, worked example producing per-class letters, Bibliography with dated anchors. No weight, band or sufficiency-constant value changed. Twin VRS-HAZ-501 regenerated to 0.2.0.	Curator Run #45; charter DEEPEN
2026-09-05	0.1.0	Draft	Initial draft — per-class letters, lowest-class display rule; data twin planned as VRS-HAZ-501	CEO goal 2026-09-05

About Veyrum Research Institute

Veyrum Research Institute is the research arm of Veyrum — the independent intelligence and trust layer for the robotics industry (research, ratings and registry, advisory, data, and specialist insurance & finance introductions).

Disclaimer

The opinions in this document are independent and current as of the date of publication, based on information believed reliable; they are not guarantees or warranties of safety, fitness, or compliance, and are not engineering, legal, or financial advice. This document may be revised. © 2026 Veyrum.

Contact: hello@veyrum.com · VRS-HAZ-201 · Version 1.0.0