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VEYRUM ROBOTICS STANDARD



VRS - HAZ - 110

Hazardous & Emergency Response — Demonstration Protocol

The Hazardous & Emergency Response sector's witnessed steps for a Certified rating — fault mid-mission and retrieval, link loss in a shielded space and operator handover, seal inspection and decontamination with a wipe test, responder emergency stop and stop-signal response, field repair in protective equipment — run in the same session as the intrinsic protocol.

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Foreword. This Test Protocol is new in the VRS 2026 edition and is the Hazardous & Emergency Response sector’s extension of VRS-GEN-203, the intrinsic demonstration protocol. The sector’s robots go where people should not — explosive atmospheres, radiological areas, burning structures, suspected devices, collapsed buildings — and are operated by responders in protective equipment who did not build them. The certifications those environments require (protection-type marking for explosive atmospheres, radiation-tolerance qualification, ingress and drop qualification) are documentary and are scored from the pack; this Protocol witnesses what the certificates do not show: what the robot does when it faults inside a structure, when the link dies behind concrete, when a responder in gloves needs it to stop now, and how it is brought out, decontaminated and repaired by a team in the field. Every hazardous condition is one already present at the site under the site’s own controls; the Protocol introduces none. It carries only what the intrinsic steps do not already witness. Steps run between Parts E and F of VRS-GEN-203, in the same session, on the same feed, into the same export. Standards carry no step identifiers; every step here names the VRS-HAZ-201 subclause that requires it. As a protocol it is versioned vX.Y.Z (VRS-GEN-004 §5.4). Requirements use “shall”.

1 Introduction

The Hazardous & Emergency Response sector has no single anchor regime; each class has its own — IEC 60079 for explosive atmospheres, radiation-tolerance qualification for nuclear work, thermal and ingress ratings for fire and search-and-rescue, the response-robot test methods developed with the fire and rescue community for mobility, dexterity and communication. What they share is the operational fact that a responder robot’s most important behaviours are the ones that happen when something has already gone wrong: a fault inside the structure, a lost link, a stranded unit in an egress route, a contaminated surface. This Protocol witnesses those behaviours in a mock structure with a marked egress route, using the manufacturer’s own shielding enclosure, tracer and field kit, and with the demonstrator dressed as the responder who will actually do the work.

The environmental step is conditional: where the site has a hazardous condition under its own controls — a heat source, a spray, a training source — the robot is shown in it; where not, the step is recorded as not present and the criterion is scored from the Verified evidence. The Protocol never asks a site to create a hazard.

2 1 Scope

This Protocol specifies the Hazardous & Emergency Response demonstration steps by which the criteria of VRS-HAZ-201 Clause 6 are demonstrated at the Certified tier, for every application class of VRS-HAZ-201 §7.3 (explosive-atmosphere · nuclear/radiological · firefighting · EOD · search-and-rescue). It applies to every Certified Hazardous & Emergency Response assessment, by every Certified route of VRS-GEN-003 §6.9.

It specifies: how this Protocol relates to VRS-GEN-203 (Clause 4); the envelope the manufacturer declares before the session (Clause 5); the steps (Clause 6); and a worked example (Clause 7). Annex A maps every VRS-HAZ-201 criterion to its intrinsic steps, its sector steps, or neither.

It does not: repeat any session requirement, step, marking rule or record rule of VRS-GEN-203, all of which apply unchanged; define any criterion, point, ceiling or ladder (VRS-HAZ-201); or define the Hazardous & Emergency Response information pack (VRS-GEN-013). No step introduces a hazardous condition; the conditional environmental step uses only a condition already present at the site under the site's own controls. No person is in the robot's path or in the mock structure during motion; the demonstrator acts as the responder at the console and in retrieval and repair.

3 Normative references

- **VRS-GEN-203**, Demonstration Protocol — Intrinsic — session requirements (Clause 4), step rules (Clause 5), marks and scores (Clause 7), Session Record (Clause 8), all of which apply to this Protocol.
- **VRS-HAZ-201**, Hazardous & Emergency Response — AR Assessment Protocol — the criteria whose Certified rows this Protocol serves; application classes (§7.3).
- **VRS-HAZ-001**, Hazardous & Emergency Response Sector Standard — the declared envelope and class fields.
- ○ **VRS-GEN-101**, Safety — the intrinsic safety criteria the Hazardous & Emergency Response pool contributes to.
- ○ **VRS-GEN-102**, Reliability & Durability — the intrinsic environmental-sample step that also serves VRS-HAZ-201 §6.4.
- ○ **VRS-GEN-103**, Serviceability & Support — the intrinsic module-swap and fault-recovery steps that serve parts of VRS-HAZ-201 §6.2 and §6.8.
- **VRS-GEN-003**, Governance Charter and Independence — Certified routes and route parity (§6.9).

4 Terms and definitions

Terms defined in VRS-GEN-001 and VRS-GEN-203 apply. In addition:

3.1 mock structure — a marked layout representing the deployment structure — walls, a doorway, a marked egress route — supplied by the manufacturer or the site.

3.2 shielded space — a declared enclosure that attenuates the operator link (metal container, basement, foil-lined room) in which the link-loss behaviour is witnessed.

3.3 retrieval procedure — the declared means by which one responder moves a de-energised or faulted robot clear: tether, drag handle, lift point or recovery mode.

3.4 declared surfaces — the external surfaces the manufacturer declares decontaminable, with their validated procedure and consumables.

3.5 tracer — a fluorescent, powder or site-simulant marker applied to declared surfaces so that decontamination can be shown by a wipe test.

3.6 responder protective equipment — the declared gloves, mask or suit in which field procedures are performed.

3.7 stop signal — the declared hand, light or voice signal to which the robot stops, given from the declared distance.

3.8 handover — the declared transfer of control between two operator consoles during a mission.

5 4 Relationship to the intrinsic protocol

4.1 This Protocol shall be run only as part of a session under VRS-GEN-203. Every requirement of VRS-GEN-203 Clause 4 applies to every step here without repetition or exception.

4.2 Position in the session. The steps of Clause 6 shall run after VRS-GEN-203 Part E and before VRS-GEN-203 Part F, so that one continuous recording and one export cover both protocols. The endurance sample opened in VRS-GEN-203 Part C continues to run through this Protocol.

4.3 Step identifiers. Steps shall carry identifiers of the form `HAZ-110.nn` ; they are Session Record step identifiers under the same rules as VRS-GEN-203 §5.1 and shall never be reused.

4.4 Required by. Every step shall name the VRS-HAZ-201 subclause(s) whose Certified row it serves. VRS-HAZ-201 carries no reference back to this Protocol.

4.5 Classes and declared subjects. Each step lists the application classes it applies to. A step whose class is not in the assessed envelope shall not be run. A step whose subject the manufacturer has not declared shall be marked *not declared* and has no effect on any score (VRS-GEN-203 §3.10). Parts 1, 3 and 4 shall be run for every Hazardous & Emergency Response assessment; Part 2 only where a declared condition is present at the site under the site's own controls.

4.6 Bound. The sum of step bounds for one class shall not exceed 120 min. Marks, failure, declined steps, continuation sessions and the Session Record follow VRS-GEN-203 Clauses 5, 7 and 8.

4.7 Criteria witnessed by intrinsic steps. Where a sector criterion's Certified row is already witnessed by intrinsic steps, Annex A names them and the criterion is scored from those marks together with any sector steps listed. VRS-HAZ-201 §6.1 (environment-specific certification) is documentary; where showable, its Certified row is confirmed by the seal-inspection and decontamination steps of Part 3.

4.8 Hazardous conditions. No step shall create an explosive, radiological, thermal, toxic or structural hazard for the purpose of the demonstration. The conditional step of Part 2 shall use only a condition already present at the site under the site's own controls and permits, and the site's controller shall have the authority to end it.

4.9 People. No person shall be in the mock structure or the robot's path during motion; the demonstrator performs retrieval and repair only with the robot de-energised or in its declared safe state (VRS-GEN-203 §4.8). A step so performed shall be marked *not achieved* and the ground recorded.

4.10 Admissibility of a mark. A step's mark shall be inadmissible, and the step shall be marked *not achieved*, where the dimension, mass, speed, force or condition it depends on was not shown on camera, or where the configuration demonstrated differs from the assessed one. The observer shall record the ground.

6 5 The declared envelope

5.1 Before the session the manufacturer shall have declared, in the information pack and per assessed application class: the application class and its anchor certification; the representative mission task; each fault-injection means and the declared safe state; the shielded-space link-loss behaviour with its time or distance (s, m); the handover procedure and authority; the retrieval means and time (s); any site condition offered for Part 2; the seals, penetrators and covers with the inspection checklist and interval; the declared decontaminable surfaces, tracer, consumables, wipe-test level and decontamination time (min); the external emergency-stop positions, warnings and marking visibility distance (m); the stop signal, distance and response time (s); the field-replaceable modules, field kit, protective equipment and field-repair time (min); and the energy-pack swap procedure and time (min).

5.2 Every apparatus in Clause 6 shall be sized from those declarations and no other source (VRS-GEN-203 §4.7). A parameter not declared makes the steps that depend on it *not declared* (4.5); a manufacturer that declares a smaller envelope demonstrates a smaller envelope and is scored against it under VRS-HAZ-201.

5.3 The declared envelope shall match the one recorded for the rating (VRS-HAZ-001, VRS-GEN-009); a step demonstrated at a value other than the declared one shall be inadmissible (4.10).

7 6 The steps

Columns: **ID** — Session Record step identifier · **Step** — outcome to witness · **Classes** — application classes the step applies to (4.5) · **Witness** — means (VRS-GEN-203 §3.13) · **Apparatus** — manufacturer-supplied, at declared value · **Bound** — minutes · **Required by** — VRS-HAZ-201 subclause(s) served.

7.1 6.1 Part 1 — Mission-critical failure, link loss and retrieval

The behaviours that matter after something has gone wrong: a fault inside the structure, a link lost behind shielding, a handover between operators, a stranded unit brought out of the egress route.

ID	STEP	CLASSES	WITNESS	APPARATUS	BOUND	REQUIRED BY
HAZ-110.01	Induced fault mid-mission. During a representative mission task in a marked mock structure, a fault is induced by the manufacturer's own procedure (drive, sensor or power subsystem); the robot enters its declared safe state, does not stop within the marked egress route, and the alert reaches the operator console; the feed shows the fault and state.	all	CAM+FEED+APP	Mock structure with a marked egress route; manufacturer's fault-injection means	8 min	Required by VRS-HAZ-201 §6.2
HAZ-110.02	Link loss in a shielded space. With the robot inside a declared shielded or attenuating enclosure (metal container, basement, foil-lined space supplied by the manufacturer), the operator link is lost or cut; the robot performs its declared behaviour (hold, retrace to last link, autonomous return) within the declared time or distance; link	all	CAM+FEED+APP	Shielded or attenuating enclosure; marks at the declared return point	10 min	Required by VRS-HAZ-201 §6.3; §6.2

ID	STEP	CLASSES	WITNESS	APPARATUS	BOUND	REQUIRED BY
	state and behaviour are shown on the feed when the link returns.					
HAZ-110.03	Operator handover under load. Control is handed from one operator console to a second during motion using the declared handover procedure; the first console loses control, the second gains it, and there is no uncommanded motion in between; a handover attempt without the declared authority is refused; every event appears on the feed.	all	FEED	Two operator consoles	6 min	Required by VRS-HAZ-201 §6.3; §6.7
HAZ-110.04	Retrieval of a stranded unit. With the robot de-energised or faulted inside the mock structure, the declared retrieval procedure is performed by one responder: tether, drag handle, lift point or recovery mode as declared; the	all	CAM+FEED+APP	The declared retrieval means	8 min	Required by VRS-HAZ-201 §6.2; §6.8

ID	STEP	CLASSES	WITNESS	APPARATUS	BOUND	REQUIRED BY
	robot is moved clear of the egress route within the declared time; the recovery alert is shown.					

7.2 6.2 Part 2 — Environmental attrition present at the site

Conditional. Only a condition already present at the site under the site’s own controls; the Protocol introduces no hazard.

ID	STEP	CLASSES	WITNESS	APPARATUS	BOUND	REQUIRED BY
HAZ-110.05	Operation in a declared hazardous condition present at the site. Where a declared condition (heat, water spray, dust, smoke, a radiological training source under the site’s controls) is present at the site and can be shown safely, the robot performs a representative task in it; the feed shows the condition reading on the robot’s own sensors and the robot’s state.	all	CAM+FEED	The site condition under the site’s own controls	10 min	Required by VRS-HAZ-201 §6.4 – Conditional – recorded as not present otherwise

7.3 6.3 Part 3 — Ignition, contamination and decontamination

The certificates say the enclosure is sealed and the surfaces are decontaminable; these steps show the inspection and the wipe test.

ID	STEP	CLASSES	WITNESS	APPARATUS	BOUND	REQUIRED BY
HAZ-110.06	Seal and enclosure inspection. Each declared seal, penetrator, vent and cover is inspected on camera against the manufacturer's inspection checklist; for explosive-atmosphere classes the declared protection-type markings and the absence of exposed ignition sources are shown; the declared inspection interval is shown in the log.	all	CAM+FEED	Manufacturer's inspection checklist	8 min	Required by VRS-HAZ-201 §6.5
HAZ-110.07	Surface-wipe and decontamination of declared surfaces. A declared marker (fluorescent tracer, powder or the site's simulant) is applied to the declared external surfaces; the validated decontamination procedure is performed from the manual with the declared	all	CAM+FEED+APP	Tracer or simulant; declared consumables; manufacturer's lamp or reader	15 min	Required by VRS-HAZ-201 §6.6; §6.5

ID	STEP	CLASSES	WITNESS	APPARATUS	BOUND	REQUIRED BY
	consumables; a wipe test of each surface shows the marker removed to the declared level under the manufacturer’s lamp or reader on camera; time from video against the declared decontamination time.					

7.4 6.4 Part 4 — Responder interaction

Responders in gloves who did not build the robot must be able to stop it, see it and signal it.

ID	STEP	CLASSES	WITNESS	APPARATUS	BOUND	REQUIRED BY
HAZ-110.08	Responder-accessible emergency stop and warnings. The declared external emergency stop is operated by the demonstrator in responder gloves from each declared side; motion halts; the declared lighting and audible warnings are shown to activate on motion start, reverse and fault; the declared markings are visible on camera at the declared distance.	all	CAM+FEED	Responder gloves; marks at the declared visibility distance	6 min	Required by VRS-HAZ-201 §6.7
HAZ-110.09	Stop-signal response. The declared stop hand-signal, light signal or voice command is given from the declared distance; the robot stops within the declared time; repeated three times from different bearings; a non-declared gesture produces no stop, showing the response is specific.	all	CAM+FEED	—	6 min	Required by VRS-HAZ-201 §6.7

7.5 6.5 Part 5 — Field repair in protective equipment

Performed in the declared protective equipment with the field kit only — the conditions under which the repair will actually be done.

ID	STEP	CLASSES	WITNESS	APPARATUS	BOUND	REQUIRED BY
HAZ-110.10	Field module swap in protective equipment. One declared field-replaceable module is replaced by the demonstrator wearing the declared responder protective equipment (gloves, mask) with the declared field kit only, per the manual; time from video against the declared field-repair time; the robot returns to service; the swap is recorded in the log.	all	CAM+FEED	Spare module; declared field kit; responder protective equipment	15 min	Required by VRS-HAZ-201 §6.8
HAZ-110.11	Energy-pack swap in protective equipment. The battery or energy pack is swapped by the same demonstrator in the same equipment per the manual; time from video against the declared time; for explosive-atmosphere classes, the declared safe-area or interlocked swap procedure is followed and shown.	all	CAM+FEED	Spare pack; responder protective equipment	8 min	Required by VRS-HAZ-201 §6.8

6.6 Timing budget. All 11 steps sum to 100 min. Per class, with every applicable step declared: explosive-atmosphere 100 min · nuclear/radiological 100 min · firefighting 100 min · EOD 100 min · search-and-rescue 100 min. Every class is within the 120 min bound of 4.6.

8 7 Worked example (informative)

A manufacturer of a hypothetical tracked reconnaissance robot for fire services (class: firefighting) declares: a representative task of traversing a two-room mock structure and reading a gas sensor; fault injection by disconnecting the rear drive; link-loss behaviour of retrace to last link within 30 s inside a steel container; handover by console key with PIN; retrieval by a drag handle and freewheel within 60 s; heat from the training centre's burn-room door offered as a site condition; twelve seals on the manufacturer's checklist; decontamination of the shell and tracks with the declared foam and a 10 min time, wiped to no visible tracer under UV; two red external stop paddles, strobe and horn on motion,

markings visible at 10 m; a raised-fist stop signal at 10 m within 2 s; a sensor-mast module swap in 12 min and a pack swap in 4 min in structural gloves and a mask.

After VRS-GEN-203 Part E the sector steps run from 12:40. HAZ-110.01: rear drive disconnected in room two, robot stops and alerts, not in the marked egress route (achieved). HAZ-110.02: robot driven into the container, link lost at the door, retraces and re-links after 18 s (achieved). HAZ-110.03: handover during a turn by key and PIN; no PIN, refused; no uncommanded motion (achieved). HAZ-110.04: robot de-energised in the corridor, one demonstrator drags it clear by the handle in 40 s (achieved). HAZ-110.05: burn-room door open, radiant heat shown on the robot's thermal sensor, task performed (achieved). HAZ-110.06: twelve seals inspected against the checklist on camera; inspection interval shown in the log (achieved). HAZ-110.07: UV tracer applied to shell and tracks; foam, rinse, wipe; no tracer under the UV lamp; 8 min (achieved). HAZ-110.08: both paddles operated in structural gloves, stop each time; strobe and horn on start, reverse and fault; markings read at the 10 m mark (achieved). HAZ-110.09: raised fist at 10 m from three bearings, stops in under 2 s; a wave produces no stop (achieved). HAZ-110.10: sensor mast swapped in gloves and mask in 11 min; logged (achieved). HAZ-110.11: pack swapped in 3 min 30 s (achieved). Sector time 92 min; VRS-GEN-203 Part F follows.

The reviewer scores VRS-HAZ-201 §6.2 from HAZ-110.01, HAZ-110.02 and HAZ-110.04 with GEN-203.28; §6.3 from HAZ-110.02 and HAZ-110.03 with GEN-203.15; §6.4 from HAZ-110.05 with GEN-203.39; §6.5 from HAZ-110.06 and HAZ-110.07; §6.6 from HAZ-110.07; §6.1 is confirmed by those two marks; §6.7 from HAZ-110.03, HAZ-110.08 and HAZ-110.09 with GEN-203.06; §6.8 from HAZ-110.04, HAZ-110.10 and HAZ-110.11 with the intrinsic serviceability steps. No number in this example is a requirement; every apparatus value came from the manufacturer's own declaration.

9 Annex A (normative) — Criterion coverage

Every criterion of VRS-HAZ-201 Clause 6 appears once with the intrinsic steps (VRS-GEN-203) and the sector steps (this Protocol) that witness it, or the statement that it has none.

CRITERION	SUBCLAUSE	WITNESSED BY
HAZ-1 Environment-specific certification / qualification	VRS-HAZ-201 §6.1	no step — documentary criterion; its Certified row is confirmed by the marks of HAZ-110.06, HAZ-110.07
HAZ-2 Mission-critical failure behaviour	VRS-HAZ-201 §6.2	intrinsic GEN-203.28; sector HAZ-110.01, HAZ-110.02, HAZ-110.04
HAZ-3 Operator-link loss and control handover	VRS-HAZ-201 §6.3	intrinsic GEN-203.15; sector HAZ-110.02, HAZ-110.03
HAZ-4 Environmental attrition qualification	VRS-HAZ-201 §6.4	intrinsic GEN-203.39; sector HAZ-110.05
HAZ-5 Ignition-source and contamination-spread controls	VRS-HAZ-201 §6.5	sector HAZ-110.06, HAZ-110.07
HAZ-6 Decontamination and disposal procedures	VRS-HAZ-201 §6.6	sector HAZ-110.07
HAZ-7 Responder interaction and incident-command integration	VRS-HAZ-201 §6.7	intrinsic GEN-203.06; sector HAZ-110.03, HAZ-110.08, HAZ-110.09
HAZ-8 Recovery logistics and field repair	VRS-HAZ-201 §6.8	intrinsic GEN-203.29, GEN-203.30; sector HAZ-110.04, HAZ-110.10, HAZ-110.11
HAZ-9 Mission incident record	VRS-HAZ-201 §6.9	no step — scored at the Certified tier from the Verified evidence

10 Bibliography

- IEC 60079-0:2017, *Explosive atmospheres — Part 0: Equipment — General requirements*.
- IEC 60079-14:2013, *Explosive atmospheres — Part 14: Electrical installations design, selection and erection*.
- ASTM E2521-16, *Standard Terminology for Evaluating Response Robot Capabilities*.
- ASTM E2592-16, *Standard Practice for Evaluating Response Robot Capabilities: Logistics: Packaging for Urban Search and Rescue Task Force Equipment Caches*.
- ASTM E2801-11(2020), *Standard Test Method for Evaluating Emergency Response Robot Capabilities: Mobility: Confined Area Obstacles: Gaps*.
- ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*.
- ISO 13849-1:2023, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*.
- IEC 60529:1989+AMD2:2013, *Degrees of protection provided by enclosures (IP Code)*.

- ISO 17874-1:2010, *Remote handling devices for radioactive materials — Part 1: General requirements*.
- NFPA 1801:2021, *Standard on Thermal Imaging for the Fire Service*.

11

Change history

DATE	VERSION	STATUS	CHANGE	AUTHORITY
2026-09-16	1.0.0 (draft)	Draft	Created for the VRS 2026 edition (rewrite Batch D; sector demonstration protocol). 11 steps in 5 Parts extending VRS-GEN-203 for the Hazardous & Emergency Response criteria of VRS-HAZ-201: induced fault mid-mission clear of the egress route, link loss in a shielded space, operator handover under load, retrieval of a stranded unit, conditional operation in a site condition under the site’s controls, seal and enclosure inspection, surface-wipe decontamination with tracer, responder emergency stop and warnings, stop-signal response, field module and pack swap in protective equipment. No hazard is introduced by the Protocol. Annex A covers all 9 criteria.	Rewrite instructions §6 (VRS-XXX-110); sector traceability matrix (HAZ derived demonstration steps); CEO ruling 2026-09-15 that standards carry no catalogue identifiers

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