

Storm Survival Fishing Vessel Level Design Package

1. Research and Real-World Grounding

Commercial Fishing Vessel Classes: We have selected three distinct vessel classes (crab pot vessel, longline vessel, and factory trawler) to base the game's levels on. Each represents a different scale and fishing method, providing unique layouts and challenges grounded in real-world design.

1.1 Crab Fishing Vessel (Pot Crabber)

- **Typical Size:** Bering Sea crab boats are stout workhorses around 110–135 ft (33–41 m) long with 27–32 ft beam, often ~150–200 gross tons ¹ ² . They need enough deck space for hundreds of crab pots and a high bow for plowing through rough seas ³ .
- **Deck Layout & Gear:** The wheelhouse is usually at the bow (forward), and the aft main deck is open for pot fishing operations ³ . Standard deck machinery includes a pot **launcher** amidships (side rail ramp) for deploying traps, a heavy **hauling davit** or **crab block** with winch on the starboard side for retrieving pots, and a knuckle-boom **deck crane** (often port side) for lifting gear ⁴ . Pots are stacked 2–3 high on the deck when transiting. High bulwarks or a “**wingwall**” along the edge protect crew from waves ⁵ . The deck usually has painted high-traction **non-skid** lanes for safer footing.
- **Interior Compartments:** These vessels have cramped but vital interiors. The **wheelhouse** (bridge) sits atop the forward deckhouse, with 360° windows for visibility. Directly below, the main deckhouse holds the **galley** (kitchen/mess) and a few **berths** for crew bunks, usually in the forward section. Often the captain's cabin is right behind or below the wheelhouse ⁶ . The **engine room** is typically beneath the deckhouse (forward or midships) and may span under the main deck ⁷ , though on some designs it's more toward midship to balance the heavy stern gear. The vessel also contains one or more insulated **holds or tanks** amidships for storing the catch (live crab held in circulating seawater). A small **head** (toilet) and storage lockers are fitted where space allows. Many doors and hatches are **watertight** with dog latches, maintaining hull integrity in heavy weather.
- **Common Safety Equipment:** Being an ocean-going commercial vessel, a crab boat carries required emergency gear. Bright orange **life rings** are mounted on deck rails (with 60 ft floating lines) for man-overboard recovery ⁸ . There are typically one or two inflatable **life rafts** in hard canisters on top of the deckhouse or wheelhouse. Each raft is secured with straps that release if the ship sinks (hydrostatic release). The boat has an automatic **EPIRB** (Emergency Position-Indicating Radio Beacon) on an upper exterior mount – vessels over 36 ft must carry a Category I EPIRB that auto-activates if submerged ⁹ . Inside, a locker contains **immersion suits** (survival suits) for every crew member ¹⁰ , usually near the berthing area or escape routes. Other visible safety items include fire extinguishers in red brackets, audible general **alarm bells**, deck **alarm lights**, and posted safety placards (e.g. muster stations). Watertight doors on deck are marked with “Keep Closed” signs. Survival craft (life rafts) have hydrostatic release units with visible expiration tags, and you'd find an **EPIRB** bracket with a beacon (typically a bright yellow case) on the wheelhouse roof or mast.

1.2 Longline Fishing Vessel (Auto-Line Longliner)

- **Typical Size:** Longline fishing vessels vary but offshore longliners are often mid-sized, around 50–100 ft in length (15–30 m) with beams ~20–25 ft ¹¹. Modern purpose-built longliners can be larger (some up to ~60 m for factory longliners ¹²), but a classic North Pacific longliner (e.g. targeting halibut or blackcod) might be ~100 ft. These carry tens of miles of line and significant fuel/catch, so they have moderate tonnage (100–300 GT for a 30 m vessel).
- **Deck Layout & Gear:** A longliner's layout is focused on line handling. They typically have an aft working deck with a low **transom** or opening where lines are set and hauled. A defining feature is the **baiting shelter/weather cover** over the stern deck to protect crew while working lines in rough weather ¹¹. The main longline gear includes a powered **line hauler wheel** or side roller (usually on the starboard quarter) for retrieving the longline, and line storage bins or a mechanized **line drum** amidships. There may be bait stations or auto-baiting machines under the shelter. The superstructure (crew house and bridge) is often forward (bow), similar to crabbers, providing a forecabin deck. Longliners also have large **ice holds** or freezers below deck to preserve the catch (20–40 tons of fish packed in ice is common for 50–100 ft vessels ¹¹). Decks are kept clear for line work: you'll see many **orange buoys and flagpoles** along the rails when gear is stowed (used to mark line ends) ¹³. Longliners typically have guard rails and handholds around the hauling station due to the dangerous taut lines.
- **Interior Compartments:** The forward deckhouse contains the **wheelhouse** on top (small bridge with necessary nav instruments). Below that, a combined **galley/mess** and berthing area for the small crew (often 5–6 people) is in the forecabin. The **engine room** on these vessels is usually toward the stern under the work deck (aft) or midship, accessed by a ladder from the main deck or via a hatch in the deckhouse. The engine space may be adjacent to a **lazarette** (stern-most compartment) which on a longliner might house steering gear and hydraulic machinery for the longline hauler. There are refrigerated **fish holds** amidships below deck, often subdivided for ice storage. Some longliners also have a separate **bait freezer** compartment. Given their size, interior passageways are narrow; watertight bulkheads separate engine, hold, and accommodation spaces. The bridge is compact, often just one helm chair surrounded by sonar, GPS plotter, and radio, with windows sometimes heated to prevent icing.
- **Common Safety Equipment:** Longliners carry similar safety gear to other fishing vessels. **Life rafts** in cradles are found on the top of the deckhouse or bridge roof. An **EPIRB** beacon will be mounted high on the cabin. Immersion **survival suits** for each crew are stored in a locker (often on the aft bulkhead of the cabin or under bunks). **Life rings** with reflective tape are typically mounted near the stern working area and bow. These vessels also often have a **hydraulic deck winch** and many moving parts, so safety guards and emergency stop switches (marked in red) are visible at the hauling station. Longliners in cold regions carry **spray nozzles** or steam lines to de-ice equipment, and you'll see anti-slip grating on deck. **Flood alarms** and **bilge pumps** with indicator lights are installed in engine and hold spaces (crew must monitor for leaks when shipping seas). Watertight doors separate the factory/processing area (if any) or are fitted at the stern shelter entry. The bridge will have a general alarm and often a **"man overboard" alert button** given the danger of crew being pulled over by a line – usually a big red button on the bridge console or near the hauling station to cut the line.

1.3 Factory Trawler (Catcher-Processor)

- **Typical Size:** Factory trawlers (also called catcher-processors or "super trawlers") are large seagoing ships, often 60–100+ m (200–330 ft) in length with beams of 12–18 m ¹⁴ ¹⁵. For example, some

U.S. Bering Sea factory trawlers are ~300 ft long ¹⁶ , housing over 100 crew, while modern Norwegian designs can be around 80 m (262 ft) ¹⁷ . These ships are high tonnage (e.g. 2,000–5,000 gross tons) because they contain processing plants, freezing holds, and massive fuel/catch capacity.

- **Deck Layout & Fishing Gear:** The hallmark of a factory trawler is a large **stern trawl ramp** and heavy-duty winches. The superstructure (bridge and accommodations) typically occupies the forward section of the vessel (many decks tall), while the aft half is dedicated to fishing operations. A stern trawler has one or two huge trawl **net drums** on deck or below a partial shelter, used to spool the nets ¹⁸ . There are powerful **trawl winches** (often 2 main winches with 40–50+ ton pull) for the warps ¹⁹ , as well as multiple smaller net handling winches (Gilson winches, cod-end winches) ¹⁸ . At the very stern is an angled ramp where the net is hauled in. On the sides of the ramp, large steel **trawl doors** and blocks are visible (these guide and spread the net). The deck has massive hydraulic power units and often a telescoping **deck crane** for moving loads ²⁰ . Forward of the ramp area, the deck may be partly enclosed as a **factory deck**, where fish are processed. There will be hatches or conveyors leading from the deck to the processing plant below. The layout is multi-level: fish caught are brought up on deck via the net, dumped into a **receiving bin**, then pass through processing machines below deck (filleting, sorting, freezing). The factory trawler's outline includes a high bow and flared sides to handle rough seas, and a cluttered stern deck packed with gear. Freeing ports and scuppers line the main deck to shed water.
- **Interior Compartments:** These ships are like floating factories. The **bridge** spans the full width near the bow on an upper deck, with extensive navigation and fish-finding electronics (radars, sonars, electronic charts, engine control systems). Below the bridge are multiple **accommodation decks** for crew: dozens of berths, galley with cafeteria, recreation/lounge areas, a hospital/first-aid room, showers, etc. Midship, typically on the main deck or one level above, is the **processing deck** (factory). This area contains conveyor belts, fish processing machines, mincers for fish meal, and packing stations. Adjacent are industrial **freezers** (plate freezers, blast freezers) to immediately freeze the catch ²¹ . Further below are large **freezer holds** where packaged product is stored (often at -20 °C). The **engine room** is sizable, usually aft below the factory deck – housing main engines (several thousand HP) plus generators (often multiple, e.g. 1,500 kW shafts ²²) to run the plant and freezing equipment. Ancillary rooms include a **machinery workshop**, **hydraulics/pump rooms**, **refrigeration plant rooms**, and a **bridge control room** overlooking the stern deck for winch operations ²³ . The vessel has many watertight compartments and fire sections given its size. Stairwells and watertight doors connect decks; for instance, you'd find an internal staircase from the bridge down to crew decks and to the factory, plus exterior stair ladders for quick access to deck. These ships carry so much equipment that you might find every inch of space used – e.g. flume tanks for stability, sewage treatment rooms, etc. It's essentially a self-contained industrial facility at sea ²⁴ .
- **Common Safety Equipment:** Being large, these vessels comply with SOLAS-like requirements. They have multiple **enclosed lifeboats** or life rafts on davits (usually visible near the boat deck). For example, a 300 ft factory trawler will often have bright orange hard-shell lifeboats amidships on each side, plus additional inflatable rafts ¹⁶ . Dozens of **immersion suits** and lifejackets are distributed at muster stations. **Fire detection and suppression** systems are robust: you'll see fire alarm pull stations in corridors, CO₂ release controls outside engine and factory spaces, and water mist or sprinkler systems. **General alarms** and alert lights are installed throughout the ship. An automatic **EPIRB** is mounted on the bridge deck and **SART** (Search and Rescue Transponder) devices are stored on the bridge. The bridge also has a **GMDSS** station for distress communication. Emergency escape route markings line the corridors. There are likely **bilge alarms** in all lower compartments, and engineers monitor a control panel for any flooding. Watertight **bulkhead doors** have indicator lights on the bridge showing open/closed status ¹¹ ⁸ . Additionally, these vessels often operate in Arctic

conditions, so they have anti-icing measures: steam pipes along deck edges, heated windows, de-icing nozzles, etc. Crew on deck will use safety lines and harness attachment points; you can spot padeyes and tether lines along the processing deck and ramp. Due to heavy machinery, **emergency stop** pull-cords run alongside conveyor belts and winches, painted red for visibility. All safety gear is clearly labeled and illuminated by emergency lighting in case of power loss.

Sources: Real-world data was referenced from fisheries agencies and vessel specs (e.g. ADF&G vessel guides, Crowley Marine designs, Trident Seafoods fleet data, and US Coast Guard safety regs). For example, Alaska's Fish & Game notes crabbers can exceed 100 ft with decks stacked with pots ³, and Crowley's crab boat design shows typical pot gear layout (hauling davit starboard, pot launcher midships, crane port, with a protective bulwark) ⁴. Longliners commonly have stern shelters and are identifiable by their buoys and aft working decks ¹¹. Factory trawlers like Trident's fleet reach 300+ ft and house processing plants with 100+ crew on board ¹⁶. Required safety items such as EPIRBs, immersion suits, life rafts, and life rings are mandated for these vessels and are visibly present ⁹ ¹⁰ ⁸.

2. Level Designs: The Three Boats (VR Playable Levels)

We design three distinct VR levels, each centered on a different fishing vessel and difficulty tier. **Each boat is an explorable 1:1 scale environment in storm conditions**, with unique layout, motion profile, and tasks. The levels escalate in complexity, hazard density, and duration (Level 1 \approx 30 min, Level 2 \approx 45 min, Level 3 \approx 60 min gameplay). All levels emphasize the game's core experience: performing urgent shipboard tasks in disorienting storms, using realistic equipment under duress. Below, we detail each level and its design attributes.

2.1 Level 1 – *F/V Seaward* (Small Crabber, Bering Sea)

A. Boat Identity: *F/V Seaward* is a 34 m (112 ft) pot fishing boat out of Dutch Harbor, Alaska (registry: USA – AK). It's an older **crabber** (1970s-built steel hull) known as a tough “old workhorse.” The vibe is very *Deadliest Catch*: the vessel operates in the Bering Sea. It has a **weathered blue hull** with white trim, though much of the paint is peeling and streaked with rust. As an aging ship, it sports visible patches and welded repairs. The crew's personal touches are evident – the wheelhouse has stickers on the electronics, a coffee thermos rattling on the dash, and the captain's lucky talisman (an old buoy) hanging overhead. The name “SEAWARD” is painted on the bow and is barely readable through the salt-stained, battered paint (authentic grime!). This boat feels gritty and lived-in: coils of line and buoys are piled on deck, and the interior has family photos taped by bunks. **Mood palette:** This level's storm setting is **Day Storm: Steel Blue Fury** as primary, with an undertone of **Calm Before the Slam: Ominous Lull**. The daylight is a cold, gray-blue overcast, so everything looks steel-blue and frothy. There are brief lulls where the light momentarily softens (ominous calm) before the next adrenaline-spiking wave.

B. Layout Blueprint: *F/V Seaward* is small enough that the player can traverse from deck to bridge in seconds, but movement is constrained by tight spaces and ladders. Below are text “blueprints” for the main areas:

- **Main Deck (Aft Working Deck):** This is the open area where crab pots are stacked. At the stern, there's a low rail and an upright sorting table. Port side aft features the hydraulic **crane (C)** and pot lift; starboard side has the **pot launcher (L)** at the rail. Pots (marked [P]) are stacked 3-high along the center and sides. A bait station with cutting board is near the port rail. Deck scuppers run along the

aft edges. Forward on this deck, against the deckhouse, is a stout **engine hatch** (marked ^^^) and a companionway door into the interior. The diagram below shows a top view:

```
[Forward / Bow ->]   (Raised foc'sle with Bridge)
+-----+ <-- Wheelhouse above
| Bridge cabin |____
| (fwd house)  | 0  <- 0 = life raft canister
+=====door====+-----
| [P][P][P]    | <- Pot stack against port rail
| C      ^^^   L | <- C=Crane (port), L=Pot launcher (stbd), ^^^=engine
hatch
| [P][P]      [P] | <- Pots stacked along starboard side too
|____Deck_____|   (Stern with sorting table, railings, crane base)
```

Main deck: A compact working area. The **wingwall** (heavy bulwark) runs along port side from the deckhouse forward to midships, providing some shelter ⁵. Handrails and safety lines are present along open edges. The primary access routes: a **door** on the forward bulkhead (center) leads into the galley; a steep **ladder** on the starboard side of the deckhouse goes up to the bridge outside (also reachable from inside). Choke points include the narrow gap between pot stacks and the rails – only one person can pass at a time. **Handholds** are everywhere – pipes, railings, ladder rungs – because the crew must grab something whenever the boat rolls. The engine room hatch on deck is a small square opening with a steel cover; it is dogged shut and labeled “Engine.” If opened, it reveals a ladder straight down. There are two rail **gates** (one each side aft) that must be latched to keep people from falling overboard when seas wash across. The player will find safety lines (tethers) running along the deck where they can clip in.

- **Bridge/Wheelhouse:** The wheelhouse is a single-room bridge atop the forward house. It’s compact and **lined with windows** on all sides. The helm station (wooden ship’s wheel and throttle levers) is central, with an array of analog gauges (engine RPM, rudder angle, etc.) ²¹ and a few digital readouts. **UI elements** are diegetic here: an old radar screen glows green (an analog **UI_RADAR_GLOW** scope) and a fishfinder/depth sounder with a blue sonar ping line (**UI_SONAR_PING**) sits to the right. The radar is the key nav instrument – it has variable range rings and the player can see the sweeping blip. Overhead, red lights (night lighting) can be switched on (**LIGHTING_BRIDGE_RED**) for nighttime, but since this level is daytime, the bridge is using normal lights and lots of natural gray light from windows. In one corner, a paper chart is pinned on a table with course lines drawn. There’s also a GPS unit (small screen) but during the storm it occasionally loses signal. The bridge has a single captain’s chair bolted to the floor and a few mug holders (one with coffee that can spill). A **radio** (VHF) is mounted above, squawking weather updates. Access: a **companionway ladder** on the aft wall leads down to the galley; also an exterior door (aft) opens to a small outside **bridge wing** platform with a ladder down to deck (starboard side). The bridge is a “safe room” relative to the deck – it’s enclosed and high, but it is also a chokepoint (small doorway). Notably, the **horizon visibly rolls** through the windows (the whole sky and sea tilt with the boat’s motion – the VR camera’s horizon will be artificially stabilized a bit to reduce sickness, see VR plan). Key interior items: analog **compass**, **barometer** (aneroid type on the wall) showing a rapidly dropping pressure ¹⁰, a **wind gauge** anemometer readout, and a panel of alarm indicators (bilge, engine oil pressure, etc.). There’s also a functional **spotlight** control (search light on the outside, can be pointed where needed) – in this level it might not be needed in daytime, but the hardware is there (lever and toggle labeled “Spotlight” – using it casts a beam **LIGHTING_SPOTLIGHT_BEAM** useful in

heavy spray). The bridge layout is such that if the player stands at the helm, they can reach most controls within arm's reach – helpful as the boat bucks in the waves.

```
[ F/V Seaward - Wheelhouse plan ]
+-----+
| Helm (wheel & throttles) |<- Front windows to bow
|                           |
| Radar screen (CRT)      | Nav console with GPS/radio
| Fishfinder, gauges      |
|                           |
| [Captain's Chair]       |
|                           |
| Chart table (maps, barometer) Door -> exterior ladder
+-----+
```

Bridge notes: It's tight – perhaps 3m x 3m floor space. The **cameras** (CCTV monitors) are in one corner, showing grainy deck views (if functioning). One monitor shows an aft deck cam – useful to check crew and gear, but on this boat it's an older system (black-and-white). A **general alarm** pull is near the door (in case of abandon ship, rings bell). This is a refuge but also where navigation happens. Choke point: the ladder down is narrow; moving from helm to door can be obstructed if another NPC is there (e.g., the captain NPC might occupy the helm occasionally). The player can use the bridge as a temporary safe zone to plan next actions (less water and wind inside), but tasks will draw them out.

- **Interior (Galley & Berths Level):** Down the ladder from the wheelhouse is the combined galley/mess and crew quarters. Immediately at the bottom of ladder is the **galley** – a tiny kitchen with a bolted-down table and benches. There's a stove range with a kettle (often sliding off in rolls) and a pot of coffee brewing (slosh sounds). A secured cabinet holds plates (can rattle). Forward of the galley through a tight door is the **berthing area**: 4 bunks (two bunks on each side), with curtains, and personal gear straps. This is the fo'c'sle space in the bow – it's cramped and V-shaped towards the bow. It moves violently in seas (big up/down motion in the bow). Personal items (books, a guitar, etc.) are stowed here; if unsecured, they can tumble. Back in the galley, a **companionway** leads to the deck through a heavy watertight door (the same door that was shown on the main deck forward bulkhead). This interior is considered a semi-safe zone (protected from direct waves), but it can still flood if water breaches a door or hatch. Lighting here is fluorescent white (with a backup red light option for night). The **floor** is checkered rubber matting (non-slip, wet from gear and rain the crew tracked in). Key points: A **first aid kit** is mounted by the ladder, an **immersion suit locker** (marked with a sticker) is under one of the bench seats, and a **damage control locker** (with pumps, patches) is in the corner. The interior corridor is essentially just these two spaces in this small vessel. Handholds (overhead grab rail) are installed along the ceiling – the player can physically grab it for stability (in VR this will engage a comfort aid).

```
[Below deck - Galley & Berths]
+-----+
| Galley: table          | Ladder ^ (up to Bridge)
| kitchenette           | <- Watertight door to deck
| [Immersion suits]|
```

```

|-----|----+
| Berth bunks || Berth bunks (4 beds total) (Bow)
| Personal storage lockers |
+-----+

```

Interior notes: Because it's small, moving through these rooms in VR under motion is a challenge – we ensure plenty of grab points (table edges, railing, ladder). The **choke point** is the single watertight door to the deck – in heavy seas it can be hard to open/close (the player will physically turn the latch). The **engine room** access is via the deck hatch (not through this interior), which is a design quirk: to check the engine or bilges, one must go out on deck and open the engine hatch. This means in-game the player must briefly go outside to get below, adding risk.

- **Engine Compartment (Below Deck):** Accessed by lifting the steel hatch on the main deck and climbing down a vertical ladder. The engine room is a single compartment beneath the main deck, forward of the stern. It contains a single large diesel engine (in the center), a small generator, and various pumps. Overhead is low – you can crouch but not stand fully upright in spots. The engine is loud and hot. There are walkway gratings around the engine and valves on the bulkheads. Key interactive items here: the **bilge pump**, **breaker panel** (for electrical circuits), and status gauges for engine oil pressure and temperature. It's dimly lit (some flickering fluorescent lights and a portable work lamp). A **fixed ladder** leads back up to the deck hatch – which is a tight vertical climb. The player will only enter the engine space for specific tasks (e.g. resetting breakers, checking leaks) as it's claustrophobic and noisy. Because it's forward (under the house), it moves less violently than the stern, but still plenty of vibration. There is a secondary escape: a **sealed hatch** aft leads to a tiny lazarette at the very stern, but it's normally kept dogged – not useful for gameplay except as an emergency route if the deck is impassable (we won't force the player through it unless a narrative event opens it).

C. Storm Profile & Motion Model: Level 1 puts the *Seaward* in a **medium-intensity storm (Storm Intensity 3/5)** – think of a strong gale or borderline storm with 5–7 m waves. The environment is the Bering Sea in daytime: iron-gray waters, overcast sky with fast-moving clouds. **Primary wave character:** short, steep wind-driven waves with occasional larger swells. Because the boat is small, it **itches and rolls dramatically** on even moderate waves. The motion model is tuned for a 34 m vessel – roll period around 6–8 seconds. The boat will roll up to ~30° each side regularly (with some extreme rolls nearing 40° on a rogue wave). Pitching is also pronounced when heading into waves (bow slamming into waves). The horizon in VR will tilt (CAMERA_ROLLING_HORIZON) but we apply a slight stabilization so the player doesn't get sick – low-frequency large rolls are shown, while high-frequency shudder is in audio/haptics.

- **Storm behaviors/events:** The boat is fighting its way **beam-on to the seas** initially, causing heavy rolls. Mid-level, the player (or NPC captain) will turn the boat bow-into the waves for the “final push” to shelter, which changes the motion to more pitching and less roll. Triggered events include: a **“rogue wave” slam** in Act 1 (a much larger wave strikes, washing over the deck – a green wall of water that knocks unsecured items loose). This is the first big **WATER_WAVE_IMPACT_SLAM** event, kicking off many tasks. Another event: an electrical sputter causes a **power flicker** – lights blink as the generator trips (this is a minor scare that prompts checking the generator/breaker, but emergency lights come on). Later, an **engine falter** (brief drop in RPM as the propeller cavitates in heavy seas) creates an adrenaline spike – the player must ensure fuel suction or cooling isn't failing. Through the level, **“impact slams”** occur frequently: roughly every few minutes a big wave crashes

on deck or pounds the hull, causing the boat to shudder (camera shake and loud boom). These become *more frequent and more intense* as time progresses (e.g. in Act 3, every minute there's a heavy slam, vs. Act 1 maybe every 3–4 minutes). The storm also delivers constant **green water on deck** – meaning large splashes of seawater frequently sweep across the aft deck (**WATER_GREEN_WATER_ON_DECK** effect). We simulate this by spawning splash volumes that rush from one side to the other, forcing the player to time dashes between safe spots. Rain is **heavy** (**WEATHER_HEAVY_RAIN**) throughout, occasionally turning to sleet. Wind ~50 knots with stronger gusts – howling from the northwest. This drives **spray (spindrift)** over the crests; fine salt mist stings the eyes (**WEATHER_SPINDRIFT**). There is no heavy icing in this level (temperature is just above freezing, so only light icing on railings if any). However, the combination of cold rain and constant motion can induce seasickness – it's intentionally disorienting but tuned to VR comfort limits. **“Where water accumulates”**: The aft deck briefly floods when big waves hit, but drains out through scuppers in 10–20 seconds if they are clear. The player will see water pooling around ankles until freed. Dangerous pooling can occur if scuppers clog (a task is to clear them). Water also tends to enter through any open hatch (so if the engine hatch or doors are left open, interior flooding can start – a fail condition). The boat's **freeing ports** (deck edge openings) visibly open with water pressure to dump water and then close; if they jam, deck flooding lasts longer. Inside, any flooding will slosh back and forth with the roll – e.g. the galley might get a film of water on the floor if the deck door was open when a wave hit. By the final act, the shoreline (distant mountains of Alaska) becomes faintly visible ahead between waves, giving the player a target to reach as the storm crescendos.

D. Aesthetic Implementation Checklist: For *Seaward* (Level 1), the art and effects focus on a chaotic daylight storm with cold, gray tones and practical lighting from the vessel.

- **Lighting:** The exterior uses natural overcast light plus the ship's working lights. On deck, **amber floodlights** are mounted on the mast and house (tagged **LIGHTING_DECK_FLOOD_AMBER**). These cast a warm sodium-vapor glow on sections of the deck, contrasting with the blue-gray ambient light. They flicker occasionally as the generator struggles. Inside the bridge, lighting is subdued; during day the crew often switches off main lights to reduce glare, but the instruments glow. We ensure the **UI_RADAR_GLOW** is pronounced – the radar scope casting a green glow on the captain's face. If the player turns on the wipers and spotlight at any point: the **spotlight beam** will be visible cutting through rain (volumetric **LIGHTING_SPOTLIGHT_BEAM**, even in day it's noticeable against dark clouds). No red lights are in use in this level (that's for night levels), but an emergency red beacon will flash if general alarm is triggered.
- **Weather VFX:** Rain is on full blast (**WEATHER_HEAVY_RAIN**) with high density particle systems. It's angled at ~30° due to wind. **Thick fog** isn't present at sea level (visibility is moderate, a few hundred meters), but distant views are hazy. We do have **spray and spindrift** effects – every wave crest generates wind-blown spray. In fact, as the boat crests a wave, you see wind ripping streaks of foam off the wave tops (**WEATHER_SPINDRIFT**). These appear as white mist passing over the deck. Occasionally, distant lightning flickers in clouds but no direct strikes (mainly for ambience; thunder is muffled by wind). The sky is dark steel-gray with low clouds racing – giving a **MOOD_DREAD_STEADY** backdrop.
- **Water and Impact Effects:** The sea color is a deep green-gray (**WATER_GREEN_WATER_ON_DECK** is literally greenish water). When waves crash, we use big splash particles and **foam streaks** on deck (**WATER_FOAM_STREAKS** decal that briefly lingers where water rushed). Each **WAVE_IMPACT_SLAM** event triggers camera shake (**CAMERA_HANDHELD_SHAKE**) and a brief **CAMERA_WET_LENS** effect – drops of water on the “camera lens”/player view to simulate seawater hitting goggles. The wet lens

drips off over a few seconds (player can manually “wipe” their goggles by a controller gesture, effectively clearing it). Green water events: a large translucent mesh of a wave washes over, combined with particle spray. We also ensure the **rolling horizon** effect is active: as the boat tilts, the whole world including horizon tilts (we keep the player’s inner ear reference slightly dampened to avoid sickness, but visibly it rolls ~75% of actual motion – enough to sense it). Surfaces are slick with **MATERIAL_WET_SHEEN**: every metal rail or deck plate reflects light from wetness. The **MATERIAL_RUST_STREAKS** and **MATERIAL_PEELING_PAINT** are applied to external walls, deck winches, etc., per the style bible – this ship is grungy. No ice materials in this level (temp is just above freezing), but plenty of dripping water and some algae/slime on deck edges. Interiors have some condensation on windows. We simulate that with a slight **fogged glass** shader at the window edges which the wipers clear in arcs.

- **Camera & VR Effects:** The VR camera is set for a first-person height of about 1.75 m on deck. We enable **CAMERA_HANDHELD_SHAKE** to mimic the head micro-bobbing when the player stands on a moving ship (low-amplitude noise to simulate engine vibration and wave impact jolts). **CAMERA_ROLLING_HORIZON** as mentioned gives the world tilt – this is critical for realism, but we have a comfort toggle to reduce it. We incorporate a subtle **breathing and pulse** effect in the camera in high-adrenaline moments (when an objective is critical, slight FOV pulse to hint at player’s heartbeat – an optional effect for immersion). If the player holds onto a handrail (using the grip mechanic), we dampen camera shake to simulate bracing (more in VR Comfort section). Also, the player’s view can get *wet* – aside from wet lens droplets, if the player is hit by a wave, we play a quick **water on goggles** overlay and muffled sound to feel like being dunked. We never completely obscure vision for more than half a second to avoid disorientation.
- **Audio:** The level’s soundscape is loud and intense but with careful layering. The **engine** (a throaty diesel) provides a constant low *rumble* and periodic *revving* when the propeller lifts out of water (a harsh rising whine followed by a cavitation noise). The exhaust stack emits a deep drone. **Wind** noise is omnipresent: a howling bed of sound that fluctuates with gusts (low-frequency rumble plus high-pitched whistling through antennas and rigging). When on deck, wind dominates; we implement a slight occlusion when the player is inside (interior muffling). **Rain** produces percussive hits on the metal deck and wheelhouse roof – a continuous cacophony that rises in big gusts. Every **wave slam** event has a distinct audio: a thunderous *boom* of water on steel plus a resonant vibration (we shake the subwoofer or controller haptics). If on deck, the player also hears the roar of water and possibly the crunch of a shifting pot stack. **Surfaces** creak: the boat’s wooden wheelhouse floorboards groan with stress, and deck fittings clank. Inside, drawers slide and dishes rattle in sync with rolls. Alarms: there’s a high-pitched **bilge alarm** that may trigger (a repeating beep) and a **general alarm bell** (repeated clang) if something major happens. The **radio chatter** is periodic – the Coast Guard weather broadcast comes through with static: e.g., “...Storm warning... seas 20 feet...” which is a diegetic hint. Crew callouts: an NPC voice (the captain) will yell short lines over the sound: “Secure that gear!” or “Brace yourself!” before a big wave (scripted before the rogue wave event). These callouts serve as diegetic guidance for objectives (no floating text, just realistic shouting). We also use an intercom squawk to simulate the captain giving instructions from the bridge if the player is on deck (“We’re nearly there – keep her afloat!”). All audio cues are 3D positioned and volume-adjusted to the environment (wind might drown out a distant shout unless an earshot mechanic boosts important lines). The interior muffling: once the player goes inside the galley or bridge and shuts the door, exterior storm noise is reduced ~50% and filtered (low-pass), emphasizing internal sounds (engine hum, alarm buzz inside). This contrast provides brief “ear relief” and a sense of refuge.

E. Audio Design Notes: (*Integrated above in aesthetic; listing key notes for summary*) For Level 1, the audio profile includes a chugging medium-speed diesel **engine** with varying load sounds (you can tell when it’s

laboring vs idling by the tone). The **wind** has multi-band components: a deep rumble that you *feel* and a high whistle that varies as you move (e.g., louder near door cracks or when you poke your head out a hatch). Wave **slams** trigger a composite sound: low boom + mid-frequency thud of water + a sharp spray hiss. Interiors dampen these booms but you still hear a dull thump. We ensure **alarms** are attention-grabbing: the bilge alarm is a bell with a blinking light, so you *hear* it in the engine room or bridge distinctly (and see the light). A **radar alarm** (if proximity alert) is a different tone (beep). Importantly, all critical sounds have visual backups (like alarm lights) due to the loud environment. **Dialogue**: The captain's voice is heard via direct line-of-sight if nearby, or via a crackly PA speaker on deck if he's on the bridge. This level uses minimal music – maybe a subtle suspenseful underscore in lulls – because diegetic sound carries the tension. We do, however, spike a bit of music sting when the rogue wave hits (to mark the event dramatically, blended with sound).

F. Diegetic UI Plan: There is **no floating HUD** – all feedback is through in-world instruments and cues. On *Seaward*, navigation and objective info are delivered diegetically:

- **Instruments & Tools as UI:** The **radar screen** (green glow CRT) provides situational awareness – e.g., if the player needs to know heading or nearby obstacles, they look at radar. A subtle **UI_RADAR_GLOW** effect makes it easy to spot important blips (like a shoreline or hazard) on the scope. Similarly, the **analog gauges** (tagged **UI_ANALOG_GAUGES**) like the engine RPM, rudder angle, and battery voltage are readable and well-lit on the console. When an objective involves those (e.g., “check wind speed” or “monitor barometer”), the player reads the actual gauge in VR (we ensure the text and needles are high-contrast and legible despite motion – using larger fonts or even a slight glow). The **sonar/depth sounder** gives pings and a digital depth readout (**UI_SONAR_PING** visual/audible) – useful if the player needs to worry about shallow water as they near shore.
- **Task Prompts & Checklists:** Since no pop-up text will say “Do X now,” we rely on diegetic prompts. For example, a **checklist clipboard** is hanging in the galley with tasks listed (initially it has a few critical items scrawled, and more get added dynamically or circled by an NPC). If the player looks at it, they see items like “Secure deck – strap pots, close hatches” etc. When tasks are completed, the character might cross them off (or the text changes color via material swap). Also, **warning lights** serve as objective prompts: if a red light on the panel labeled “Hatch Open” is lit, that implicitly tells the player “go close the hatch.” Similarly, an **immersion suit locker** might have a light if open/unlocked (some boats have indicators). We incorporate subtle highlights: e.g., the first time an objective appears, an NPC voice or radio will mention it (“*We’ve got water coming in – check the bilge!*”), and perhaps a nearby indicator flashes.
- **Time Pressure Indication:** There’s no countdown timer on screen; instead, the world conveys urgency. One mechanism is the **barometer** – it’s visibly dropping fast ²⁵ ; players who know can interpret that as “storm worsening soon” (and we have a task specifically to note it, clueing them in). Another cue is the **alarm cadence**: for instance, the bilge alarm beeping becomes more frequent if water rises (like a warning that failure is nearing). We also use the **engine telegraph**: the captain rings the brass telegraph (ding sound) to order a speed change if approaching harbor – that can signal “final stretch, hurry up” to the player. Additionally, **environment changes** act as timers: by 75% through the level, the shoreline (safe harbor) is in sight between waves, implying the player just needs to hold out a bit longer – but simultaneously the storm is peaking (waves largest now). This creates a race-feel without explicit timers.
- **Accessibility & Clarity:** All critical UI elements are designed with high contrast and intuitive analog style, so even a motion-sick or panicked player can read them. For example, the **compass** has a clear “lubber line” and bold numbers. Instruments that deliver important info (like the bilge level alarm)

have both light and sound. The **crew's dialogue** also reinforces some UI info ("*Bilge alarm in Engine Room!*" if it goes off). If text is used (like labels on a breaker panel or checklist notes), we ensure they're large and lit by a task light so the player can read them even while the scene is shaking – or they can bring it close in VR. We avoid any tiny fine print. There's an option for players to enable a subtle **horizon line overlay** for comfort (a VR comfort aid – not diegetic, but a thin line across the view to give a stable reference ²⁵ ²⁶). By default it's off on this level to preserve realism, but available in settings.

G. Level Gameplay Loop: *F/V Seaward* Level 1 follows a three-act structure with increasing stakes:

- **Act 1 – Stabilize the Deck:** The level begins amid the storm with an initial big wave strike (a surprise **MOOD_ADRENALINE_SPIKE** moment where crates shift and water floods the deck). The immediate objective is to stabilize the situation: the player must rush out on deck to **secure loose gear and close openings**. Task chains here include lashing down pots and barrels (securing cargo), closing the deck hatch and any open doors, and clearing the scuppers of debris so water can drain. These tasks force the player to traverse the deck, fighting slippery surfaces (hazard: slip) and incoming waves (hazard: impact). For example, one early task: a stack of crab pots starts to slide – the player uses a chain binder to re-tighten it (if they fail or delay, a pot could break loose leading to a fail state of serious hull damage or injury). This act trains the player on handholds and basic interactions under pressure. Mood-wise, it's frantic but short-lived spikes with small lulls after each mini-crisis. By the end of Act 1, the deck is reasonably secured (no immediate threat of capsizing from loose cargo). **Fail states:** If the player ignores a major task (e.g. leaves a hatch open), water ingress could exceed a threshold – the ship would slowly **flood** and eventually capsize (game over scenario, though we telegraph it with alarms and heavy listing). Another fail state: getting swept overboard – if the player doesn't tether when a massive wave hits, they could be thrown off (which we represent as a blackout and "Man overboard" fail screen). However, we provide safety nets: generous tether grab volume and a second-chance QTE if they start slipping towards an edge (like the game auto-grabs a railing for them if they react in time).
- **Act 2 – Repair and Secure Systems:** Just as the player catches their breath (a brief **MOOD_OMINOUS_LULL** where waves momentarily ease and the sky lightens slightly), new problems arise. Act 2 focuses on internal ship systems failing under strain, requiring the player to move between the deck, interior, and engine room. For example, after deck stabilization, the **generator** hiccups and some lights flicker – the player needs to go below and **reset a breaker** or start the backup generator (guided by alarm and possibly an NPC engineer voice). While in the engine room, they might also notice a **minor leak** (a shaft seal dripping) and have to jam a rag or mark it (deliberately introduced so they perform a flooding control task). Then a call from the bridge: the **autopilot is malfunctioning in heavy seas**, so they must come up and possibly switch it off to manual (or assist the captain by holding the wheel steady while he fixes a nav setting). Meanwhile, a **bilge high water alarm** sounds – maybe a compartment is flooding from earlier damage. The player grabs a portable pump and deploys it in the fish hold to keep water down. These tasks chain logically: fix power -> address flooding -> adjust navigation. Each requires going to a different part of the boat, making the player traverse ladders in a storm (gameplay challenge: climbing while the ship rocks). Hazard density here is high: the deck is slippery *and* the interior has hazards like flying objects (open drawer in galley, swinging light fixtures). We introduce the **"lull to spike"** pacing: after each fix, a new bigger wave or wind gust hits (spike). For instance, once the bilge pump is set, suddenly a **rogue wave** bigger than before slams the boat – triggering Act 3. Act 2's primary difficulty comes from multi-tasking: the player might have to temporarily leave one problem to

address another (e.g., pump the bilge then run to steer the boat). However, we design it so tasks cue sequentially not all at once, to not overwhelm. **Fail states:** If the player neglects something too long, consequences cascade. E.g., if they don't reset the generator, eventually power dies and the ship broaches (could lead to capsizing). If they ignore the bilge alarm, flooding could worsen. These are time-critical but with reasonable windows (the "time pressure" conveyed by faster alarm beeps, etc., not an arbitrary timer). We also include some **assist systems:** important interactive items are slightly magnetized (the game will "snap" the player's hand to a switch or valve when they reach for it, compensating for VR wobble). Two-hand tasks (like carrying the pump) are made easier by stabilizing the object if the player grabs with both hands (tool tethering so it doesn't slip away in a wave).

- **Act 3 – The Final Push (Navigate to Safety):** The shoreline (or rather the entrance to a harbor or leeward side of an island) is now visible ahead in brief glimpses – offering hope. But the storm is at its worst (constant **MOOD_ADRENALINE_SPIKE**, high tension). In this act, the player primarily assists in **navigation and survival until reaching the waypoint**. The captain might be injured or busy manually steering, so the player must run around ensuring everything holds together. Tasks include: making a **"brace" call** on the intercom before the biggest wave hits (they see it on radar coming) – this warns any crew (diegetic way to say "get ready"). Also, manually **plotting a waypoint** or checking the compass to make sure they're still on course to the harbor (diegetic objective: the player might have to mark the chart or call out bearings). Outside, a piece of deck equipment breaks loose under final strain – e.g. a deck crane hydraulic line snaps causing it to swing; the player must quickly secure the crane (perhaps by locking the pivot or tying it down) while waves batter. This is the most dangerous deck task yet (hazard: heavy impact). The final critical task could be deploying a **sea anchor or riding anchor** as they near the coast to help stabilize in huge surf (for example, the objective: "Deploy anchor to hold position"). This is a hectic rope-handling task on the bow (rare for a crabber, but maybe dropping a spare anchor to avoid being pushed onto rocks). If implemented, the player would have to coordinate releasing the anchor at the right moment (perhaps with NPC help). During all this, the **adrenaline** is high: alarms blaring, waves at max height. The culmination: once the anchor/waypoint is secured, the boat rides out the last wave series and finds relative calm in the lee of land. The storm eases to a drizzle. A mood of **MOOD_EXHAUSTED_RELIEF** sets in. A final task might be to **sound the horn** or confirm via radio that they made it. A tired NPC might say, "We're safe... good job." The level ends with the boat in safe waters, battered but afloat. **Fail state:** The final fail possibility is if the player doesn't secure that last loose hazard (say the swinging crane) and it causes catastrophic damage (like smashing the wheelhouse windows or capsizing the boat). This would be a dramatic fail cutscene. But if they've made it this far, we give plenty of leeway and dramatic hints (the captain yells "*That crane will kill us, tie it down!*" etc.).

- **Assist/Anti-frustration features:** Throughout the level, we quietly help the player succeed in ways that don't break realism. For instance, the **handhold mechanic:** when the player grabs a railing, we implement a kind of "magnetic hand" that locks their viewpoint to the ship's motion more smoothly (so their VR view isn't overly jerky – preventing nausea and simulating bracing). Also, important small tools are **tethered:** if the player drops a wrench or flashlight, a chord or lanyard keeps it from sliding away forever (it might swing so they can catch it again). If they truly lose a critical item overboard, the game will have a spare spawn in an accessible spot (e.g., another wrench in the toolbox). Navigation wise, if the player is disoriented, an NPC might holler the next objective direction ("*Get to the wheelhouse, now!*"). We also utilize an optional **AR overlay** (diegetic AR, say the character's tablet) that can highlight mission-critical interactables with a blink – this is for accessibility if the player toggles "assistance mode." By balancing realism and some forgiving design (e.g., slower water

accumulation than reality, generous interaction zones), we ensure the level is intense but fair. The nausea level is monitored – if a player seems to struggle (we can detect if they stay in one spot unmoving, etc.), an on-screen prompt suggests enabling comfort mode or taking a break (in a diegetic way: e.g., a crew voice “*Catch your breath inside for a second!*”).

Overall, Level 1 serves as a **training ground in storm survival**, with forgiving consequences compared to later levels. The goal is that by the end, the player feels like a hero on a small boat who managed to keep it together long enough to reach safety. They’ll have learned to respect the sea – and hopefully have their “sea legs” for the next challenge.

2.2 Level 2 – *MV North Star* (Mid-Size Longliner, North Atlantic)

A. Boat Identity: *MV North Star* is a 55 m (180 ft) auto-longliner operating in the North Atlantic (think Grand Banks or Barents Sea). It’s a **modernized longline vessel** (class: combination longliner/ice-rated trawler) built in the late 1990s but retrofitted with new tech. The region vibe is the North Atlantic: sub-arctic waters, perhaps off Norway or Newfoundland. The ship’s registry is Bergen, Norway (NOR). The *North Star* has a distinct **green hull** with a white superstructure, sporting reflective strips for visibility. It’s known for fishing cod and halibut with longlines and has a reputation for enduring fierce **freezing spray** conditions. Age-tier: this vessel is middle-aged but well-maintained – not as rusty as the Level 1 boat, but still showing wear like scuffed paint and some rust at weld seams. Visual signatures: the *North Star* has a prominent **stern shelter** (a steel cover extending from the stern forward about 5 m, like a half hangar) to protect deck workers. It also has a pair of tall **auto-line drums** on deck for mechanized line hauling, which immediately set it apart visually from a crabber. The wheelhouse is enclosed with high windows and has a couple of **satellite domes and antennae** bristling on the roof (modern nav equipment). Crew personalization is subtler – perhaps a painted logo of a star on the funnel, and the crew’s rain slickers hanging on hooks with name tags. Being a Norwegian vessel, interior signs are bilingual (Norwegian/English), adding authenticity. **Mood palette:** Level 2 primarily uses **Twilight Storm: Fog and Glow** – the scene starts in an eerie dusk, with thick fog banks and the occasional golden glow of a low sun muted by clouds. As the level progresses into night, it shifts to **Night Deck: Sodium Amber Chaos** – the deck is lit by harsh amber lights against pitch black night and roaring seas. We get a mix of foggy twilight transitioning into chaotic darkness, forcing reliance on ship’s lights.

B. Layout Blueprint: *North Star* is larger and more complex than *Seaward*. It has multiple decks and interior corridors. The exploration spaces include: main working deck (stern), shelter deck area, interior hallways (connecting to galley and crew quarters), engine room, and a multi-level bridge. ASCII maps for key areas:

- **Main Deck (Stern Working Deck):** The primary work area is at the stern, where longline operations happen. This deck is partly covered by the stern shelter roof. There’s a stern slipway/opening for launching and hauling lines. The **line hauler** (H) is on the starboard side under the shelter – it’s a powered wheel that pulls the longline in. Port side stern has a large **net drum/line storage** (D) since this ship can double as a small trawler. Center stern is the ramp with an open hatch leading to a below-deck fish handling area. We also have a **hydraulic crane** (C) on the starboard side, used for moving buoys and heavy gear. Deck lockers line the sides (port has a locker for line bins, starboard has one for tools). There’s a **freeing port** at the extreme stern (a big opening to let water out). Toward midships, a set of steps leads up from the stern deck to the main deck level (since the stern deck is slightly lower). On the port forward corner of this deck, a **door** leads inside to the

factory/processing room. Starboard forward corner has an exterior ladder up to the boat deck (where lifeboats are). The deck is crisscrossed by **safety lines** to clip onto.

```
[Bow forward]      (Under Shelter)      Open Stern
+-----Superstructure bulkhead-----+   ___ stern ramp ___
| [Door]      [Winch controls]  [] | <-- [] = ladder to boat deck
|
|      D   (deck drum)      H           C|   <- D=Line drum (port), H=Hauler
(stbd), C=Crane
|
|_____<< Longline guide <<_____||   <- Stern opening where line goes out
|      Stern deck floor (non-skid)   ||
|_____Freeing ports & scuppers_____||
```

Main deck notes: This deck is larger than level 1's deck and more segmented. **Access routes:** besides the interior door forward (into processing area), there's a stair up to the boat deck (exterior, starboard) and a ladder down to the engine room (through a flush hatch near the door). **Choke points:** the stern ramp opening is a hazard zone (a big wave can come through it), so a safety chain is across it when not in use. The space under the shelter can feel cramped with machinery. **Handholds:** Pipes, railing along the shelter edges, and overhead bars under the shelter are all grab points. The player must navigate around the big drum and winch – narrow passages on either side.

- **Bridge/Wheelhouse:** *North Star's* bridge is more spacious and high-tech. It spans the width of the ship, with forward windows overlooking the bow and side windows down each side. There's an **arched console** with multiple touchscreen displays and analog backups. We have two helm stations: one forward center (main wheel, throttles) and one aft-facing mini-console (for watching aft deck during fishing). The primary helm has modern **UI screens** – radar, electronic chart (ECDIS), and CCTV feeds of the deck. At night, these are mostly dimmed and red-lit (bridge uses **red light vigil** at night – minimal white light). The layout includes a captain's chair and a co-pilot/nav chair, both on swivels. Instruments include advanced **autopilot** controls, **sonar** fish-finder screens, and banks of **analog gauges** for engine systems (these appear as clusters of round dials – UI_ANALOG_GAUGES for things like shaft RPM, rudder angle, winch tension). There's also a console for **environmental controls** (like deck light switches, horn, etc.). The bridge has **stairs** that go down to the deck below (ship offices and captain's cabin). On the starboard side inside the bridge is a **chart table** with paper charts and a secured bookshelf (which can spill books when things get rough). The vibe is professional but cluttered with coffee mugs, logbooks, and an emergency HF radio kit strapped to the wall. Because this is a mid-tier difficulty, the bridge will be used more for complex tasks (like adjusting radar settings, reading instruments), so it is detailed accordingly. Bridge ASCII layout:

```
[ North Star - Bridge Deck ]
+-----+
|      [Windows]      (Night mode: red lights)|
| Main Helm & Wheel   | Radar & ECDIS screens |
| (Captain Chair)    | (Co-pilot station)    |
|                    |                      |
|      Console banks (radio, autopilot, etc) |
```

```

|                                     |
| Chart table           Aft control station (stern)|
| (maps, barometer)   (Winch CCTV, floodlight ctrl)
+-----door to stairs & outside wing-----+

```

Bridge notes: There are two side **bridge wing** doors (port and starboard) that lead to small exterior platforms – on these are manual helm controls for docking plus powerful **searchlights**. In the storm, those wings are rarely used (too dangerous outside), but the searchlights might be used to spot things. The bridge has multiple **alarm panels**: a fire alarm panel, a bilge alarm repeater, etc. The **UI radar** here is more advanced (color screen), but we will still highlight contacts with a glow. This level might require the player to interpret the radar to avoid hazards (e.g. icebergs or land). The layout allows the player to walk around the whole console – an important consideration as they might need to physically move to reach certain controls (we will offer teleport for those who need it). Handholds are fewer here (since it's interior and typically stable), but in a storm, crew would grab the console edges or mounted handles on the ceiling. We add those so the player can steady themselves.

- **Interior Corridors (Crew Deck):** *North Star's* interior is more extensive. One deck below the bridge is the accommodation deck. A central **corridor** runs fore-aft, connecting spaces: crew cabins, a galley/ mess room, a drying room for gear, etc. This corridor has water-tight interior doors at intervals (with clips to hold them open normally). The galley is larger than level 1's – it has a full table for 12, a kitchen with electric appliances, etc. This being a longer trip vessel, there's also a **freezer room** and pantry near the galley (could be a walk-in freezer). The interior passage is lit by fluorescent lights (which may flicker if power fluctuates). There are hazard signs like "Mind Your Head" and "Fire Extinguisher" on walls. In a storm, this corridor can become a bowling alley for loose items if not secured. The player will navigate here for tasks like checking crew areas, securing loose objects, or fetching emergency gear. There's also a **radio room/office** adjacent to the bridge (on the same deck, just behind it) which might contain the EPIRB, logbooks, etc. The interior map is complex but we'll focus tasks in key areas to avoid the player getting lost – e.g., tasks in the galley, the drying room (maybe an immersion suit locker check), and corridors themselves (latching cabinets).

```

[Crew Deck Corridor - North Star]
+=====+
| [Captain cabin] [Officer cabin]      | <- Forward cabins
| --- WT door ---                      |
| [Galley & Mess]    [Stairs up to Bridge]
| [Recreation lounge] [Drying room/Lockers]
| --- WT door ---                      |
| [Crew cabins port/starboard]          |
| [Engine control room access]          | <- A small control room off corridor
near engine
| --- Stair down to Engine Room ---    |
+=====+

```

Interior notes: Key safety elements here: **Fire extinguishers** in corridors, **emergency lights** with battery backup on the ceiling (which kick in if power fails, glowing dim red/green). **Handrails** run along both walls of the corridor, waist-high, because crew use them in rough seas – perfect for our VR handhold. Cabin doors

can swing open if not dogged – we might script one banging open and shut to add to chaos (player might have to latch it). The **engine control room** mentioned is a small room near the engine but accessible from crew area – *North Star* being larger, it might have a separate control station with monitoring panels, which is a quieter place to check engine status. We can use that for tasks (like reading generator outputs) instead of sending player fully into the loud engine room every time.

- **Engine Room:** Far more spacious than *Seaward's*, *North Star's* engine room spans the full beam, with multiple levels (catwalks above the main engine). It houses a large diesel main engine, likely two generators, plus hydraulic power packs, an air compressor, etc. The layout includes a **control console** on a side platform where engineers can start/stop systems. This console has alarm panels for water, oil pressure, etc., and we will use that as an interactive spot (e.g., resetting breakers or silencing alarms). There's a **loudness** and complexity that add difficulty – pipes crisscross, and it's hot. We probably won't simulate a full multi-deck engine room (could overwhelm), but at least a sizable single space with enough room to walk around the engine. Hazards here include slippery oil on floor plates, and low head-clearance in spots. A **lazarette** (rudder machinery room) is accessible via another door aft of the engine – possibly a task could involve checking steering gear if something fails. The engine room is accessible from the crew corridor (down a stair) and also from a direct outside hatch on the main deck (used for bringing in parts, etc.). Likely tasks here: resetting tripped breakers, checking a vibrating machine, manually starting a backup generator if main fails. We incorporate numerous **material details** here: MATERIAL_OIL_STAIN, etc., for realism.

C. Storm Profile & Motion Model: Level 2 ups the ante with a **severe storm (Intensity 4/5)**, including some *unique twists like fog and icing*. It's set in twilight transitioning to night, which means visibility challenges. **Primary wave character:** longer period swells mixed with wind-driven waves – the *North Star* is larger, so it doesn't react as violently to chop, but it will ride over big swells. Expect significant rolls around 20° and pitching, but slower than Level 1. However, “confused seas” (waves from multiple directions due to wind shift) cause unpredictable motion. There's also **surf and cross-waves** near the fishing grounds (perhaps we imagine ice floes causing weird wave reflections, or crossing currents). The motion model will combine a steady roll with occasional sudden lurches when the hull slams into an oncoming secondary wave. Frequency: roll period ~8–10 seconds (heavier ship), but irregular.

- **Storm Intensity & Weather:** The storm here is a North Atlantic winter gale, perhaps bordering on a storm/hurricane. Winds ~60–70 knots. It begins at **dusk**, thick fog banks limiting visibility to maybe 50 m – you mostly see the glow of the ship's lights against darkness (**WEATHER_FOG_THICK**). Freezing spray is a factor: supercooled wind-blown spray that forms ice on impact. Through Act 1 and 2, **icing** accumulates on the bow rails, deck equipment, etc. (We'll use **MATERIAL_ICE_ENCASING** on surfaces gradually). The player might have to knock ice off something as a task. By Act 3, the fog might partially clear but it's full night – now the only visibility comes from ship's floodlights and the occasional lightning or distant shore lights. This means **Night Deck: Sodium Amber Chaos** is in full effect: the deck floods cast stark moving shadows as waves crash and lights swing. We use **strobing lightning** occasionally to momentarily reveal the silhouette of looming waves or ice ahead (shock moments). There may also be **snow/sleet** in the mix if temperature is below freezing (whiteout conditions briefly – **WEATHER_SLEET**).

- **Triggered Events:** Level 2 has more varied triggers:

- Early on, a **fog-related near-collision**: perhaps radar shows a hazard (an iceberg or another ship) suddenly close due to fog, triggering an alarm and requiring evasive action (player might need to help on radar or lookout). This spike raises tension in a different way than waves – it’s about navigation stress.
- **Green water & Icing event**: as freezing spray builds, at some point a large wave dumps water that *instantly* freezes on some surfaces – causing equipment jamming. For instance, a winch or the rudder might freeze briefly (introducing a task to break ice).
- **Rogue wave/“rogue gust”**: a massive wave hits off-angle in Act 3, combined with a squall of wind – even bigger than Level 1’s. This might knock the ship nearly on its side (like a 45° roll). Unsecured items definitely topple (we ensure by Act 3 some new items become loose to amp difficulty).
- **Power loss**: perhaps more dramatic here – a wave flood could short something and cause a temporary **blackout** (all lights off for a few seconds until emergency lights come on). The player then must help get the generators back. The darkness plus storm is terrifying, raising adrenaline.
- **Deck flood & drain cycles**: The bigger ship doesn’t get swamped as easily, but when it ships water, it might take longer to drain due to possible clogged freeing ports by ice. The game escalates these events if the player hasn’t been clearing ice: e.g., if freeing ports freeze up, a subsequent wave causes persistent deck flood (the ship will list from weight) until cleared – a dynamic consequence.
- Impact slams are frequent (level 4 storm), likely every minute or less in Act 3, with moderate ones throughout. The *North Star*’s hull booms echo a bit deeper (bigger hull).
- **Water Accumulation**: Besides deck floods, interior flooding can happen if something fails (like a broken pipe from the water intake, or if deck hatch to processing area isn’t sealed). There’s also the factor of **ballast shifting** – not simulated deeply, but an event might simulate the ship listing from asymmetrical ice accumulation, effectively like water weight on one side. The player might need to counteract by moving some weight or ensuring a ballast pump is on. Water on deck will find its way to scuppers, which could be blocked by ice chunks – requiring clearing. The engine room could start taking water through a vent if a big wave hit and a vent damper froze open – introducing an engine-room flooding scenario to handle. All these are somewhat advanced mechanics to push the player’s multitasking and awareness.

D. Aesthetic Implementation Checklist:

- **Lighting**: Early level uses the dim natural twilight plus **deck/work lights**. We have numerous **LIGHTING_DECK_FLOOD_AMBER** fixtures along the *North Star* – under the shelter, on the mast, etc. These cast that industrial orange glow on fog, creating dramatic light cones. As night falls (mid-level), **Bridge red lights** are activated (the bridge interior turns red-lit to preserve night vision – the player will toggle this via a task around dusk, say at 1900 hours game time, fulfilling the “switch to bridge red lighting” task ¹¹). Exterior, the player will rely on **spotlights** for certain tasks – e.g., shining a **LIGHTING_SPOTLIGHT_BEAM** from the bridge wing to search for a missing buoy or to locate an iceberg in fog (a task explicitly has them use the spotlight ²⁷). The spotlight’s beam is powerful, cutting through the fog somewhat, and we ensure a volumetric effect. Interior accommodation lighting is fluorescent white (with backup battery lights that glow faintly if main power goes). Once power is lost, red emergency lights kick in corridors (spooky but helpful).
- **Weather VFX**: **Thick fog** banks are key in Act 1 – we use a volumetric fog with some turbulence; it glows when the ship’s lights hit it, reducing visibility dramatically (the player might only see the bow faintly from the bridge). **Heavy sleet/snow** is included – diagonal streaks of wet snow that accumulate on surfaces as **MATERIAL_ICE_ENCASING**. We’ll visibly grow icicles on rails and edges

over time (with a shader or swapping models). Wind in this storm is fierce; we might show it by how the fog moves and how snow swirls. Possibly add a **waterspout** funnel in the far distance or some dramatic cloud shapes when lightning flashes, to emphasize the storm's power (only if performance allows).

- **Water and Effects:** The ocean now is nearly black at night, with white foam contrast. We accentuate **WATER_FOAM_STREAKS** – as waves break, we leave long foam trails that the wind rips off. **Green water** on deck is slightly less “green” visually at night (colored by amber deck lights, it looks more orange-tinted), but it's heavy – big volumes hitting the stern. When these waves impact, we combine them with flying chunks of ice (if near ice fields) or at least huge spray plumes. We also implement an **icing overlay** effect for the player's view when directly hit by freezing spray: a brief frost on the “goggles” that the player has to wipe. After heavy icing events, the **MATERIAL_ICE_ENCASING** is applied to player's gloves (just a thin ice sheen to show even they are freezing!). The **wet lens** effect still occurs but now perhaps mixed with frost.
- **Materials:** Rust and wear are present but less extreme than Level 1. We emphasize **MATERIAL_WET_SHEEN** on all decks and equipment because everything is perpetually wet or ice-coated. Non-skid deck paint is visible where not iced. **Peeling paint** on older parts (like the winch) can be seen but often hidden under rime. Interiors use a lot of **slicker fabric** hanging (rain jackets), glossy tile in galley (wet from spills), and **fogged glass** in portholes due to temperature differences. We'll have a set of assets with an “iced” variant: railings, winches, even the life raft canisters get a white frost layer. The **UI elements** like analog gauges will have a bit of fog on their glass which the player might wipe with a rag as a minor interaction.
- **Camera/VR:** We continue the **CAMERA_ROLLING_HORIZON** and **CAMERA_SHAKE** concept. Possibly more aggressive shakes on major impacts – the player might even stumble (we could simulate a momentary VR stumble by shifting camera slightly or blurring). But we maintain VR comfort by letting players “brace” to negate it. We might introduce a **subtle vignette** during extreme motion as a comfort feature (darkening edges to reduce peripheral flow, optional). The camera also simulates **eye adaptation** to low light: e.g., when the power black-out happens, it's pitch dark for a second, then the eyes adjust and you see by starlight and foamy glow until emergency lights come – this is both realistic and prevents complete blind panic. Another effect: **breath vapor** – in the frigid air on deck, the player's breath is visible. During high exertion (player running around, though we don't literally track physical exertion, we simulate it after many tasks), the breathing gets heavier and the vapor more pronounced, adding to immersion and indicating the cold.
- **Audio:** The *North Star* in a gale is incredibly loud, possibly requiring the player to listen carefully for certain cues. The **engine** here is a deeper throb (maybe a medium-speed diesel, 2000–3000 HP) – we hear it through decks, especially in the engine room where it's a roar. When the ship pitches, you can hear the propeller beat (but less overt prop-racing than small boat). There's also an **auxiliary** hydraulic winch noise that might start up unexpectedly (e.g. if an automated system engages – causing a startling metallic whine). **Wind** sound is almost constant high-pitched shrieking around the bridge wings and through antennae. At times, wind gusts create an eerie moaning in the mast (we can incorporate that for atmosphere). The **foghorn** on *North Star* might sound automatically every minute due to low visibility – a deep bellow that the player will hear and even feel (might be a task to ensure it's on). **Waves:** We hear larger wave impacts as not just booms but also long *rumbles* as the big hull resonates – a different character than the small boat's slam. We have the sound of **ice**: when ice forms or breaks off, it makes glassy crackle noises. We use that when the player knocks ice off (satisfying *crunch*). If there are nearby icebergs or growlers in waves, occasional distant *grinding* or *echoing thuds* might be heard – spooky environmental storytelling. **Alarms and voice:** The ship's alarms are more extensive. A **navigation alarm** triggers if they're on collision course – a loud intermittent buzzer on the bridge (the player must acknowledge it at the console). A **winch overload**

alarm could go off if gear is snagged (distinct tone). We also simulate a **PA system**: the captain can make announcements from bridge to all decks ("*All hands, brace brace brace!*" before a huge wave). Crew chatter is more numerous (maybe 2-3 NPC voices), but given the storm noise, they often communicate via handheld radio with headsets – the player might hear a muffled voice in their "ear" for certain messages (diegetic radio comms). This level might have segments with little visibility where **audio** is the only warning – e.g., the sound of an oncoming breaker or the change in wind pitch hints a big one coming. We lean into that for tension. Inside, the galley might have dishes crashing, and if something like a microwave breaks loose, you hear it clattering down the corridor. The interior also has a **different muffling**: because this ship is sturdier, inside is relatively quieter (until an alarm or impact).

E. Audio Design Notes: Summarizing level 2's key audio features: a **lower frequency engine** and ship noise to communicate bigger scale (the player feels vibrations in sub-bass). **Wind** that howls and shrieks, possibly requiring us to duck certain sound cues (we might sidechain important alarms so they punch through wind noise). A **foghorn** that blasts regularly, adding to tension and also orientation in fog. Use of **silence**: after a full blackout, there's a moment where even the engine might stall – just the sound of waves and wind in darkness, to unsettle the player, then the engine cranks back up. We incorporate **radio comms**: the player may receive a distress call from another ship or a Coast Guard broadcast about conditions worsening – all through realistic radio static. **3D audio positioning** is crucial with low visibility: e.g., an object banging to starboard should help the player locate it by sound. The **diegetic UI pings** (radar beep, sonar) are more noticeable in this quiet or interior moments to help the player with tasks. NPCs might speak in a mix of Norwegian and English for authenticity ("*Is på dekk!*" meaning "Ice on deck!" – followed by translation or obvious context). The overall mix tries to convey the overwhelming loudness outside versus relative calm inside a closed bridge – stepping out a door should be a shocking increase in volume (we will implement a filter that removes muffling instantly when a door opens, akin to removing earplugs).

F. Diegetic UI Plan: *North Star* has more instruments, so more diegetic info:

- **Navigation Instruments:** A modern **radar-ECDIS display** shows the ship's position and hazards. If the player needs to mark a waypoint, they can use this interface (e.g. press a button to drop a mark at the harbor entrance). We ensure waypoints and course lines are visible (maybe highlight blinking on screen after set). The **radar** also has an automatic clutter filter that the player might toggle as a task (to deal with storm clutter). The **wind indicator** on the bridge is digital, showing wind speed/direction; the **barometer** is digital or analog – either way, easily observable dropping pressure (with maybe a red LED arrow indicating rapid drop). All these are clearly labeled and backlit for night.
- **Ship Systems Monitors:** There's a **bilge alarm panel** with compartment labels – if flooding in "Engine Room", that light blinks red. Also a **watertight door indicator** panel – each door has a tiny LED (green=shut, red=open) ¹¹. So if the player sees a red light for, say, "Aft Deck Hatch," they know it's open (perhaps they forgot to close it earlier). There's no omniscient HUD arrow; it's all these panels providing state.
- **Communication as UI:** The captain or first mate often shouts or radios tasks, effectively serving as mission prompts. Example: an NPC might yell "*We need to clear that ice off the antenna – we're losing radar!*" which tells the player exactly what to do next (climb and de-ice radar). Similarly, a crew on intercom might say "*Flood in processing hold!*" – cue to go pump it. These voices are effectively your quest markers, keeping the UI immersive.
- **Time Pressure & Progression:** The progression to safety might be time-linked to reaching a certain coordinate (land). We show progress via the **GPS/plotter** – maybe a distance readout to harbor: e.g., "Harbor 5 nm" and counting down. The player can glance at it to feel progress (and if it stalls or goes

up, something's wrong like they got off course). Also, as time goes, the **barometer stops falling and steadies**, indicating maybe the worst is over (end of Act 3 in sight). Another indicator of timeline: the **sky** – starts twilight purple, ends black with maybe first hint of dawn or lights on horizon by final success (depending on narrative).

- **Minimal Text:** If any text appears, it could be via a **label printer** or sticky notes an NPC slaps on a console – for instance, marking a broken system “OUT OF ORDER” after it fails. Or using the **clipboard method** again: an engineer's checklist pinned in engine control room that updates with tasks. We might implement a system where when the player opens their in-game notebook or clipboard, it *automatically* lists current objectives as written notes (diegetic “quest log”). This way, if they forget what to do, they can check that instead of a meta menu. The notebook could update after each radio call or alarm with scribbled notes (e.g., “Ice crush – check antenna”). This is optional but can assist.
- **Accessibility:** The bridge screens might be hard to read in VR at lower resolutions, so we ensure they are bright and can be zoomed by picking up binoculars or a portable tablet that links to them. In an accessibility mode, key instrument data could be shown as floating captions **when looked at** (e.g., stare at barometer, a tooltip “976 mb” appears). That would break pure diegesis but can be disabled normally. Also, color-blind considerations: all indicator lights should have shape or label differences (not just red/green color – for example, door lights might have an “O” or “C” letter). We also ensure alarms have distinct sound patterns to complement lights (multi-sensory cues).

G. Level Gameplay Loop: The structure for *North Star* is similar 3-act but with more concurrent challenges:

- **Act 1 – “Secure and Adapt”:** The level begins in thick fog at twilight as the ship is hauling lines. The initial event: an unexpected iceberg (or rock) appears on radar very close on the current course (due to fog, they didn't see it). This prompts immediate action – the player (with others) must help **avoid collision**. For example, they acknowledge the radar alarm and perhaps run to ensure the **autopilot is disengaged** so the captain can hand-steer a hard turn (a task: confirm the rudder responds to manual control). Success: the ship veers, missing the hazard, but in doing so gets beam-on to the swell. Now a wave slams the side, causing deck gear to shift. Act 1 then flows into securing the deck and adapting to storm mode: **stowing any gear** from fishing that wasn't secured (longline gear perhaps left on deck as they were working). The crew transitions the ship from fishing mode to storm-running mode. Tasks: Lock down the line hauler, tie off loose lines, close the stern ramp hatch if possible, etc. This is similar to Level 1's initial scramble but on a bigger scale and with more systems (like turning off deck hydraulics – perhaps a task to lock a winch and hit a “safe” toggle). Another early issue: **icing begins** – an NPC reports ice accumulating on bow rails, so the player might need to go forward with a mallet to knock off some ice (if not, the bow will get heavy). This introduces the new hazard (slip + cold) gradually. Act 1 ends when the ship and crew are fully in “storm-running” mode: all gear secured, all doors dogged, navigation adjusted to ride the waves more safely (heading perhaps into the wind now). A brief **lull** follows – perhaps they get out of the fog or into a slight lee, giving the player a breather. **Fail/Challenges:** A possible fail in Act 1 is hitting the hazard (leading to flooding and mission fail), but that's avoidable if radar is handled. Another is if a major piece of gear (like a longline cage) wasn't secured and slides, it could injure crew (we'd simulate that as a fail state if player totally neglects all securing). But we give plenty of hints to avoid that.
- **Act 2 – “Systems Under Siege”:** Now fully dark, the storm intensifies (wind howls, waves higher). Act 2 focuses on internal systems failing and critical ship operations. Key events:

- **Power fluctuations:** heavy ice or waves might clog a cooling water intake, causing a generator to overheat and shut down. Lights flicker. The player needs to go to the engine room or control room to **reset breakers or start the standby generator**. This might involve a mini-game of flipping the correct breaker (with schematics on panel) ²².
- **Flooding in hold:** maybe a shock caused a seal to leak in the fish hold, water is coming in. The bilge alarm for "Processing Hold" goes off and the player must deploy a portable pump (again carry + place + hose out) ²⁷. But now with icing, the pump outlet may freeze, adding complexity.
- **Steering issue:** The combination of ice and waves causes the steering gear to jam momentarily (perhaps ice on rudder or hydraulic fluid too cold). A **rudder angle indicator** discrepancy is noticed (the wheel says 10° port but rudder isn't moving). The player might need to go to the aft steering compartment to manually bleed a line or switch to alternate steering mode (i.e., engage emergency tiller). This is a unique task bridging mechanical and navigation.
- **Crew aid:** A crew member could be injured (non-graphic, maybe sprained ankle from a fall). The player might be tasked to get the **medical kit** and bring to the bridge or infirmary ¹⁰. This introduces a humanitarian task under duress, adding emotional weight. Meanwhile, maybe also brew coffee or provide a warm item to an NPC (from tasks list like delivering a hot drink ¹⁰) to keep them functional – a sort of secondary objective that improves NPC performance if done. During these, the player is running between the bridge (to acknowledge alarms, operate valves), the engine room (to fix machinery), and the deck (to chip ice or adjust something). The pacing is high, with one problem leading to another. But an important narrative beat: during Act 2, the **destination (safe harbor)** might be radioed as **closed or unreachable**, meaning the plan might change (perhaps they aim to ride out storm at sea instead of run for port) – adding to despair mood.
- **Communication challenge:** The radio or antenna iced up might fail – requiring the player to climb to the top of the bridge (outside) to clear the antenna (a precarious climb with harness). This is an optional but dramatic set-piece if we include it. **Fail states:** Not fixing the generator in time leads to total power loss (dead ship in water – likely fail if not restored quickly). Too much flooding not pumped = stability loss (fail). But we provide multiple ways to mitigate each (redundant pumps, etc., as long as player tries something).
- **Act 3 – "Final Storm and Approach":** With systems patched up, the captain decides to make a final run to shelter (perhaps a nearby fjord or behind an iceberg field to break the waves). This is the climax: the storm is at peak (perhaps a **full blizzard/whiteout** now). The player's focus shifts back to navigation and survival. Objectives in Act 3:
 - **Navigate to safe waters:** The player is needed on the bridge to help monitor radar/sonar for coastal dangers (e.g., shallowing depth – they must keep an eye on the depth sounder, which shows decreasing depth approaching ice or shore). They might plot a **final waypoint** or update the course on the ECDIS.
 - **Brace for massive wave:** The biggest wave of the game is detected (maybe visually by moonlight or on radar as unusual return). The captain orders a "brace" – player ensures all crew are informed (over intercom) ²⁷ and personally might need to tie themselves or trigger a special "secure mode" (perhaps instructing everyone to stay put). The wave hits – the ship might partially broach (roll heavily), some minor damage occurs (maybe a window cracks or a mast equipment breaks off). But if braced, no one is lost. If the player failed to warn (fail state: an NPC washed overboard maybe, ending scenario).
 - **Critical damage control:** That rogue wave could cause something like a **fire** in the engine room (electrical short) or a **serious leak** (if we want an ultimate challenge). The player and crew then race

to contain it just as they reach shelter. For instance, a small electrical fire triggers the engine room fire alarm – the player can remotely activate CO₂ suppression (with alarm and countdown) or manually use an extinguisher. This all happening while the ship is moments from safety is peak chaos. It teaches to prioritize and that even at the end, you can't relax.

- **Safe Haven:** Finally, the ship enters calmer water behind a headland or in a cove. The contrast is stark – wind dies down a bit, waves ease. The player might assist in dropping anchor or ensuring the ship holds position (maybe using the **UI_ANALOG_GAUGES** engine telegraph to slow engines). A last task might be to **check on crew** – e.g., go down and make sure everyone's accounted for and okay (a narrative wrap-up via interacting with NPCs or seeing them safe). The level ends with a sense of relief as the remaining tasks are cleanup, possibly the captain thanking the player and noting that dawn is breaking or the coast guard is sending help.
- **Fail states & Assists in Act 3:** The major fail risk is if any final disaster isn't managed – e.g. if the fire isn't put out, it might engulf the engine (leading to abandon ship scenario -> fail). Or if they navigate incorrectly and ground the ship (depth alarm ignored leads to running aground – fail). We try to avoid a fail right at the very end by giving clear hints and maybe an NPC can step in if the player doesn't – e.g., if the player ignores the depth, the captain might still save it (but then scold them). At this point, fail would be very frustrating, so we design it so that Act 3 fail is only from egregious neglect or earlier compounded failures (like if they limped in with too much flood and then the last wave capsizes them – essentially fail stemming from earlier missed tasks). Assists: The game might slightly auto-correct course if the player doesn't respond in time to a navigation threat (since a real captain's also there). Think of it as NPCs having some agency: the player is key, but not the sole savior. So act 3 is more about teamwork feel – NPCs call out things, player does them, NPCs handle something else, etc. This dynamic reduces pressure a tad and makes success feel like a group achievement (common in these scenarios).

Level 2 Outcome: If successful, the *North Star* endures the worst and finds relative calm. The final scene might show the ship at anchor or slowly moving in calm water, with first light on the horizon, ice glinting on the rails – a hard-won victory.

2.3 Level 3 – *FV Polaris* (Large Factory Trawler, Arctic Ocean)

A. Boat Identity: *FV Polaris* is a 95 m (312 ft) factory freezer trawler – the “boss level” ship. It operates in the Bering Sea and Arctic Pacific, targeting pollock and cod. Registry is Seattle, USA, but it fishes Russian waters too (a nod to international waters). Age-tier: relatively new (built 2018, for example), so it's a state-of-the-art “super trawler.” It features a massive white and red hull with a prominent factory deck house midship and a tall bridge tower forward. Visual signature elements: a giant trawl net **stern ramp** that's like a gaping maw at the back of the ship, huge **trawl doors** stowed on deck, and a line of deck cranes. The *Polaris* is also decked out with modern satellite comms, multiple radar arrays, etc. Crew personalization is minimal (corporate feel), but there might be some graffiti in the crew rec room or stickers on hardhats. One of its unique props: it has a **helicopter pad** on the bow (some large fishing vessels do for crew change or medevac) – this visually sets it apart as very large. **Region vibe:** Truly high-latitude – think Winter in the Barents Sea or Bering Sea during a superstorm, with darkness at noon. **Mood palette:** This level is pure **Ice and Whiteout: Frozen Hell** as primary and **Night Bridge: Red Light Vigil** as secondary. Essentially, we have near-total whiteout blizzard outside (day or night doesn't matter because it's dark from storm) and on

the bridge the crew rely on red emergency lighting and instrument glow to manage. It's the ultimate storm scene: blinding snow, everything coated in ice, constant darkness punctuated by the ship's lights and occasional electrical arcing or flares.

B. Layout Blueprint: *Polaris* is huge and multi-deck. We will constrain playable areas to those needed for gameplay to avoid literal 100+ rooms. Key areas:

- **Main Deck (Processing & Working Decks):** This ship has multiple decks: an **open stern deck** where net hauling happens, and internal factory decks. The **stern working deck** is relatively small but exposed: essentially the area around the stern ramp. There are two large net **drums** here (marked D1, D2) for port and starboard trawl nets. Heavy **winches** (W) are mounted along the deck edges, with wires leading to the stern. The deck is cluttered with huge ropes, spare trawl net sections, and mechanized blocks. There's a big **power block crane** overhead at the ramp mouth. Most of this deck is surrounded by high bulwarks with freeing ports. Doors lead forward into the factory on both port and starboard sides. A stair on the port side goes up to the **trawl deck** (above the factory) where spare gear and the trawl winch control station is. The processing factory itself is largely below this – technically on the main deck inside and one deck below main. The ASCII below tries to capture stern external:

```
[Aft Factory Deck Interior]      Stern Ramp (open)
+-----+                        ____\ net ramp /____
| Door      [processing]  |      (Stern opening with rollers)
| Door      [C] | <- C = overhead crane for cod-end
| W      Net Drum (D1)   W | <- W = winches port/stbd for warps
| W      Net Drum (D2)   W |
|_____|      (Stern deck with gratings & ice)
```

Stern deck notes: It's the most dangerous outdoor area – machinery, slipping, waves, all at once. But it's somewhat sheltered by design (low to water but with high walls). The player will come here for tasks like freeing a snarled net or securing a loose trawl door. Since it's the largest ship, green water on this deck is less frequent but still possible with extreme waves. Access to interior is via those heavy doors into the factory deck.

- **Factory Deck (Interior):** This spans much of the ship's beam midships. It's basically an industrial plant: conveyor belts carrying fish, processing machines (skinners, filleting machines, freezers). Normally, dozens of crew work here, but in a storm scenario many would be sent off duty for safety (also to not simulate so many NPCs). The factory has low ceilings, lots of pipes, and can flood if water enters or if a pipe bursts. There are floor drains. Key points: a **control room** within the factory with status panels (for refrigeration, etc.), perhaps where an engineer or factory boss monitors. Also a **freezer hold access** (hatch to lower hold). It's likely some tasks happen here like patching a pipe or resetting a freezer that went offline. The player might also need to navigate through here to reach other parts (like engine room forward or aft steering). The noise of machinery and ammonia smell (we could simulate a leak for drama) are factors. We might partially cordon it so player doesn't wander aimlessly – e.g. locked sections with lights flickering behind windows to imply others are working there or that area is inaccessible due to hazard.

- **Bridge & Superstructure:** The *Polaris* bridge is multiple levels above the water, giving an expansive but currently useless view (whiteout). It likely has an **integrated bridge system** – many screens but they might be networked together. The layout: more spacious than North Star's, maybe with additional stations (communications console separate, an engineering monitor station, etc.). There's a **bridge team** NPC or two besides the captain – perhaps the player interacts with a first officer. The vibe is high-tech but in emergency mode: many alarms, parts of consoles maybe turned off if malfunctioning. Bridge ASCII (top-down):

```
[Polaris Bridge]
+-----+
| Helm (center): 2 chairs, 360° view          |
| Consoles: Radar x2, ECDIS, Sonar, Engine monitors |
| Side: Comms desk (GMDSS, Sat radio), Weather station |
| Aft bridge station: Trawl winch controls, CCTV wall |
| Overhead: arrays of indicator lights (doors, alarms) |
|                                                    |
| (Multiple doors to bridge wings, internal stairs down) |
+-----+
```

Bridge notes: Because we have “Night Bridge: Red Vigil” palette, the primary lighting is red or off – only screens glow. The player might have to toggle to white lights in an emergency (blinding but maybe needed to read a chart). Bridge wings: each has fully enclosed wing cabs on modern ships, but we might treat them as smaller side stations. Possibly an objective requires going out to a wing to manually deploy an antenna or flare. In this storm, outside the bridge is extremely hostile (winds maybe 100+ mph gusts), so stepping out is like being blasted – we simulate that with strong push and noise, maybe risk of being blown off if not tethered.

- **Engine Room & Machinery:** The *Polaris* has a huge engine room likely spanning two decks high. It houses multiple generators, main engine, possibly separate propulsion motor if diesel-electric. There's also a **control booth** here where engineers can sit and monitor gauges. Likely tasks: restart engines if they trip, switch fuel tanks if one got contaminated, fix a cooling pump. There are also **fire suppression** systems (CO₂ room) and **emergency generators** possibly one deck up. The complexity is high but for gameplay, we will clearly mark important panels with labels/lights. The engine room also connects to thruster rooms or boiler rooms – probably off-limits for game or used in a single task (like an auxiliary boiler fails – no heat for crew, prompting manual intervention).
- **Crew & Other:** The accommodations decks have many cabins, but relevant to game might be: a **sickbay/medical bay**, a **mustering area** with survival gear (immersion suits, life rafts controls), and perhaps the **fire locker** room with firefighting equipment. In a dire scenario, the player might go here to initiate abandon ship prep or treat an injured crew. But given scope, we might script minimal usage of these to avoid labyrinthine search quests.

C. Storm Profile & Motion Model: Level 3 is the apex: **Storm Intensity 5/5 – a full Arctic superstorm** possibly a polar low or “white hurricane.” The ship is huge, so it has a slow roll (~15–20 second period), but

the waves are enormous – 15+ meter significant waves, with occasional 20+ (60 ft) rogues that can hit even a ship of this size hard. It's effectively like a small building in an earthquake at sea.

- **Primary wave pattern:** long **swell plus wind waves** on top – monstrous rolling hills of water, with chaotic peaks from multiple directions due to surrounding ice fields or land. The *Polaris* will typically ride one or two waves over several seconds then SLAM into a third (because at that scale, the hull may bridge two wave crests then fall into a trough). Each slam is like a bomb going off in sound and vibration. So the motion is a mix: mostly slow heaving (which might be almost comfortable in VR if just that), punctuated by sudden unpredictable lurches when a wave crest hits midships or a freak wave strikes on the beam. We add also a **heavy yaw** element – maybe the ship's bow thrusters can't hold it perfectly into wind, so it yaws side to side, making tasks like walking akin to being on a twisting path.
- **Environmental extremes:** **Wind** likely 80–100 knots sustained, with higher gusts – effectively hurricane force. **Visibility** zero – it's night and a blizzard (or could be midday but dark from clouds and snow). **Snow and blizzard:** Snow is falling horizontally, icing every surface instantly (we treat it as continuous icing; any exposed surface regains ice coating minutes after you chip it off). Possibly **thundersnow** – lightning and thunder within the snowstorm for dramatic effect. The temperature is extremely low (-20°C?), but windchill far worse. We incorporate that by the player's **stamina** or movement slowing if outside too long (simulate heavy gear or just the difficulty, though we must be cautious in VR). There's also an element of **ice floes** or sea ice – the ship might be near an ice edge, meaning in addition to waves, *impacts with ice* could occur. We might simulate that by random hull shudders that are not waves (like a low crunch indicating hitting some ice – an extra hazard to machinery and hull). Another possibility: Because conditions are so bad, the *Polaris* might be trying to **run to open ocean** to avoid being trapped in ice – so time is of essence before ice closes in (a narrative layer adding urgency).
- **Triggered Events:**
 - **Multi-system failures:** In such a storm, multiple things go wrong at once. Early in the level perhaps a major **electrical bus failure** occurs (so one generator trips, causing load to shift to others, maybe partial blackout). Not full drifting dead, but enough to juggle.
 - **Injuries and crew factors:** Maybe an NPC gets seriously injured by falling equipment in Act 2, adding a medical emergency on top of technical ones.
 - **Flood + Fire simultaneously:** A dramatic scenario could occur where a **fire breaks out** in one part (maybe an electrical fire in the factory due to water ingress shorting machinery) at the same time a **serious flood** is happening in engine room. The crew must split to fight fire and flooding – the player can only be in one place, so delegating to NPC or prioritizing is key. E.g., they might activate fixed firefighting system for fire while personally pumping water in engine.
 - **Capsize threat (Near-miss):** Possibly the ship nearly capsizes due to a rogue wave – say a massive wave strikes beam-on when ballast is uneven, causing a dangerous list. The player gets a list of tasks to correct list: e.g., “shift ballast to port” by pumping water between tanks (done via valves in engine control). This is an advanced task (pumping ballast) but if not done, the next wave could roll them over (fail). This simulates the brink of disaster and forces quick systems management.
 - **Lifeboat deployment/abandon ship scenario:** If things really go south as a fail-safe, the scenario might push an abandon-ship decision (the ultimate fail state if they actually have to abandon). But perhaps to test the player, near the end an order is given to prepare liferafts – so the player has to go

out and prep rafts, maybe even cut lashings. If they then save the ship last minute, they stand down from abandoning. If not, that's the fail (ship lost).

- **Impact slams & Structural damage:** The big difference here: the ship can suffer **structural damage**. For instance, a heavy wave might crumple some railings or crack a hull plate leading to flooding. Or the **factory stack** (some large exhaust funnel) could topple, causing debris on deck. We might script a dramatic event like a **mast collapse** (radar mast breaks due to ice accretion and wind). Sparks fly, and the radar goes out (complicating navigation). The player then deals with backup systems (maybe they launch a **drogue beacon** or use backup handheld GPS).
- **Water Behavior:** On a ship this big, **green water** on deck is rarer but when it happens, it's catastrophic – e.g., a wave breaking over the bow could smash windows, or a wave filling the factory deck through an open ramp could flood it with many tons of water. So we'll have fewer but more consequential water on deck events. Freed water is drained by big scuppers and pumps, but if power is down or ports freeze, even this big ship can accumulate dangerous water. Interiors are usually sealed, but if a door was left open (or breaks open), massive volumes can enter. We possibly simulate an event where a **factory deck door gets stove in** by a wave, causing a flood inside. The player must then close internal watertight doors to contain it. The **freezer hold** is below waterline, if it floods the ship is likely doomed due to free surface effect – so an imperative might be to check the hold isn't shipping water or all product is secured (sliding cargo could capsize the ship – another subtle threat).

D. Aesthetic Implementation Checklist:

- **Lighting:** It's almost entirely artificial lighting. Exterior: the *Polaris* has powerful **LED floodlights** (still amber or white) that illuminate its decks and maybe forward area. However, in the whiteout blizzard, these lights often reflect back, causing glare – we can show that by bloom/haze when looking into snow with a light. The **bridge windows** have external floodlights shining forward, but they often just light up the snow. We likely have moments of **complete darkness** when power fails – emergency lights (red) come on inside, outside it's pitch black except maybe phosphorescent paint on stairs. Later, perhaps emergency portable floodlights or handheld flares are used if deck lights fail. Interiors: the factory deck normally is bright-white lit (for work), but if we are in emergency mode, maybe they are on backup, so dim red or minimal lighting there too (to focus power on critical systems). We definitely use the **Bridge red light** mode as primary (only switching to white if e.g. the crew needs to see something critical, but then switching back). The **UI elements** like radar screens will be among the brightest objects (and we ensure they don't blow out the player's eyes by tuning brightness).
- **Weather VFX: Blizzard** conditions with very high particle density for snow. Possibly too high density to see through normally, so we might dynamically reduce snow when player is indoors or looking through windows (simulate glass windows clearing some snow). **Spindrift** is extreme – snow and ice crystals being blown along surfaces (we could repurpose sandstorm techniques). **Fog** also present as whiteout is basically fog+snow. Lightning might flash occasionally with a muffled rumble due to snow. We can have dramatic **St. Elmo's fire** (a phenomenon where corona discharges glow on masts in storms) – perhaps a bluish static glow on tips of antennas briefly, just as an Easter egg effect, indicating how electrically charged the air is.
- **Water & Ice:** Water is nearly black in darkness but churned with white foam. Each huge wave crest has streaks of foam horizontally (wind ripping tops off). We exaggerate **WATER_FOAM_STREAKS** to show the violence. Impacts produce colossal spray that instantly turns to ice on surfaces. **Material**

transitions: all exposed surfaces start covered in **MATERIAL_ICE_ENCASING** from the get-go, and it might be so thick that things take on ghostly white shapes (over-whitened by ice). When something breaks or is cleared, you see the actual color underneath (momentarily until it ices again). Interiors near openings have **frost** too – e.g., around a partially opened door, the floor gets frosty. Also, cold steam – the factory might have freezing mist swirling from the processing water that's spilled and freezing. We should show **icicles** hanging from ceilings in unheated spaces. The player's **avatar** (if visible in any reflection) is presumably in a full survival suit, so their hands might appear gloved and iced. We ensure the **camera wetness** effect can also do frost: water droplets on lens may freeze into a blur – requiring a “wipe” to clear, maybe even a “scrape” multiple times. We incorporate subtle **camera frosting at edges** in extreme cold for ambience.

- **Materials:** Everything is layered. The base materials (painted steel, etc.) are mostly hidden under ice, but we still use **RUST_STREAKS** where appropriate (maybe inside engine room or on some older pipes). **Peeling paint** on interior bulkheads of the factory show where years of salt and wear happened. **Wet sheen** is mostly moot because things are frozen; however, in engine room or warm interior, surfaces are dripping (as ice melts from heat in engine room). That contrast could cause condensation everywhere – e.g., in galley you have moisture dripping from ceiling as heat inside meets cold walls. We unify it under the style: this is “Frozen Hell” – so mostly white and blue tones with occasional orange (lights or fire).
- **Camera & VR:** With such violent conditions, VR sickness risk is high if we fully simulate. We might intentionally limit how much the player has to be outdoors in crazy motion (use more interior sequences where horizon not visible). But when outside, the **rolling horizon** is full-scale (though horizon not visible, but gravity perceived via snow movement and sea surface tilt). We continue strong **camera shake** for impacts – perhaps even adding a brief *screen tilt or player stumble* effect on the biggest slam to simulate being knocked over. If the player avatar falls, maybe we do let them fall and require standing up (press a button to simulate picking self up). We should have **two-hand bracing mechanics** solid here: if player grabs two fixed points, we lock orientation with minimal view drift (like hardcore comfort mode).

Also new: we might simulate the cold and stress via **visual effects** on camera – slight edge vignette that pulses (like tunnel vision) if the player's character is near collapse or freezing. Perhaps if they stay too long in blizzard, a frost vignette closes in until they return inside or warm up (danger of hypothermia).

- **Audio:** This storm is loud beyond loud. We might incorporate a **dampening** effect to simulate the player's hearing protecting itself (like ears ringing or muffling after particularly loud booms). Wind is a continuous shrieking howl, so relentless it becomes a background drone. We modulate it with gusts that have a rising *EEEE* then a sudden drop (gust front passing). Thunder in snow is weirdly muffled but we'll have some low booms. **Hull stress** sounds should be introduced: deep groans and occasional *bangs* as metal contracts in cold or flexes. It gives an ominous sense that the ship itself is in pain. **Machinery** in this level might fail often, so one moment you hear a giant winch motor straining (like a metallic *whirr* followed by a snap and wind-down if it breaks). We should include some **springs and metal snapping** sounds for rigging that breaks.

Alarms are constant but we differentiate: e.g., the general alarm might actually be activated to signal abandon ship readiness (a whoop repeating) and local alarms like engine or fire are distinct. Possibly **alarm fatigue** is a theme – so many alarms that the crew have to prioritize. We might dramatize that by overlapping alarms until the player hits acknowledge, etc.

The **crew voices** here are more numerous but also more organized (they have clear roles). There might be a bridge team, an engine team on comms, etc. The player might get voice messages via intercom from multiple points: e.g., “Engine room to Bridge: we have a fire!” or “Bridge to all hands: prepare to abandon ship” – these come through loudspeakers. We maintain that any critical objective is communicated in voice at least once (so if a player is overwhelmed visually, they get an auditory cue).

Music might reach a climax in this level – maybe very subtle up to now, but at some point (like the near-capsize) we might bring in a low orchestral swell to heighten the oh no moment – though it must not drown out alarms or sound. Could be optional cinematic mode.

E. Audio Design Notes: A final summary for audio level 3: virtually an **all-channel assault** – we use sub-bass (for huge wave impacts felt as rumble), mid for engine/fuel explosions maybe, high freq for wind shriek and alarm whistles. The mix will duck less critical sounds when a new critical one triggers – e.g., if the “abandon ship” alarm starts (a distinct pattern bell), we might slightly lower constant wind noise volume so the player perceives it through the chaos. Similarly, NPC voices might get a volume boost + radio filter if they’re on intercom to cut through wind. Underwater or external perspective might be used for a narrative moment if the ship nearly capsizes – e.g., hearing things muffled as if underwater to signify how close they were (just an idea if we do a slow-mo moment).

Given many players might not physically tolerate constant super loud noise, we can dynamically balance: when the player is inside (bridge or engine room), we muffle external noise to give relief – though inside engine is loud but differently (mechanical rather than wind). We can also add an “OC (Occupational) headset” effect – maybe at some point the player dons ear protection (we could prompt it to reduce volumes – an in-game “sound dampener” option essentially). This could double as an accessibility feature – e.g., put on virtual ear defenders and the game volume for harsh noises lowers by 30% with a slight muffle filter, making it bearable. Diegetically appropriate too because crew do wear ear protection often.

F. Diegetic UI Plan: The *Polaris* being advanced has perhaps too much info, but we focus:

- **Integrated Systems:** There’s likely a **central monitoring system** (a computer screen showing ship status: watertight doors, tank levels, engine status, etc.). The player can consult that if needed – maybe an objective to check the damage control computer if confused. If that’s out, there are backup indicator panels and analog gauges (like a big damage control board with lights).
- **Navigation & AI aids:** Possibly an **AIS (Automatic Identification)** system that shows other ships (if any left out here) – not too needed since none around, but could show a distress beacon or lifeboat if abandon scenario arises.
- **No HUD crosshair etc:** The usual – we keep using real instruments. If we absolutely must convey something not easy via world, perhaps the player’s wrist device (like a smartwatch or an old-school pocket checklist) might glow text. But ideally, everything – from time to next big wave (barometer drop and wave patterns) to tasks – is shown through environment changes and crew dialogues.
- **Time & progression cues:** The storm’s worst should correlate with final tasks – e.g., when the barometer stops dropping or wind sound slightly eases, that’s a sign the worst is passed. If the gameplay time is say 60 min, we might have a clock or simply a log in the ship’s computer that shows time passing (like entries). But players likely won’t check a clock under duress, so better to signal via environment (maybe the sky very slightly lightens or the nature of waves changes).
- **Objective prompts:** The complexity might warrant an in-game checklist like previous levels but bigger. Possibly a **whiteboard in the bridge** where the captain writes priorities: “1. Stop flooding, 2.

Fight fire, 3. Check crew” etc. The player can glance at it to orient if lost. Crew might update it as tasks complete (erasing or checking off). This sort of in-universe UI helps coordinate without a magical HUD arrow.

- **Abandon ship sequence UI:** If it comes to that, the abandonment process itself is a UI – lights flash, an automated voice might count down to CO₂ release in engine (for fire), etc. And the lifeboat station has indicators (green lights when boat is ready to launch). The player might have to watch a gauge that shows when to cut loose (like “all crew boarded – light on”).
- **Accessibility:** At this final stage, the game could offer an “auto-complete” for players who can’t manage – maybe in settings – but we design expecting the user is prepared by prior levels. High contrast mode might be an option; but here environment is basically high contrast (dark vs bright snow).

G. Level Gameplay Loop: Finally, the battle with *Polaris*:

- **Act 1 – “Storm of the Century”:** It starts with the ship already in extreme weather. Perhaps they attempted to retrieve nets early due to forecast, but not in time – so Act 1 tasks revolve around **cutting loose the fishing gear** to save the ship. For example, the first objective: the net is still partially out and causing dangerous drag, plus icing on it. The player must assist in an emergency net cutaway – e.g., go to stern, physically cut a thick rope or release a jammed shackle while waves crash (very dangerous). This sacrifice saves the ship from being pulled down by the net. Then, **immediately** a major wave hits and wrecks something: maybe a **trawl door** (massive metal plate) breaks loose on deck and is sliding. The player secures it with chain (like lashing a multi-ton object – using a winch or chain stopper). Meanwhile, the **factory water ingress** starts because waves splashed into an open ramp during that chaos, so minor flooding in factory to deal with (closing ramp door and starting pump). Essentially Act 1 is jettison fishing operations and batten down absolutely everything. Because the crew is large, NPC teams handle some tasks – you might get messages like “Forward deck secure!” after time, focusing player on where needed. After initial crazy scramble, the ship is as prepared as possible. They navigate to try to escape the worst – heading towards marginally safer waters (maybe behind a large iceberg or closer to some islands). Mood: sustained dread, no real lull, just slight slow when net finally cut and they think “okay, we shed that burden.”
- **Act 2 – “All Hell Breaks Loose”:** The full brunt hits. Multiple systems fail one after another, as described. Structure:
 - **Power failure:** One of three generators fails (overload or saltwater short). Lights flicker, some sections go dark. The player goes to engine control to tie remaining generators together, maybe manually start the emergency generator. This is complicated by perhaps an electrical fire in the failed generator’s panel (so you also grab a CO₂ extinguisher to put it out, then reset breakers).
 - **Flooding:** Almost concurrently, a **hull breach alarm** in a forward void or factory hold. Might be from stress or an ice impact. The player or NPCs go to assess – let’s say an access tunnel shows seawater spraying in via a crack. They use temporary patch (damage control kit with wooden wedges or epoxy). Then rig pumping from that compartment.
 - **Fire:** As feared, maybe a fire erupts in the processing plant – a motor overheated due to low voltage and caught fire near packaging materials. The fire suppression system should activate but might be offline from the power issues. So player (with any NPC help) must don SCBA (self-contained breathing apparatus) – represented by a simple mask overlay maybe – and fight the fire with hose or extinguisher. Possibly remotely activate CO₂ after ensuring evacuation. Now you have simultaneous

flood and fire – dramatic. We time it so if the player did well with power, the emergency power kept pumps and some fire system working to assist. If not, they are in the dark fighting it manually.

- **Crew injury:** With all this, one or more crew get hurt (smoke inhalation or slipped and broke something). The player might be asked to **bring medical supplies** or even drag an unconscious crew to sickbay (heavy VR interaction: grabbing a character under arms and pulling – we might simplify by just assisting another NPC doing it). By end of Act 2, the main crises (fire, flood) are just barely contained. But the ship is in bad shape – down to minimal power, possibly listing a bit (water remaining), and still far from safe harbor. This act will have the highest multitasking and probably the tensest atmosphere (alarms everywhere, chaotic).
- **Act 3 – “Last Stand”:** It’s questionable if the ship can be saved. The storm’s peak hits with one or two enormous waves (we can sequence two rogues in a row for shock). The first might cause the near-capsize scenario: the ship rolls say 50° (we simulate by tilting everything, stuff falls). Bridge screams “rollover!” etc. But it rights slowly. In that moment, maybe an NPC triggers distress call (EPIRB manually) just in case. The second wave maybe does some structural damage – e.g., shatters a bridge wing window or crumples some railing. If they still have engine power, captain tries to *surf* the wave or keep bow into it. The player at this point mostly follows bridge orders to ensure survival:
 - Perhaps **ballast shifting** as mentioned, or manually steering since autopilot is off (holding course while captain manages engine).
 - Possibly **launching a sea anchor** (large drogue) to stabilize heading into waves – a task: deploy the drogue from stern on a winch, then secure the line.
 - Checking that **everyone is safe** (roll call via radio, or physically checking a muster station). If earlier fail-scenarios didn’t occur, the ship should ride out these killer waves. By now the worst passes. But one more challenge: they are drifting towards an ice field or rocky shore (depending scenario), and engines need to be back online to avoid it. So the player heads to engine room to help get propulsion back to full (maybe clearing an intake or topping up lube oil or literally hitting a manual override to force engine on). This is a final timed task: e.g., “We have 2 minutes before we hit the ice pack – get that engine running!” Tension as the start sequence or fix occurs last second, engine roars to life, ship steers clear. If fail, they collide and that’s game over (with perhaps lifeboat deployment cutscene). Assuming success, the *Polaris* regains basic functionality and limps towards open water or calmer lee side.
- Optionally, we could incorporate an **abandon ship false alarm**: at peak, captain orders prepare to abandon. The player helps prep lifeboats (like cutting lashings, activating davit). But then engine returns, situation stabilizes, and they stand down. This would be a powerful emotional moment (facing the possibility of giving up ship).
- **Conclusion:** Level 3 ends either with (a) ship saved – battered but afloat, crew safe, perhaps meeting a rescue cutter or simply out of immediate danger, or (b) ship lost – which would be a fail state to avoid if player does reasonably well. Given the nature, we might allow a “bad ending” if player misses major stuff – e.g., they save themselves on a lifeboat scenario cinematic (with score reflecting it). But canon success means *Polaris* survives. The final scene might be dawn breaking through storm clouds, illuminating the ice-laden ship as the storm quiets, with radio chatter that rescue aircraft is en route or similar, giving a sense of achievement and relief.

Throughout, we provide **assist systems** albeit less obvious: NPCs automatically handle some tasks off-screen so player isn't literally doing everything (we might mention "Engine team got #2 generator online, good" as feedback to reduce load). We ensure crucial interactions aren't frustrating: any heavy item moving is partly automated (player initiates, NPCs "finish" it in cutscene maybe). Tools are always within reach or highlighted. And physically, we broaden grab zones as much as needed because fine motor in shaking VR is tough.

This level is the culmination of all prior lessons: reading instruments, managing comfort (the player should by now use bracing, etc.), prioritizing tasks (maybe multiple objectives blinking in their mind), and dealing with extreme environmental effects (low visibility, etc.). It's meant to feel like surviving the impossible – a **Deadliest Catch** super-episode times ten, combined with disaster movie scenarios. The styling (Frozen Hell) and mood (Exhausted Relief at the end) should leave the player breathless.

The three levels collectively escalate the complexity, from a small crew on a crabber focusing on basic deck safety, to a mid-size longliner balancing deck and interior issues, to a giant factory ship where the player coordinates advanced crisis management. Each level feels distinct in silhouette, scale, and atmosphere: from open exposed deck of a crab boat in daylight, to foggy night on a longliner, to an iced-over factory ship in total whiteout. Yet all tie together with the style bible: the sensation of relentless storm and the triumphant (or tragic) outcomes earned by skill and quick thinking.

3. Storm-Adaptive Task Library (100 Tasks)

Below is a comprehensive library of 100 realistic crew tasks that the player may encounter, spanning all three levels. Each task is described with its context location, required tools/props, primary hazard type, how a storm intensifies the challenge, and the diegetic completion cue (how the game indicates the task is successfully done through in-world feedback).

To keep the design document organized, tasks are grouped by category (A–F). This library serves as a reference for mission designers to create objectives and for gameplay programmers to implement interactive mechanics. These tasks are **game-adapted** (simplified for VR interaction but grounded in real ship operations). They deliberately avoid detailed real-life procedure that could encourage unsafe imitation – instead focusing on the *gameplay actions* and *feedback*.

A. Deck Safety and Securing (Tasks 1–25): Core tasks involving securing the vessel's exterior and preventing accidents on deck.

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
1	Lash down loose deck crates	Deck	Rope straps or chain	Impact/Trip	Crates slide faster on heavy rolls	Crates immobile (lashed tight, no movement)

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
2	Secure spare fuel or oil drums	Deck	Ratchet straps, chocks	Impact/Spill	Drums teeter as deck tilts sharply	Drums strapped against bulkhead (no rattle)
3	Check and re-tension tie-down straps	Deck	Tension wrench	Impact	Straps under strain flap in wind	Strap ratchets tight (audible click, strap taut)
4	Close and dog a deck hatch	Deck	None (hand operation)	Water Ingress	Waves spurting through until sealed	Hatch dog clamped (metal latch clanks, leak stops)
5	Confirm freeing ports are clear	Deck	Hook/gaff (to poke debris)	Flooding	Spray and ice clog deck ports	Sudden gush of water out port (drain cleared)
6	Clear scuppers of debris	Deck	Scraper tool	Slip/Flooding	Constant wash keeps clogging them with trash	Water pooling on deck drains with gurgle sound
7	Stow a sliding tool box	Deck	None (push into nook)	Trip	Box skids rapidly with each roll	Box wedged in secure spot (no sliding noise)
8	Lock a swinging crane/boom in position	Deck	Crane pin, lock lever	Impact	Wind gusts swing boom violently	Lock pin engages (loud clunk, crane stops moving)
9	Clip in to a safety line (harness)	Deck	Safety harness tether	Fall Overboard	Deck pitch makes standing precarious	Tether carabiner clicks onto line (harness icon/flag shows secured)
10	Retrieve a dropped glove or tool	Deck	None (hand pickup)	Motion (Balance)	Item slides toward edge with water flow	Item grabbed (visual confirmation in hand/inventory)
11	Move loose hook or gaff to rack	Deck	None (hand carry)	Puncture/Trip	Hook skitters with ship's roll, hard to grab	Hook set in rack notch (audible snap in sheath)

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
12	Reposition rolling coil of rope	Deck	None (manual rolling)	Trip/Entangle	Coil unravels and snakes in the waves	Rope coil placed in bin (coil stays put)
13	Close a partially open watertight door	Deck	None (hand dog)	Water Ingress	Wind and water force door open, hard to close	Door dogs shut (handle turns, seal compresses, spray stops)
14	Re-seat a leaking hatch gasket	Deck	None (manual adjust)	Water Ingress	Cold stiffens gasket, water spurts through gap	Rubber gasket pops into groove (spray reduced)
15	Check rail gates are latched	Deck	None (visual & hand)	Fall Overboard	Waves bash hull; an open gate = big risk	Gate latch clicks (gate secure, indicator flap shows latched)
16	Cover an exposed electrical junction	Deck	Protective cap/shroud	Electrocution	Rain directly hitting open wires	Waterproof cover fitted (no more sparking visible)
17	Fasten a flapping tarp over gear	Deck	Bungee cords, ties	Impact (flail)	Tarp whipping violently in gale	Tarp strapped down (flapping noise stops)
18	Secure a net or line tail whipping in wind	Deck	Rope tie-off	Entangle/ Impact	Line whips dangerously fast in high wind	Line tied off to cleat (tail stops whipping)
19	Lock a winch control in neutral/safe	Deck	Safety pin or latch	Equipment Motion	Vibration could knock lever into gear	Control lever in locked slot (small lock light glows)
20	Attach a safety tag to out-of-service station	Deck	"DO NOT USE" tag	Accident Risk	Wind can rip tag away, crew might miss it	Bright tag hanging on device (clearly visible)

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
21	Verify deck lights are functioning	Deck	None (visual check)	Visibility	Heavy rain/fog reduces light reach – must all work	Amber floods all lit (deck illuminated uniformly)
22	Replace a broken deck light lens	Deck	Spare lens, screwdriver	Water Ingress/Vis	Rain entering broken fixture, light dim	New lens cover snaps on (light shines clearly, no water inside)
23	Confirm CCTV deck cam is secure	Deck	None (visual check)	Visibility	Camera shaking in storm, might break off	Camera housing steady (view on monitor stops jittering)
24	Collect scattered float markers	Deck	Storage crate	Trip/Overboard	Waves may wash loose buoys overboard imminently	All floats in crate (none rolling on deck)
25	Wipe salt spray off critical placard	Deck	Rag or sleeve	Visibility	Constant spray re-blurs text quickly	Placard text visible (player can read it clearly)

B. Fishing Gear Management under Storm (Tasks 26–45): Tasks related to securing or handling fishing equipment (nets, lines, pots) when weather threatens to wreak havoc on them.

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
26	Secure a net drum (prevent rollback)	Deck	Drum brake lever, pin	Impact/Entangle	Huge waves can overcome brake, unwinding net	Drum brake engaged (drum stops, thudding into lock)
27	Lock pot launcher or stack gate	Deck	Safety pin/ bolt	Impact	Wave impacts stress gate, shaking pots	Pin in place (launcher gate doesn't budge, indicator flag)
28	Stow a spare block and shackle set	Deck	None (hand stow in locker)	Impact	Pieces scatter with each roll	Parts in locker (door latched, clanking stops)

#	Task	Location	Tools/ Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
29	Check line bins aren't spilling over	Deck	None (visual + hand)	Entangle/ Trip	Waves toss coils out of bin	Lines pushed down, all line inside bins
30	Confirm hydraulic lines not whipping	Deck	Ties or clamps	Impact	Wind makes loose hoses flail about	Lines tied back or weighed down (no whipping)
31	Secure a buoy rack from sliding	Deck	Chain lashings	Impact	Heavy roll slams buoy rack against rail	Rack chained to rail (no slide, chain taut)
32	Re-hang a float that came loose	Deck	None (hook back on)	Trip/ Overboard	Wind could take it overboard any second	Float back on hanger (buoy line taut, secure)
33	Move tangled line away from pinch point	Deck	Gaff or hook to lift	Entangle/ Caught	Erratic tension as ship moves, line could snare	Line freed from pinch (snag resolved, line slack)
34	Reposition snagged net off hatch edge	Deck	None (pull by hand)	Jam/ Ingress	Net jerked by waves, jammed in hatch, flooding	Net section clear of hatch (hatch can close)
35	Stow a hauling hook in its sheath	Deck	None (insert hook)	Puncture	Boat lurch could swing hook at you	Hook clicks into sheath (no longer swinging)
36	Clamp down a vibrating guard plate	Deck	Wrench or hand knobs	Impact/ Noise	Engine strain & waves increase vibration	Rattle stops (plate secured, sound gone)
37	Cover gear controls from direct spray	Deck	Canvas cover	Water Short	Continuous spray hitting electronics	Cover in place over controls (water beading off)
38	Move a drifting fish tote to secure spot	Deck	None (push/drag)	Impact/ Trip	Water rush moves tote rapidly across deck	Tote wedged by wall (no longer sliding)

#	Task	Location	Tools/ Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
39	Secure the bait table lid/cover	Deck	Latch or bungee	Impact/ Slip	Gusts fling lid open, bait spills making deck slick	Lid latched shut (click, lid stays closed)
40	Tie off a loose messenger line	Deck	Rope cleat/tie	Entangle/ Trip	Line whipping violently in wind	Line tied to cleat (slack gone, line steady)
41	Check pot stack chain tension	Deck	Chain binder wrench	Impact/ Collapse	Pots shifting as ship rolls, chain jumping	Chain tightened (pots snug, chain links creak then quiet)
42	Verify gantry area clear of loose parts	Deck	Visual scan, hand remove parts	Impact	Violent shaking can drop anything not bolted	No loose items visible (clear deck under gantry)
43	Inspect a snapped strap on pot stack	Deck	Tag (mark broken strap) / spare strap	Collapse	Stack swaying with broken strap, risk topple	Broken strap tagged & replaced (new strap pulled tight, stack stable)
44	Confirm deck non-skid lanes are clear	Deck	None (visual)	Slip/Trip	Ice or junk covering safety walkway	Walkway path visible and unobstructed
45	Stow a rolling bucket (trip hazard)	Deck	None (kick or pick up)	Trip/Slip	Bucket tumbles unpredictably with each roll	Bucket secured (placed in rack or wedged, no movement)

C. Bridge Navigation & Awareness (Tasks 46–65): Tasks performed on the bridge (or using bridge equipment) to maintain navigation and situational awareness despite the storm.

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
46	Check radar range for near hazards	Bridge	Radar controls (dial)	Collision (Nav)	Sea clutter hides small targets	Radar tuned (short-range clarity, hazard blip visible)

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
47	Confirm GPS track after course change	Bridge	GPS/chart display	Navigation Error	Storm pushed vessel off course line	GPS course line realigned (display shows on-track)
48	Reduce radar clutter (sea return filter)	Bridge	Radar settings	Visibility (Instrument)	Heavy waves cause false echoes	Clutter removed (radar screen clears extraneous dots)
49	Acknowledge a navigation alarm	Bridge	Alarm panel (button)	Situation Awareness	Multiple alarms sounding simultaneously	Alarm silenced (sound stops, alarm light steady)
50	Check wind speed indicator trend	Bridge	Anemometer gauge	Weather Hazard	Wind gusting towards dangerous high	Wind reading noted (e.g. "70→80 kts rising", gauge needle observed)
51	Check barometer drop rate	Bridge	Barometer (analog/digital)	Time Pressure	Rapid pressure drop signals storm spike	Barometer reading logged (e.g. 980→970 mb fast drop)
52	Verify running lights status	Bridge	Indicator panel / visual	Collision (Other Vessels)	Driving rain may short out nav lights	Panel shows all nav lights green (or visual check from bridge confirms lights on)
53	Switch to bridge red lighting (night ops)	Bridge	Light mode switch	Visibility (Night Vision)	White lights would blind crew in dark	Bridge floods change to red (ambient light now red, crew can see outside better)

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
54	Check rudder angle indicator responsiveness	Bridge	Rudder gauge	Steering Failure	Heavy seas strain rudder, possible lag	Rudder needle follows wheel input (indicator moves in sync when wheel turned)
55	Confirm engine telegraph vs engine note	Bridge	Engine telegraph & listening	Propulsion Mismatch	Storm noise hides engine issues; mis-comm could occur	Telegraph setting matches actual RPM (audibly and gauge confirms)
56	Log a "shelter bearing" waypoint	Bridge	ECDIS or chart mark	Navigation Planning	Need safe harbor coordinate before instruments fail	Waypoint plotted on map (icon/mark appears at bearing on display)
57	Listen to and confirm weather radio update	Bridge	VHF/SSB radio	Weather Awareness	Static and wind make broadcast hard to copy	Key info heard (player or NPC repeats forecast details, radio fuzz clears briefly)
58	Use spotlight to confirm an obstacle	Bridge	Searchlight controls	Collision (Visual)	Driving rain/fog limit beam range	Obstacle sighted in beam (e.g. iceberg silhouette visible briefly in light)

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
59	Cross-check depth sounder trend	Bridge	Depth gauge/sonar	Grounding Risk	High waves and storm surge confuse depth readings	Depth steady/ increasing (no shoal ahead, alarm silent) OR depth shoaling fast (if hazard, triggers alarm) – player confirms no fast shallowing
60	Verify watertight door indicator lights	Bridge	Door status panel	Flooding Risk	A jarred door might show open – easy to miss	All door lights green (closed) on panel (no red indicators)
61	Confirm bilge alarm status panel	Bridge	Bilge alarm panel	Flooding Risk	Many false alarms in rough seas – must verify real ones	Active alarm zones identified (blinking red lights corresponding to flooding compartments) or panel reset to normal (all clear)
62	Check bridge window wipers operation	Bridge	Wiper switches	Visibility	Heavy rain/ sleet overwhelms wipers	Wipers sweeping normally (windows clearing, motor hum audible)
63	Clear a fogged window patch (defog or wipe)	Bridge	Anti-fog spray or cloth	Visibility	Interior condensation freezing on glass	Small clear view opened on window (player can see through that spot)

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
64	Confirm autopilot mode and disengage if unsafe	Bridge	Autopilot panel	Control Risk	Autopilot can't handle extreme seas, may cause broach	Autopilot off (indicator off, helm free) or mode adjusted (e.g., switched to manual, confirmed by wheel responsive)
65	Place a "brace for impact" call over PA	Bridge	PA/intercom mic	Crew Safety	Need to warn crew seconds before big wave hits	"Brace" alarm sounds shipwide (alarm tone or player voice echoing on PA)

D. Flooding Control & Water Management (Tasks 66–78): Tasks to manage, contain, or monitor water ingress and flooding during storms.

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
66	Check bilge level indicator (compartment)	Engine/Below	Bilge sounder gauge	Flooding	Sudden sloshing can jam float gauge	Gauge read (e.g., "Bilge 30%" – indicator steady, or alarm if high)
67	Acknowledge a bilge high-water alarm	Bridge/Engine	Alarm panel button	Flooding	Multiple alarms ringing simultaneously	Alarm silenced (buzzer off, alarm light still red until resolved)
68	Move a portable pump into position	Various (flooded area)	Portable pump unit, hose	Flooding	Sloshing water, slippery floor while carrying	Pump placed (correct spot, hose in water, pump humming as it starts)

#	Task	Location	Tools/ Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
69	Confirm a bilge discharge line isn't kinked	Engine/ Below	Discharge hose, visual check	Flooding	Hose shifts as ship moves, could kink or snag	Hose straightened (water flowing freely, hose vibrates with flow)
70	Close an interior hatch to isolate water	Interior	None (hand dog)	Flood Spread	Water sloshing through open hatch rapidly	Hatch sealed (water stops flowing past it, hatch dogged tight)
71	Retrieve absorbent pads from locker	Interior	Absorbent spill pads	Slip/Fire (oil)	Supplies sliding as ship rocks	Pads in hand (inventory), ready to deploy
72	Re-seat a loose deck hatch cover after wash	Deck	None (manual adjust)	Water Ingress	Green water washed cover off seat, water pouring	Cover flush in place (water leak slowed/ stopped)
73	Check a drain channel isn't blocked	Deck/ Interior	None (visual & clear debris)	Flooding	Debris/ice blocking drain as water rises	Drain runs clear (water seen flowing out)
74	Confirm compartment light works after spray	Interior (flooded)	Light switch or visual	Visibility	Water shorted light, area in darkness	Light on (compartment illuminated) or alternate light set up if main fails
75	Inspect a leaking pipe area	Engine/ Below	Flashlight (visual)	Flooding	Hard to see source amid spray and steam	Leak source identified (e.g. spray from crack visible, maybe marked with chalk)

#	Task	Location	Tools/ Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
76	Tag a flooding hotspot on map/clipboard	Bridge/ Control	Grease pencil/ clipboard	Communication	Hard to track multiple leaks in chaos	Map/board marked (flood location noted for crew, checkmark or note visible)
77	Clear floor so water runs to drain properly	Interior (floor)	Push broom/ boot	Flooding	Loose rags/ gear blocking flow as ship tilts	Path cleared (water seen flowing to drain instead of pooling)
78	Verify portable pump power source	Engine/ Interior	Generator outlet/ panel indicator	Flooding	Generator fluctuating causing pump to stop	Pump power light on (or audible change in pump pitch confirms power stable)

E. Engine Room & Mechanical Reliability (Tasks 79-90): Tasks focused on engine, generator, and mechanical systems stability under storm stresses.

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
79	Check generator status lights	Engine control	Status panel (LEDs)	Power Loss	Vibration might false-trigger indicators	All generator lights green (normal) or fault light identified (steady red)
80	Confirm ventilation fans are running	Engine/ Mechanical	Visual/aural check, hand test airflow	Overheat/ Fume	Wind might back-draft fumes if vents fail	Fan hum and airflow felt (telltale ribbon blowing)

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
81	Check for unusual vibration hot spot	Engine room	Hand on machinery, vib sensor	Equipment Failure	Storm shaking can mask new machinery vibration	Vibration source found (you feel a strong shake on a specific pump/mount)
82	Secure a sliding spare parts case	Engine room	Bungee/ strap	Impact/Trip	Rolls send heavy toolbox skidding on grates	Case lashed to railing (no movement, rattle stops)
83	Confirm a belt guard is in place	Engine room	Visual (cover on belt)	Entanglement	Vibration could loosen guard screws	Guard cover secure (cover visibly in position, no belt exposed)
84	Check a pressure gauge in safe range	Engine room	Pressure gauge	Explosion/ Failure	Pressure spikes with engine surges	Gauge reads within green band (needle steady, perhaps slight fluctuation but safe)
85	Report abnormal engine noise via intercom	Engine/ Bridge	Intercom mic	Diagnostic Delay	Storm noise makes it hard for bridge to hear engine	Report sent (bridge acknowledges e.g. "heard, will reduce throttle" over comm)
86	Reset a tripped breaker panel	Engine room	Breaker switches	Power Loss	Multiple breakers tripping from surges	Correct breaker toggled (lights/ equipment in area come back on, breaker stays in on position)

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
87	Confirm emergency lighting is available	Various (walkthrough)	Emergency light units (visual)	Visibility	Main power flickers, need backup lights	Emergency lights glowing (dim red/green lights on in corridors)
88	Check a watertight bulkhead door latch	Engine/Lower	Door lever/dogs	Flood Spread	Hull flex might loosen latches	Latch fully closed (lever tight, indicator if any shows secure)
89	Inspect minor leak for escalation	Engine room	Flashlight, clock (timing drips)	Flooding	Leak can worsen under continued stress	Drip rate noted (e.g. one drop/sec, stable), marked and time logged (no sudden gush)
90	Retrieve a spare fuse kit from locker	Engine control	Locker, fuse kit box	Downtime	Hard to find items in dark, shaking control room	Fuse kit in hand (inventory updated, box rattling with spares)

F. Crew Welfare, Comms, & Survival Readiness (Tasks 91–100): Tasks related to human factors – ensuring crew safety, communication, and survival equipment readiness during the storm.

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
91	Locate and confirm immersion suit locker contents	Interior (berthing)	Locker, suits (visual count)	Survival (Exposure)	Suits may have shifted or fallen in heavy seas	All suits present (e.g. “6/6 suits” label or visual count of suits in locker)

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
92	Confirm life raft cradle straps intact	Deck (rafter)	Visual on raft canisters straps	Survival (Launch Fail)	Extreme wind could snap weak straps	Straps tight and undamaged (no frayed ends, raft secure – perhaps a green indicator on cradle)
93	Check EPIRB bracket presence	Deck/ Bridge roof	EPIRB unit in bracket (visual/ touch)	Survival (No distress signal)	Waves or ice could knock EPIRB off mount	EPIRB secure in bracket (unit seen firmly in place, maybe blinking OK light)
94	Secure a medical kit in accessible spot	Interior (mess or bridge)	Med kit, strap or shelf	Medical (Availability)	Kit sliding could hide it or spill contents	Kit strapped or wedged (red cross box visible and not moving)
95	Deliver a handheld radio to bridge	Various (crew area to bridge)	Portable VHF radio	Comms Failure	Person on bridge needs comms amid loud storm	Radio handed over on bridge (bridge NPC takes it, static then clear two-way established)
96	Check a crew member's headlamp battery	Interior (berth)	Headlamp, spare battery	Visibility (Crew)	Batteries drain faster in cold, lamp dimming	Fresh battery in, headlamp shines bright (crew gives thumbs up)
97	Brew and deliver hot drink to wheelhouse	Galley -> Bridge	Kettle/ thermos, cups	Crew Fatigue/Cold	Hard to carry liquid on rolling ship (spills)	Thermos delivered (steam visible as crew pours, morale boost dialog "thanks")

#	Task	Location	Tools/Props	Hazard	Storm Modifier (High Intensity)	Completion Cue
98	Replace a soaked checklist with dry one	Bridge/ Engine	Dry laminated checklist	Info Loss	Original paper checklist ruined by water	New checklist posted (legible tasks, perhaps crew ticks an item to show it's readable)
99	Latch a loose galley drawer	Galley	Drawer latch (built-in)	Impact (flying objects)	Drawer sliding and banging with each roll	Drawer clicked shut (audible latch, drawer stays closed)
100	Stow a personal item sliding in berths	Berths	Personal item (photo frame, etc.)	Trip/ Damage	Crew bags/ items tumbling across cabin	Item tucked in shelf or tied down (no longer sliding, crew area tidy)

Each task above includes a **diegetic completion cue**, meaning the game will signal success through in-world changes: sounds (clicks, alarms stopping), visuals (lights turning green, objects staying put), or NPC reactions – rather than abstract UI pop-ups. This ensures the player stays immersed and can trust their senses to know the job is done.

(Optional: These tasks can be implemented as interactive events or mini-games in VR. For instance, task 9 “Clip in to a safety line” could be a physical VR action of grabbing your harness tether and snapping it to a line, which we’d implement with a simple snap-to-slot mechanic. All tasks should be tested under various motion conditions to ensure they remain achievable during ship movement.)

Important Safety Note: While these tasks are inspired by real maritime procedures, in-game they are simplified and contextual. We avoid providing exact real-life instructions (e.g. which specific valve to turn in an engine room) – the focus is on *gameplay action* (press, hold, carry, etc.) and *problem-solving*. The narrative context and these design notes ensure the player understands the gravity without ever implying they should try this outside a game.

4. VR Motion and Comfort Tuning

Simulating a storm-tossed ship in VR is a delicate balance: we want players to feel off-kilter (“sea legs” sensation) but not to the point of VR sickness. Below is the comfort design plan to maintain immersion **and** safety:

Motion Simulation Model: We separate ship motion into **low-frequency tilt** and **high-frequency vibration**, handling each differently: - **Low-frequency roll/pitch:** The large slow sway of the vessel (the

horizon tilting, deck inclining) is directly rendered to the player's view, but can be scaled. We'll offer three presets ("Sea Legs Mode" Low, Medium, High) adjusting amplitude. In Low mode, horizon tilt is, say, 50% of true, making motions milder. In High, full motion is shown. Medium is our default, corresponding to about 75% real motion. This scaling helps users build tolerance ²⁵ ²⁶ . The roll and pitch are always **gradual** – e.g., a 10° per second roll, which the inner ear can handle better than jerky moves. - **High-frequency jolts:** Impacts and rapid shudders (like a wave slam or engine vibration) are NOT represented by instant camera movement (which would be nauseating). Instead, we convey these via **haptic feedback** (vibration in controllers/bodysuit if available) and **audio**. The camera might do a subtle **CAMERA_HANDHELD_SHAKE** – a very small, rapid oscillation – but not a full positional jerk. For example, when a wave hits, we play a quick screen shake and blur to imply impact but keep rotational changes minimal. The heavy *sound* and *vibration* fools the brain that the shock happened without physically throwing the player's viewpoint too fast. This approach leverages that the vestibular system (inner ear) conflict is minimized if we avoid ultra-fast unpredictable view shifts.

Dynamic Horizon & Reference Aids: We provide an **optional artificial horizon overlay** – a faint line or graphics in peripheral vision that stays level with true gravity ²⁸ . This is proven to reduce motion sickness by giving a stable frame of reference ²⁶ . In our game, we call it the "**Horizon Helper**." It's off by default for hardcore realism, but players who need it can toggle it on in comfort settings. Diegetically, we justify it as the character focusing on horizon through a HUD in a headset or simply an accessibility feature. Additionally, interior spaces have reference frames (e.g., pipes, railings) that stay fixed to the ship – players can focus on those if needed (like real sailors advise focusing on the boat or horizon). - When the ship tilts, **furniture and objects remain fixed relative to ship**, which means from player perspective they tilt too. That's crucial for presence (no sliding unless physically moving from physics). However, small items might slide in-world but that's an object motion, not the environment itself – easier for the brain to accept.

Comfort Toggles ("Sea Legs Mode"): - **Low (Green):** Minimal motion: horizon tilt greatly reduced, some ship motion instead conveyed by moving objects and sound. Use for very sensitive players – the experience still shows storm ambience (rain, etc.) but the deck feels more stable (like stabilized camera effect). - **Medium (Yellow):** Default. Moderate camera roll/pitch as described (~75% real motion). Enough to feel off-balance but usually manageable after a short adjustment period. - **High (Red):** Full motion: for players who want maximum realism. The horizon and deck move exactly as the simulation dictates. We will display a warning for this mode that it's intense. - We allow on-the-fly switching (perhaps mapped to an in-game "Sea Legs" setting on a smartwatch UI or pause menu) since a player might find they acclimate and want to increase later.

Vignette Options: We include a **vignette** (tunnel vision) option during intense motion. When the player moves or the ship has a quick yaw, if vignette is on, the field of view edges will darken ²⁹ . This reduces peripheral flow which often triggers nausea. It's adjustable: partial vignette or full tunnel (user choice). We won't force it except maybe in extreme events by default (like if the ship does a sudden lurch, we dynamically vignette briefly to soften it). - Also, a "**crouch comfort**" mechanic: if the player virtually crouches (like holding a handgrip labeled "Brace" or physically crouching), we can automatically narrow FOV slightly and stabilize view – simulating bracing stance reduces apparent motion. This encourages players to take a stable pose in heavy seas (mirroring reality and aiding comfort).

Interaction Stability: We implement several measures so interactions (grabbing, pressing) aren't frustrating while everything moves: - **Magnetized handholds:** All ladders, railings, grab bars – when the player reaches and "grabs" them, we magnetize the player's virtual viewpoint to that object. Essentially the

game applies an opposite motion to compensate ship sway ³⁰. This means if they hold a rail, the world tilt still happens visually, but their egocentric view stabilizes a bit (like anchoring). This greatly reduces motion sickness and simulates realistic bracing (the brain expects stability when holding something fixed to earth). We'll still allow some relative motion (so you feel the ship move under you a bit) but largely dampened. - **Two-hand bracing mechanic:** If the player grabs with both hands (say two points on a ladder), we could even go further – slightly reduce camera roll to near zero, as if the character locked themselves to the structure. The UI might indicate “Braced” when both hands hold firm points, letting the player know motion is reduced. This is a conscious design to encourage holding on, which is also thematically appropriate. - **Generous grab volumes:** All interactable switches, valves, etc., have an expanded collider so the player doesn't have to be pinpoint accurate while the world is shaking. For example, a button might “highlight” when the hand is in a 10 cm range, then you press – you don't need to exactly touch the small surface in a jittery environment. - **Tool tethering:** Tools like wrenches or extinguishers have short tethers to the player when held, so if dropped they dangle instead of flying off. This prevents frustration of losing an item due to a sudden ship lurch. It's diegetic (some tools are literally on lanyards on ships, and we extend that logic to most hand tools for convenience). - **Snap zones for items:** When placing objects (pump, crate, etc.), we use snap-to-slot logic once the item is near target, so you're not fiddling with precise placement while swaying.

Allowable Nausea vs Guardrails: We intentionally allow some discomfort to sell the “storm” – mild nausea or unease is part of the experience, but we control it: - The gameplay loops are structured to give short breaks inside calm(er) areas after intense outside sequences. E.g., after 5 minutes on the wildly moving deck, the next tasks bring the player to the engine room where, though still moving, they don't see the horizon and have more fixed frame references (walls). This alternation provides recovery time. - **Guardrails:** We monitor player physiological signs as we can (indicators like erratic head movement can hint at discomfort). If a threshold is crossed (say we detect the player hasn't moved or is wavering), we can trigger an in-game suggestion: e.g., the character's inner voice or a crew says “Take a breath, focus on something stable!” and present the option to temporarily enable extra comfort mode (like heavy vignette or teleport to a safe room). We won't outright force it, but we provide easy access (maybe a quick access “comfort boost” button that instantly reduces motion by another 50% until toggled). - No continuous artificial locomotion: The player doesn't use a joystick to move long distances – movement is mostly natural (room scale to walk small spaces) or short teleports if needed for bigger ship (blink teleport between decks). This avoids VR sickness from self-motion. The only “locomotion” is the ship's motion, which we handle as above. - **Teleport and Snap Turn:** We allow teleport movement for traversal (with an option for those who prefer smooth locomotion, but default to teleport to avoid compounding ship motion with player motion). For turning, we default to **snap turning** (discrete 30° steps) so the player isn't spinning smoothly while also rocking – this prevents overwhelming the vestibular system ³¹. They can turn it off if they want. - The **play area** often is confined (ship interior corridors etc.), which helps as the brain has nearby stationary references (walls) – an advantage in VR sickness reduction. The worst is on open deck looking at moving horizon – we mitigate with the horizon helper if needed and strong audio/haptic cues for motion (since hearing and feeling the motion can reduce sensory conflict ²⁵).

Testing and Tuning: We will user-test with people prone to motion sickness and adjust curves. For instance, we might find a slight phase lag of the visual horizon vs motion can help (some research suggests aligning VR motion with real inner ear input helps ²⁸ – though here inner ear feels nothing, we might lean visuals a tad behind so brain has time to adjust). We also ensure **90 FPS** at all times – any frame drop in VR especially with motion is disastrous for nausea. So performance budget (particularly for Level 3 with heavy VFX) is tuned to maintain FPS.

In-game “Sea Legs” acclimatization: To enhance comfort, early gameplay (level 1) starts in a milder motion scenario and ramps up. This is intentional to let players acclimate – by level 3 they (and their characters) have their “sea legs.” We even acknowledge this narratively – NPCs joke “getting your sea legs?” in first level. Research shows repeated short exposures help build tolerance, so the campaign naturally does that.

Summarily, our strategy is **realism with escape hatches**: the full storm experience is there for those who can handle it, but at any time players can opt into a more comfortable mode via diegetic cues (e.g., going inside, bracing) or settings (horizon line, reduced motion). We want players to feel unsettled and challenged – maybe a bit queasy in dramatic moments to sell it – but we have robust safeguards to prevent it from ever becoming unplayable. The goal is “comfortable discomfort”: the *illusion* of perilous motion without the actual ill effects.

5. Production Package

Delivering these levels at AAA quality requires careful asset planning. Below we detail the production assets needed, categorized by type, along with a testing checklist and a suggested build order for development.

Asset List per Boat/Level:

Each level (boat) will need a library of props and environment pieces. We list key ones (not exhaustive of all 50–120, but grouping major categories):

- **Level 1 (Crabber “Seaward”) Assets:**

- *Exterior/Deck Props:* Crab pots (stackable, dynamic), pot launcher frame, hydraulic winch, crane with pulley, coiled lines, buoys and float markers, bait station table, deck hatch, scuppers and freeing port models, life ring, life raft canister, EPIRB unit, deck floodlights, CCTV camera, safety railings, chain lashings, hook, gaff.
- *Interior Props:* Wheelhouse console (steering wheel, throttle levers, analog gauges cluster, radar CRT, radios, GPS unit), captain’s chair, coffee mug, charts, toggle switches, alarm panel, windshield wipers (animated), binoculars. Galley: table, benches, stove, sink, cabinets (with latch), plates, coffee pot. Berths: bunk beds, personal lockers, loose items (book, photo, guitar), immersion suit bag, first aid kit.
- *Engine Room Props:* Main engine model (medium diesel), generator, batteries, breaker panel, valves, pipes, bilge pump, portable pump object, oil drums (spares), toolbox with tools, rags, ladders, gauges (pressure, temp), worklight.
- *Safety Equipment:* Harnesses and safety lines (attach points along deck), fire extinguishers, alarm bell, survival suits (object in locker), flares box perhaps.

- **Level 2 (Longliner “North Star”) Assets:**

- *Exterior/Deck Props:* Longline hauling station (roller + motor), line bins with coils, floats with flags, buoy rack, stern shelter structure, net drum (if combination vessel), power block, deck crane (small), anchor winch on bow, icing (mesh overlays for rails, etc.), anti-slip mats, lifeboat or raft on bridge deck, mast with lights.

- *Bridge Props:* Modern consoles (flat screens for radar/ECDIS/sonar), analog backup gauges, autopilot panel, intercom handset, wind gauge digital, barometer analog, nav chair, chart table with maps and pencils, PA speaker, indicator panels (doors, bilge, etc.), control levers for throttle, rudder indicator gauge, overhead red lights, binoculars, spotlight control stick, wiper controls.
- *Interior Props:* Galley (larger: stove, microwave, fridge, big table, chairs with straps, cabinets, coffee machine), crew bunks with lee cloths, recreation room couch and straps on TV, drying room hooks with gear, spare lines racks, medical bay bed and cabinet, lockers with labels, emergency signage (exit arrows, muster station signs).
- *Engine & Mechanical Props:* Larger engine model, multiple generators, workbench, lathe (maybe for detail), electrical panels with breaker switches, alarm klaxon, ventilation fans, fuel manifolds, ballast pump control, SCBA sets on wall (for fire), foam fire suppression nozzles, steering gear assembly in aft compartment.
- *Fishing Gear Props:* Spare net sections, barrels of bait, hydraulic hoses with clamps, line spools (for branch lines), hook bins, snap hook devices, pot (if it also carries pots for cod, optional).
- *Safety Gear:* Fire extinguishers (multiple types: CO₂, foam), fire hose reel, general alarm switch, muster station board (with crew count tags perhaps), survival craft (inflatable rafts in larger canisters), EPIRB, SART (radar transponder), emergency helmets/headlamps for crew.

• **Level 3 (Factory Trawler “Polaris”) Assets:**

- *Exterior/Ship Props:* Massive hull with stern ramp, trawl doors (two large steel boards), net drums (large, possibly below deck partially), multiple heavy winches, gantry crane at stern, deck cranes midship, containerized lifeboats on davits (hard lifeboats), helicopter pad on bow (with tie-downs), large radar/comm array on bridge top (multiple radars, sat dome, antennae), funnel with logo, ice buildup variants for all exposed surfaces (icicles, ice sheets).
- *Factory Deck Props:* Conveyor belts (animated), fish processing machines (fillet machine, sorter, mincer), packing tables, plastic fish crates/totes, pallet jack, freezers (vertical plate freezers stacks), freezer hold hatches and hoist, overhead crane for moving product, drainage grates, steam pipes (for heat, maybe icing).
- *Bridge Props:* Integrated bridge system – touchscreen consoles (we'll simulate with interactive screens), a 5-monitor array for cameras and sonar, separate comm station with GMDSS radio, INMARSAT phone, distress panel (sealed with break glass), EOT (engine order telegraph backup), navigation compasses (gyro and magnetic), captain's chair plus two officer chairs on rails, large windows with wiper sets, perhaps window heating elements visible, bridge wing consoles (minimal wheel and thruster control, spotlight).
- *Accommodation Props:* Dozens of cabin props (though we may not enter all): bunk beds with curtains, desks bolted, communal mess hall (long tables with benches on gimbals?), industrial kitchen (steam kettles, etc.), laundry room? (maybe not needed to show).
- *Engine Room Props:* Huge slow-speed diesel or diesel-electric engine, generators (multiple big ones), switchboard (floor-to-ceiling breaker panels), engine control room (computers, mimic diagram of ship with systems, big red EMERGENCY STOP buttons), pumps and valves for ballast, fuel separators, turbochargers, gauges and dials wall, CO₂ fire suppression system (big red tanks cluster), emergency generator (smaller unit up high), alarm horn, bilge high-level sensors (wired floats).
- *Survival/Comms Props:* Launchable lifeboats (with winch davits, release lever), lots of immersion suits racks for 50+ crew (maybe just implied), line-throwing device, flares locker, EPIRB auto-deploy unit on bridge top, multiple life rings, PA speakers all over ship, muster station signage, emergency backup

radio (hand-crank?), medical infirmary fully equipped (bed with straps, defibrillator maybe just for set dressing).

- *Special Effects Props*: Broken mast sections (for when it collapses), sparks particle systems for electrical failures, fog machines (for smoke, steam leaks), water burst particle for hull breaches, interactive valves (for isolating leaks), flood lights portable, collision bumpers, high-pressure washer hoses (maybe to de-ice, if used).

• Shared and Miscellaneous Assets:

- Weather effects: Rain, snow, fog volumes, lightning (light + branching bolt texture).
- Water: 3D wave meshes (for deck washes), particle splashes, foam decals.
- Materials: A library of materials as per style tags: rusted metal, peeling paint (with layers for different base colors per ship), wet sheen (with environment reflections), ice encrusted (subsurface scattering or frosty look), slick raincoat fabric (bright orange suits for crew), foggy glass, etc. We'll create these materials in a scalable way (e.g., a Material Instance that can increase/decrease icing).
- Characters: Though not specifically enumerated, we have crew NPC models: e.g., level 1 maybe 1-2 other crew, level 2 ~5 crew, level 3 up to 10 visible in scenes. They need appropriate outfits (rain slickers, boots, life vests if on deck, etc.) with variations (and color coded or labeled for roles). Animations for them doing tasks or bracing.

Material Set List:

We will prepare a consistent set of PBR materials applicable across levels, often with variants: - **METAL_SHIP_HULL_BASE**: Painted steel with wear. Variants: clean paint, **MATERIAL_PEELING_PAINT** (alpha layer of flaked paint exposing primer or metal), **MATERIAL_RUST_STREAKS** (dripping rust from bolts and edges). - **METAL_NONSKID_DECK**: Textured deck paint with grit, wet variant (**MATERIAL_WET_SHEEN**: high specular in puddles), icy variant (**MATERIAL_ICE_ENCASING** overlay). - **WATER_SURFACE_GREEN**: For green water on deck – translucent green with white foam edges (used in particles/meshes). - **FOAM_STREAK_DECAL**: White foam lines for after wave passes (projected decal). - **GLASS_BRIDGE_WINDOW**: Slightly tinted safety glass. Variants: dry, **fogged glass** (interior condensation, maybe dynamic), rain-splattered (with normal map animations of droplets). - **FABRIC_SLICKER**: Bright orange PVC textile for crew raincoats, shiny and wet shader. Also **fabric_oxidized** for older gear (duller). - **RUBBER_WET**: E.g., for hoses, cables – has wet look if outside. - **ICE_RIME**: A material or shader overlay that makes any base material look ice-coated (could use a detail normal of frost, a translucent white fresnel, etc.). We'll apply it on top of metal, wood, etc. when needed. - **WOOD_DAMP**: For any wooden interior parts (crabber wheelhouse might have wood panels) – with salt stains. - **ELECTRONIC_SCREEN**: Emissive screens for radar, etc., with slight bloom. Needs state switching (on/off, perhaps flicker). - **FIRE & SMOKE**: Particle materials for flames (additive glow, heat distortion) and smoke (alpha blended gray/black, possibly lit by environment for night). - **OIL_SLICK**: Oily water material for engine bilge or spill – reflective with rainbow sheen, dangerous slip. - **BLOOD_WATER** (we might have fish blood on factory deck, but probably skip graphic content – keep it clean or minimal). - **FABRIC_UPHOLSTERY**: For interior (mess seating), with mildew/wear maybe. - **PLASTIC_CASE**: E.g., med kits, fuse boxes – with logos, high contrast text. - **DECAL_LABELS**: Various signage: "Watertight Door – Keep Closed", draft marks on hull, bridge instrument labels, etc. We include high-contrast, large font for VR readability.

VFX Systems List:

We identify needed VFX and dynamic systems beyond static assets: - **Storm weather systems:** - Rain spray particle emitters (Level 1 heavy rain angled, Level 2 rain+fog, Level 3 snow blizzard with moving emitter attached to player for consistency). - Wind mist (spindrift): Particle systems emitting from wave crests or bow in heavy wind. - Lightning: Light flash + branching bolt mesh (from sky to water) triggered occasionally, with thunder sound sync (we manage distance delays). - **Green water volumes:** Use fluid simulation or pre-modeled mesh waves that spawn on deck and flow. Possibly use GPU particles or flow maps to have water ooze. Specifically, for each deck we might have a few predefined “wave wash” meshes that roll across with collision. - **Foam decals:** As said, applied after waves – fade out over time. - **Wet lens / camera droplets:** A post-process or overlay. We will create an animated normal map of water on “camera” and an occlusion effect. Also a frost version for freezing. - **Fire & smoke:** Fire likely in engine or factory – flame particles (with light) and smoke that collides with ceilings. We’ll tie smoke to ventilation (e.g., smoke fills a room unless vent fans on). - **Electrical sparks:** Emitters at broken panel or mast, sporadic bursts with light. - **Steam leaks:** White steam from pipes (e.g., if a pipe ruptures in engine). - **Interactive water in bilges:** Possibly a planar fluid simulation or just particles representing sloshing water on floor. It should move with ship physics (maybe using flow maps triggered by tilt). - **Ice forming:** We might cheat by swapping models with iced versions gradually. But a VFX approach: have a shader that grows ice (via world position mask and time). Simpler: a particle effect of freezing (white shimmer) at edges when icing event occurs. - **Crew breath fog:** Small particle from NPC mouth in cold (level 3). - **Alarm lights:** Flashing red rotating beacons for general alarm, small strobe for specific (like bilge alarm light blinking). - **UI sonar ping:** Visible wave on sonar screen plus an audible ping (so a sound VFX). - **Wet spray on deck:** Ongoing tiny splashes around, and drips from railings (mesh or particle dripping at intervals). - **Explosion/Water impact big:** If something explodes (fuel ignites) or heavy ice hit – a combined particle: flash + debris + water spray.

All VFX will be optimized for VR (no super heavy smoke that drops framerate, we’ll use sprite sheets etc.). Also we ensure they are comfortable – e.g., particle effects that attach to camera (like rain on lens) should be subtle to not cause focus issues.

Testing Checklist (VR Readability & Performance):

We will rigorously test: - **Legibility:** All instrument text in VR at default resolution – ensure radar blips, gauge numbers, labels can be read at a glance. Adjust fonts, add glow or outlines as needed for contrast against dark backgrounds ¹⁰. For example, in dark bridge with red light, white text stands out; in bright outside, black on yellow for labels. - **Interaction during roll:** Use automated test harness to simulate ship rocking while a tester tries to press buttons, etc. Tune magnetism and input buffering. A QA will purposely do tasks in worst-case motion and ensure success is possible. - **Navigation in darkness:** Test with minimal lighting – can players find doorways, ladders? We add luminous strips on floors/walls (common on ships) if needed. Also the player’s own headlamp or handheld flashlight item will be given in high difficulty – ensure its light works properly and is comfortable (not too narrow causing nausea, etc.). We test that players can orient by the emergency lights if main power off. - **Comfort at extremes:** Have sensitive VR users test each motion preset. Adjust Sea Legs Mode if majority still uncomfortable at Medium – maybe make Medium a bit gentler. Use the University of Minnesota VR sickness guidelines (like focusing horizon trick which we did ²⁵) as reference. - **Grab mechanics:** Test grabbing items when both the item and player are moving. E.g., a floating crate in flooding water while ship rolls – can player reliably grab it? We’ll refine collision and maybe slow relative motion in such scenario to allow catch. - **Tool usage in darkness or chaos:** E.g., using fire extinguisher with flashing lights and smoke – ensure particle transparency doesn’t hide important visuals and frame rate stays high. - **Audio balance:** In VR, too loud can be uncomfortable physically – we check that even at storm peaks, the audio stays below discomfort threshold (dB wise). And that crucial cues (alarms,

NPC voice) are discernible. Possibly implement dynamic range compression to duck background in presence of voice. - **Frame rate & performance budgets:** Each level tested on target hardware (likely PC with VR, possibly console VR if targeted). We must keep 90fps. We'll use LODs aggressively on far objects (though ship levels are relatively constrained space). Use fixed foveated rendering if available to reduce peripheral cost (fits with vignette concept). - **Physics stress:** Simulate worst-case scenario with many physics objects (level 3 with crates, barrels moving, ragdoll NPC if someone falls) and ensure stable performance and no weird physics explosion (like objects jitter due to conflict). - **Network (if any MP):** Game is mostly single-player but if co-op considered, test sync of physics motion – likely out-of-scope for now. - **Edge cases:** Player doing something odd like standing on railing during big wave – ensure not launched out of world (we likely have invisible colliders or reset logic to keep them in bounds if they manage to get “thrown”). Also if player sticks head through wall (VR typical issue), we fade screen or prevent to avoid motion conflict (we have Head in Geometry check as per AC example ³²). - **Dark skin vs bright UI:** Check that UI elements (like subtitles or any overlay) have proper contrast in both dark night and bright snow backgrounds. Might need drop shadows on text. - **Locomotion sickness:** Evaluate if teleporting while ship moves is disorienting. If so, consider adding small tween or using “world teleport” which moves reference frame. We'll iterate to find least jarring method. - **User fatigue:** The physical motions of bracing, moving in VR – ensure tasks not too physically demanding. E.g., requiring crouch for long time or hold arms up constantly could tire players quickly. We design tasks in bursts (lots of variety) to use different motions. Also implement a “crouch toggle” for accessibility so players who can't squat IRL can simulate it via button (with smaller vignette to mimic lower stance).

After internal QA passes, we'll also run a beta with experienced VR users to see if any comfort issues remain in extended play (levels can last 30–60 minutes, which is long in VR; we might consider a mid-level pause option, diegetically perhaps when reaching a lull or safe mode, an option appears to take a break).

Finally, on performance, keep in mind the worst case: Level 3 with heavy particles. If needed, we'll scale particle counts down or reduce concurrent events (no need to have fire, smoke, snow, foam all full-blast same frame).

Build Order (Prototyping Plan):

To efficiently achieve this ambitious project, we propose the following build sequence, focusing on core mechanics first and gradually layering complexity:

1. **Core Ship Motion & VR Comfort Prototype:** *(First, 2–4 weeks)* Build a simple test scene: a flat platform (deck) with a horizon and some reference objects. Implement the ship motion system (sway, pitch) and Sea Legs presets. Test VR comfort thoroughly at this stage, adjusting stabilization, horizon aid ²⁸. Prototype the handhold bracing mechanic (e.g., grabbing a pole reduces camera motion). This ensures our foundational movement will work for all later content. **(Milestone: A VR demo where player can stand on a moving deck comfortably for 10 minutes.)**
2. **Interaction & Physics Prototype:** *(Next 4–6 weeks)* In the same testbed or a basic ship interior, implement grab mechanics, object physics under motion, and a couple of representative tasks. For example, prototype Task 9 (clip to safety line) and Task 68 (deploy pump). Use simple shapes (no art) but get the interaction flow and cues working (sound of clip, pump turning on, etc.). Also prototype one **water on deck** event with a placeholder particle. **(Milestone: Player can pick up an item, secure it, and see a result on a moving platform.)**

3. **Level 1 Blockout & Systems:** Build the F/V Seaward environment in greybox (approximate dimensions of deck, cabin, engine). Integrate the previously prototyped systems into it. Script a basic version of Level 1 gameplay loop: e.g., a wave hits, crate slides, player lashes it, etc., through to driving towards shore. Focus on getting the timing and triggers right for events. Minimal or no NPC at this point (maybe text or simple cues as placeholder). **(Milestone: Playable Level 1 in greybox – all main mechanics working though visuals rough.)**
4. **Art Pass Level 1 & Polish Mechanics:** While artists produce the actual crab boat model and assets, programmers refine tasks feedback (lights, alarms) and fix any issues from greybox testing (e.g., maybe the pot stacking needed adjustments). Integrate art assets as they come (deck props, etc.) into the level. Conduct thorough testing on Level 1's comfort and fun factor. **(Milestone: Level 1 Beta – fully arted environment, most interactions functional, ready for fine-tune.)**
5. **Level 2 Blockout & New Mechanics:** In parallel to finishing Level 1 art, designers create the *North Star* layout in greybox. Identify new interactions not in Level 1 (e.g., the longline hauling, radar usage). Prototype those: for radar, perhaps a separate sim where an object moves and radar picks it up, and player fiddles with controls. This stage also includes implementing NPC crew behavior framework (so multiple things can happen at once with crew assisting). **(Milestone: Level 2 core mechanics prototyped – radar console functional, longline anchor/cut system working, etc.)**
6. **Dynamic Event Systems:** Develop underlying systems for dynamic weather change, alarm triggers, and fail states that all levels will use. E.g., a generic flooding system that can be applied to any compartment and tied to an alarm and pump mechanics. Test this in a dummy scene (flood a room and pump it out). This will later plug into Level 2 and 3 easily. **(Milestone: Engine can handle multi-threaded events like flooding+fire without script conflict.)**
7. **Level 2 Integration & Art:** Bring the mechanics into the Level 2 environment. Add longliner-specific art as it's created (stern shelter, line equipment, bridge consoles). Start implementing the narrative/scripted sequence – e.g., fog collision scare, etc., using our event system. Because Level 2 is more complex, iterate frequently with QA to ensure it's not overwhelming (maybe cut or simplify events if needed). **(Milestone: Level 2 Alpha – playable from start to finish in greybox+some art, though NPCs may be temp and some polish lacking.)**
8. **Level 3 Blockout & Performance Prep:** Begin *Polaris* layout in greybox with basic geometry for key areas. This level is asset-heavy, so concurrently, tech artists set up LODs, occlusion culling regions, etc., to prepare for big environments. Identify potentially expensive VFX (blizzard, etc.) and prototype lightweight versions (maybe volumetric snow via particle imposters). Also, implement advanced systems like engine room fire suppression sequence in a test (since it's new and critical). **(Milestone: Level 3 layout established, performance strategy in place, no show-stoppers predicted.)**
9. **Art and Content Production Sprint:** At this point, a lot of asset creation is parallel. Artists complete remaining models (especially Level 3's many machines). Animators work on NPC animations (like bracing, tying knots). Sound designers start curating storm sounds, alarm sounds, etc. We integrate assets into Level 2 (Beta stage now) and start populating Level 3 greyscale environment with first art passes (maybe reusing some Level 2 assets where possible – e.g., reusing the generator model in Level 3 multiple times, with material tweaks). **(Milestone: Level 1 polished, Level 2 Beta with art, Level 3 Alpha greybox.)**

10. **Level 3 Implementation & Iteration:** Time to bring Level 3 to life. Program the multiple simultaneous events using our event manager. Likely need iterative tuning to make it playable (we might start with fewer events then add if it's too easy). Integrate NPC logic heavily here (crew must act or else player truly can't do everything). Ensure all the style bible elements (red bridge lights, etc.) are correct. Pay special attention to performance: profile often and optimize effects (e.g., possibly limit how many physics objects can move at once by using kinematic behavior during extreme tilt, etc.). **(Milestone: Level 3 Beta – fully scripted with placeholder or some final art, needs polish but feature-complete.)**

11. **Polish & Optimization Phase:** Now polish across all levels. This includes:

- Visual polish: better textures, decals for grime, better lighting (perhaps baked lighting for interior).
- Audio polish: layering in all sounds, 3D mixing, ensuring thunder matches lightning visually.
- NPC polish: voice lines recorded and implemented, NPC animations synced to events (like crew actually grabbing rail when brace call).
- UI/UX: finalize any menu or comfort toggles UI visuals (maybe a start-up menu where they choose comfort preset, or an in-game wrist menu).
- Performance optimization: final LOD tuning, particle optimization, possibly simplifying geometry not in view (rooms behind closed doors can be culled).
- Bug fixing: e.g., fixing any glitch where items fall through ship when it moves, or alarms not resetting, etc.

12. **Final Testing & Balancing:** Run full playthroughs with fresh eyes testers. Balance difficulty (e.g., adjust timers on fail conditions so they're fair). Possibly add tutorial tips for critical actions if many testers miss them (like a subtle highlight on that safety latch players keep forgetting). Ensure each level hits intended difficulty curve: Level 1 easy intro, Level 2 challenging, Level 3 very intense but doable with knowledge. Incorporate any feedback to smooth rough edges (both in comfort and in gameplay clarity).

13. **Gold Master & One-Page Build Order Plan Review:** The above essentially is the build order. Each step builds on previous, tackling risk early (VR motion was biggest risk, so did first). We would finalize documentation so future devs can maintain these systems easily (like a Storm Event Editor tool for designers to script sequences without coding – handy if expansions or tweaks come).

One-Page Build Order Plan (for quick reference): 1. **Motion & Comfort Prototype** – Get ship movement and anti-nausea features working in VR. 2. **Interaction Prototype** – Ensure grabbing, using items under motion is solid (in a test scene). 3. **Level 1 Greybox** – Implement small boat scenario with basic tasks. 4. **Level 1 Art & Polish** – Finish crab boat environment and mechanics. 5. **Level 2 Greybox + New Systems** – Build longliner layout and introduce radar, multi-task events. 6. **Global Event System** – Create systems for alarms, flooding, etc., to reuse. 7. **Level 2 Art & Integration** – Complete environment and scenario for mid boat. 8. **Level 3 Greybox & Performance** – Layout factory trawler, plan for heavy load. 9. **Asset Production Marathon** – All remaining assets (machines, props, NPC models) created. 10. **Level 3 Mechanics & Partial Art** – Implement big ship events, integrate critical assets (can reuse earlier ones scaled up). 11. **All Levels Beta** – Have each level fully playable with temp or final assets, begin cross-level tuning (make sure progression of learning works). 12. **Polish & Optimize** – Graphics, audio, NPC behaviors, UI, performance to final quality. 13. **Final Testing & Debug** – External VR testers to ensure comfort and enjoyment, fix last

bugs. 14. **Release Prep** – VR platform compliance, accessibility final pass (subtitles on voices if needed, colorblind checks on indicators, etc.).

By following this order, we mitigate risks early (VR sickness, core mechanics) and avoid crunch on the most complex level by prepping systems beforehand. The result will be a high-quality, immersive and *comfortable* storm survival experience across all three difficulty tiers.

This concludes the design package. With meticulous planning and iterative testing, “Deadliest Catch: VR Storm Survival” will deliver an intense yet player-friendly simulation of riding out nature’s fury on three very different fishing vessels. Safe (virtual) sailing!

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