To instantiate the safety case pattern for the Generic Patient-Controlled Analgesia (GPCA) system using the provided predicates and domain information, we must fill placeholders based on specific system knowledge. Here's the instantiation and hierarchical tree representation using a GPCA system where operational hazards involve "Overinfusion" and "Underinfusion":

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Goal (G1, Operational safety is verified in GPCA)

Strategy (S1, Argument over the satisfaction of all specs over GPCA) - Uninstantiated

Goal (G2, All operational hazards are mitigated)

Strategy (S3, Argument over operational hazards)

Goal (G3, Underinfusion is mitigated)

Strategy (S4, Argument over the applied scenarios of Underinfusion)

Goal (G4, Underinfusion is mitigated under scenario of low patient response)

Strategy (S5, Argument over all specs related to low patient response scenario)

Goal (G5, Flow rate sensor is equipped for low patient response scenario)

Strategy (S6, Argument the appropriateness of Flow rate sensor over properties)

Goal (G6, Flow rate less than 90% of the programmed rate is appropriate for Flow rate sensor)

Strategy (S7, Argument over the source of the Flow rate definition)

Goal (G7, FDA standard is appropriate and trustworthy)

Solution (Sn1, FDA standard certification)

Goal (G8, Flow rate definition is sufficient)

Solution (Sn2, Expert opinion and previous studies)

Goal (G3, Overinfusion is mitigated)

Strategy (S4, Argument over the applied scenarios of Overinfusion)

Goal (G4, Overinfusion is mitigated under scenario of high dosage error)

Strategy (S5, Argument over all specs related to high dosage error scenario)

Goal (G5, Dose limit exceeded alarm for high dosage error scenario)

Strategy (S6, Argument the appropriateness of Dose limit exceeded alarm over properties)

Goal (G6, Dose limit is appropriate for Dose limit exceeded alarm)

Strategy (S7, Argument over the source of the Dose limit definition)

Goal (G7, Manufacturer specifications are appropriate and trustworthy)

Solution (Sn1, Manufacturer quality assurance)

Goal (G8, Dose limit definition is sufficient)

Solution (Sn2, Clinical trial evidence)

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\*\*Explanation:\*\*

- \*\*G1\*\*: The top-level goal, claiming the verification of operational safety for the GPCA system.

- \*\*G2\*\*: Addresses all operational hazards; here specifically instantiated for "Underinfusion" and "Overinfusion."

- \*\*G3, G4\*\*: Addresses specific scenarios and mitigation thereof for both hazards.

- \*\*G5, G6\*\*: Specify how technical aspects ("flow rate sensor", "Dose limit exceeded alarm") fit the spec.

- \*\*G7, G8\*\*: Validate sources and sufficiency of definitions, supported by evidence or Solutions (Sn1 and Sn2).

- \*\*Strategies (S1 to S7)\*\*: Structured arguments breaking down each requirement and linking to technical evidence or justification.

- \*\*Contexts\*\* (e.g., C1-C6) are implied based on the placeholder instantiation not explicitly modeled in the hierarchy but integral for understanding relationships and definitions.

\*\*Use of Uninstatiated and Developed Predicates:\*\*

- S1 and S2 are marked as Uninstatiated due to lack of developed strategies or corresponding supportive evidence set forth in the pattern and domain data.

\*\*Multiplicity Representations:\*\*

- Multiple hazards and scenarios are managed using Multiplicity predicates, demonstrating the approach for various instances depending on operational reality and specification details.

This structure thus integrates the domain-specific knowledge into the given safety case pattern using Goal Structuring Notation (GSN).