To instantiate this safety case pattern for the GPCA system, we will replace all placeholders with specific system information provided in the domain information. Using Goal Structuring Notation (GSN) in a hierarchical tree format, we create a visual representation of the assurance case as follows:

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Goal (G1, "Operational safety is verified in GPCA system")

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

- Context (C1, "All specs are given by FDA standard, Expertise opinion, Previous knowledge")

(Undeveloped)

- Goal (G2, "All operational hazards are mitigated")

- Strategy (S3, "Argument over operational hazards")

- Context (C2, "Operational hazards are overinfusion and underinfusion")

- Goal (G3, "Overinfusion is mitigated")

- Strategy (S4, "Argument over the applied scenarios of overinfusion")

- Context (C3, "All related scenarios for operational hazards")

- Goal (G4, "Overinfusion is mitigated under default scenario")

- Strategy (S5, "Argument over all specs related to default scenario")

- Context (C4, "All related specs given by 'Flow rate sensor equipped'")

- Goal (G5, "Flow rate sensor equipped spec is appropriate for default scenario")

- Strategy (S6, "Argument the appropriateness of specs over properties")

- Context (C5, "Properties are given by 'Flow rate less than 90% of programmed rate'")

- Goal (G6, "Flow rate less than 90% of programmed rate property is appropriate for Flow rate sensor equipped")

- Strategy (S7, "Argument over the source of the property definition")

- Context (C6, "Source is given by FDA standards")

- Goal (G7, "FDA standard is appropriate and trustworthy")

- Solution (Sn1, "source")

- Goal (G8, "Flow rate less than 90% of programmed rate property definition is sufficient")

- Solution (Sn2, "property")

```

### Explanation:

- \*\*Goals and Strategies\*\*: This structure starts at the top-level Goal (G1) defining the overarching aim to verify operational safety in the GPCA system, supported by Strategy (S1), which remains undeveloped at this point, indicating further specification is needed to fully substantiate it. As the assurance argument develops, further goals such as G2 (mitigation of hazards) add granularity to the safety assurance argument.

- \*\*Contexts\*\*: These provide system-specific or environmental information that bounds or defines the scope of the argument. For instance, C1 provides sources of specifications, while C2 details the specific hazards faced.

- \*\*Solutions\*\*: Specific artifacts or outputs like regulatory standards or property specifications that support claims made in goals G7 and G8.

- \*\*Multiplicity and Placeholder Replacement\*\*: Through the instantiation process, placeholders like `{system}`, `{operational hazard}`, and `{scenario}` are replaced with specific information from the GPCA system's domain. Multiplicity decorators indicate where multiple scenarios or properties might interact with the system or specifications to be considered for each applicable relationship.

This safety case aims to thoroughly argue the mitigation of critical operational hazards through structured mitigation strategies, goal-specific substantiation via evidence (solutions), and contextual information, reflecting the detailed planning for ensuring patient safety.