To instantiate the given safety case pattern for a Generic Patient Controlled Analgesia (GPCA) system to a specific safety case, I will replace the placeholders with concrete, system-specific information about a GPCA system. We'll also populate the context, solutions, assumptions, and justification elements based on hypothetical data to describe the system comprehensively. Here is the instantiated safety case represented in a hierarchical tree format:

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

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

- Context (C1, "All specs are given by GPCA system specifications")

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

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

- Context (C2, "Operational hazards are identified throughout the GPCA system")

- Goal (G3, "PCA by proxy hazard is mitigated")

- Strategy (S4, "Argument over the applied scenarios of PCA by proxy")

- Context (C3, "Scenarios involving PCA by proxy are reviewed")

- Goal (G4, "PCA by proxy is mitigated under high patient load scenario")

- Strategy (S5, "Argument over all specs related to high patient load")

- Context (C4, "Specs related to high patient load are defined for PCA operation")

- Goal (G5, "Alarm system spec is appropriate for high patient load scenario")

- Strategy (S6, "Argument the appropriateness of alarm system spec over properties")

- Context (C5, "Properties related to GPCA alarm system are defined")

- Goal (G6, "Visibility property is appropriate for the alarm system spec")

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

- Context (C6, "Source of property definitions is the GPCA design document")

- Goal (G7, "GPCA design document source is appropriate and trustworthy")

- Solution (Sn1, "Verified source document from GPCA manufacturer")

- Goal (G8, "Visibility property definition is sufficient")

- Solution (Sn2, "Research paper on visibility standards in medical devices")

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### Explanation of Instantiation Process

1. \*\*Replacing Placeholders\*\*:

- `{system}` was instantiated to "GPCA system".

- `{operational hazard}` was instantiated with specific hazards such as "PCA by proxy".

- `{scenario}` was specified as "high patient load".

- `{spec}` was replaced by "alarm system spec".

- `{property}` was made specific as "visibility property".

- `{Source}` was defined as "GPCA design document".

2. \*\*Adding Context and Justifications\*\*:

- Context elements (C1, C2, ... C6) offer detailed descriptors of the areas of focus like system specifications, identified operational hazards, scenarios involving specific hazards, etc.

- Solutions (Sn1, Sn2) provide concrete evidence supporting the trustworthiness and sufficiency of the source specifications of properties.

3. \*\*Reflecting Tree Structure\*\*:

- Each goal can have nested goals under a strategy which further develops the argument. Strategies justify the relationship between parent goals and their nested goals.

- Elements like 'Underdeveloped' and placeholders are removed or resolved into actual system details per the instantiation process requirement.

This instantiated safety case uses specific GPCA system scenarios to articulate how the system ensures operational safety by focusing on mitigating tangible, identified risks under specified scenarios. Each strategy and its supporting goal details how the system's specifications contribute to overall safety.