To instantiate the given safety case pattern for a Generic Patient-Controlled Analgesia (GPCA) system, we will specify placeholders with appropriate real-world values and develop the structure into a concrete safety case. This explanation is structured hierarchically using the specified format.

### Safety Case Derived from the Pattern

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@Assurance\_case

- G1: Operational safety is verified in the GPCA system

|- S1: Argument over the satisfaction of all specs over the GPCA system

| |- C1: All specs are given by operating requirements of GPCA

|- G2: All operational hazards are mitigated

| |- S3: Argument over operational hazards

| | |- C2: Operational hazards are given by failure mode and effect analysis of GPCA

| | |- G3: Electrical failure is mitigated

| | | |- S4: Argument over the applied scenarios of electrical failure

| | | | |- C3: All related scenarios are given by electrical risk scenarios in GPCA

| | | | |- G4: Electrical failure is mitigated under battery malfunction scenario

| | | | | |- S5: Argument over all specs related to battery malfunction scenario

| | | | | |- C4: All related specs are given by battery safety requirements of GPCA

| | | | | |- G5: Battery specification is appropriate for battery malfunction scenario

| | | | | |- S6: Argument over the appropriateness of battery specs over properties

| | | | | |- C5: Properties are given by battery design specifications of GPCA

| | | | | |- G6: Heat resistance property is appropriate for battery specification

| | | | | |- S7: Argument over the source of the heat resistance property definition

| | | | | |- C6: Source is given by battery manufacturer standards

| | | | | |- G7: Battery manufacturer is appropriate and trustworthy

| | | | | | |- Sn1: Certification from battery safety authority

| | | | | |- G8: Heat resistance property definition is sufficient

| | | | | |- Sn2: Engineering analysis of battery heat resistance

|- S2: Argument over reliability in all suitable levels of GPCA system

@End\_Assurance\_case

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\*\*Explanation\*\*:

- \*\*G1\*\* asserts the operational safety of the GPCA system, supported by arguments regarding specifications (`S1`) and mitigation of hazards (`S3`).

- \*\*G2\*\*'s focus is on hazard mitigation, branching into specific hazards (`G3`), such as electrical failures.

- Within \*\*G3\*\*, further exploration in context (`C3`) and specific scenarios (`G4`) is conducted, detailing how the battery malfunction scenario is handled (`G4-G8`).

- Cascading goals under \*\*G4\*\* specifically focus on the applicability and sufficiency of specs and properties regarding battery malfunction, ensuring that standards and sources are understandably identified and verified through solutions (`Sn1, Sn2`).

Each goal and strategy is tied to its context to align the detailed safety analysis with the overall operational integrity of the GPCA system. This instantiation leverages real-world parameters and established standards, grounding the safety case in actionable, documented practices and specifications.