Balloncraft

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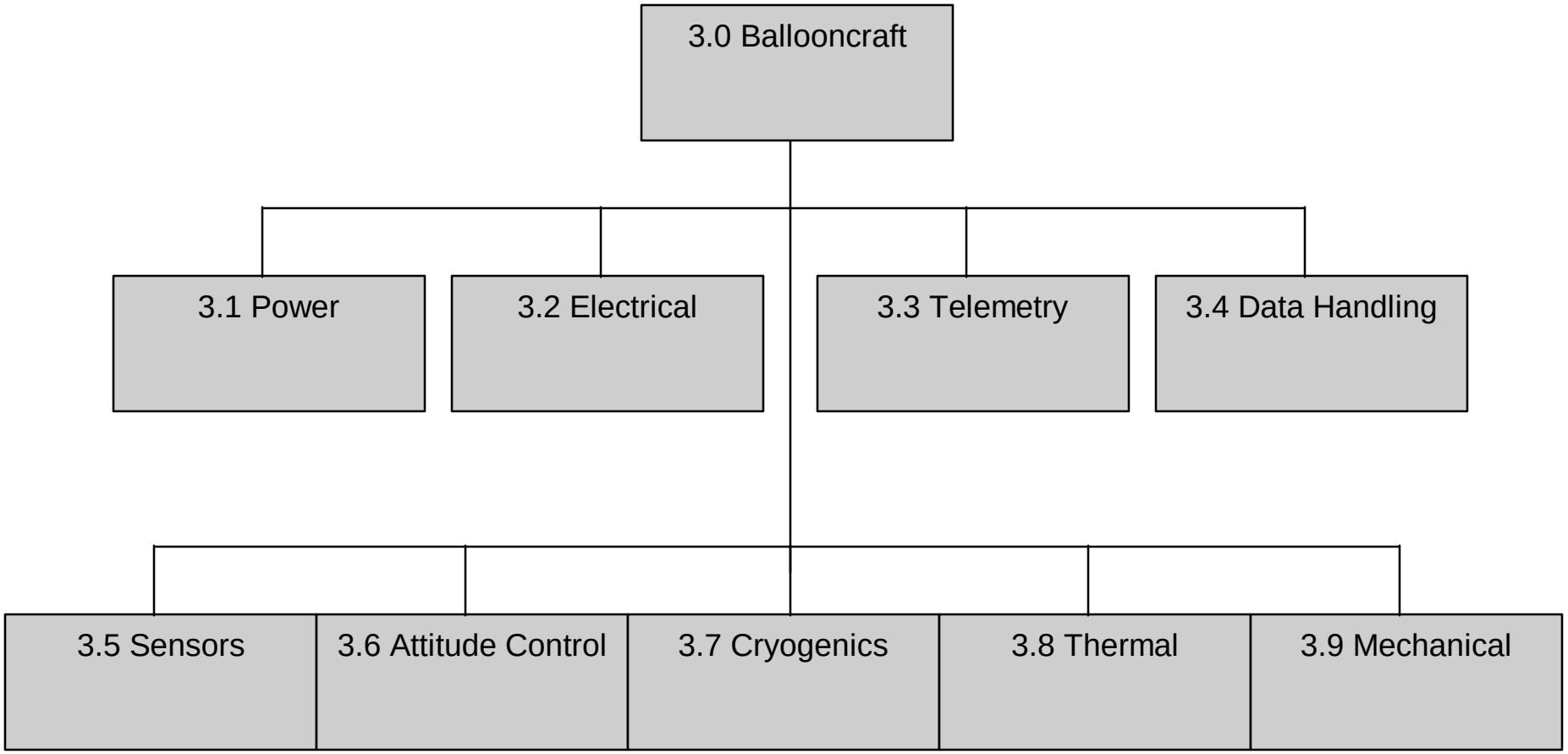
Balloncraft
Product Breakdown Structure

ULDB

WALLOPS FLIGHT FACILITY



ULDB
3.1 Power Systems

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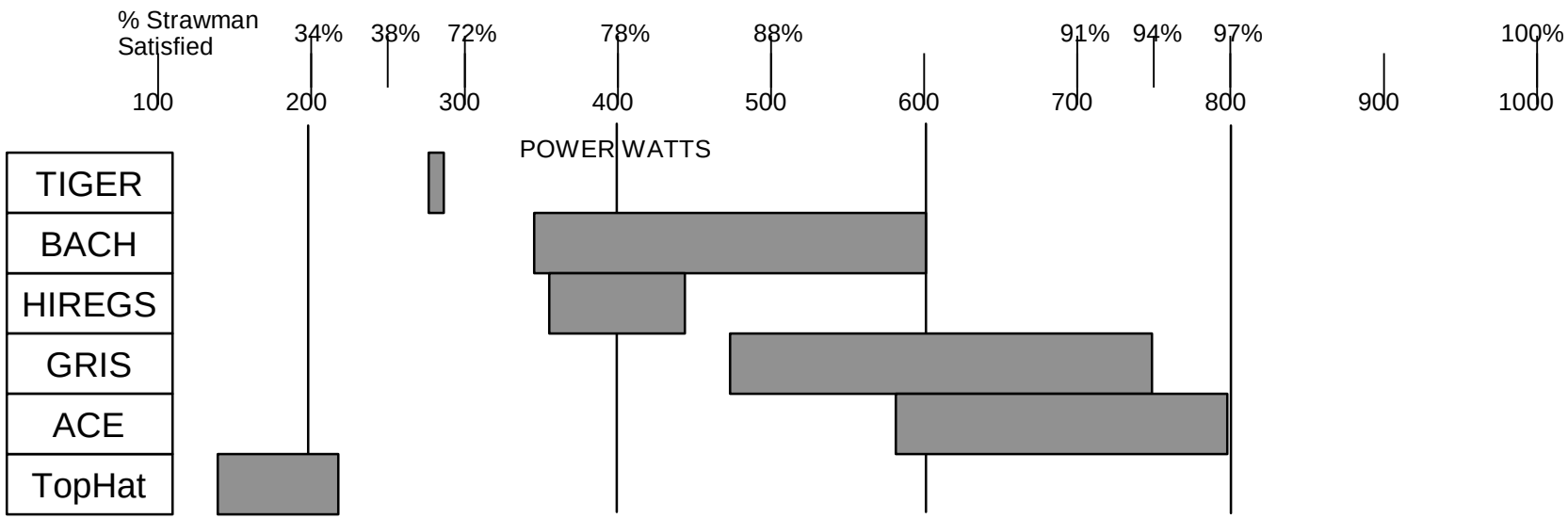
- **Science User Requirements**



- **ULDB Power System Functional Requirements**
  - **Provide scalable DC power to experiment and support systems for Flight Profiles which include day/night cycles**

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3.1 Power Systems

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- **Target Design-to Requirements**
  - **Scalable, mission specific system, maximum 1000 watts (800 W for instrument, 200 W for support systems) based on 12 hour day/12 hour night, 28 VDC +/- 4V**
- **ULDB Subsystem Manager - Herb Morgan**
- **Leading Design Concepts**
  - **Advanced Solar Power Systems**
    - » **Deployable sun tracking panels**
    - » **Higher power density rechargeable batteries**
- **Other Technology Research Areas**
    - » **Fuel Cells**
    - » **Flywheel systems**
    - » **Stirling engine systems - SBIR**

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3.2 Electrical Systems

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- **Functional Requirements (user)**
  - **Power Distribution Relays (science, mission)**
  - **Pyrotechnics for Terminate, Parachute cutaway (mission) and Deployment (science, mission)**
- **ULDB Subsystem Manager - Chuck Williams**
- **Leading Design Concepts**
  - **Power Distribution**
    - » **LDB system with upgraded relays**
  - **Pyrotechnics**
    - » **Current Holex systems work well**
    - » **More severe static buildup and/or flight environment may require hardened cutters or laser actuators**

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3.3 Telemetry

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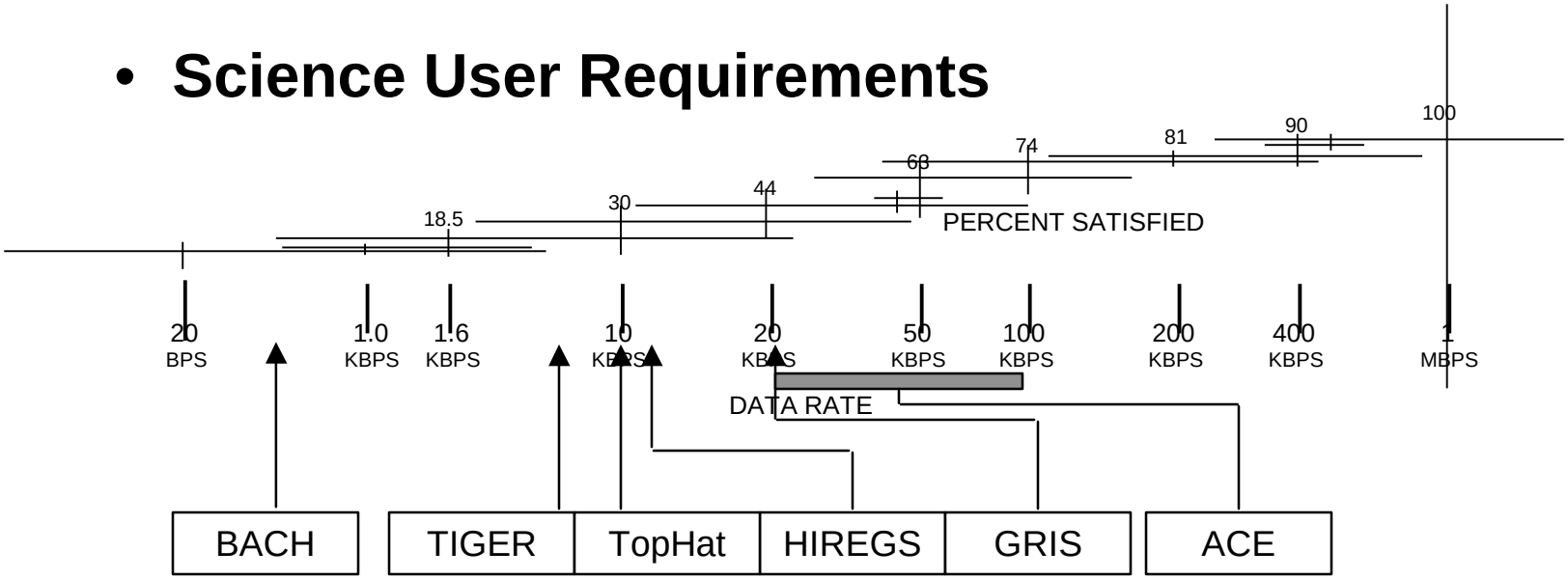
- **Science User Requirements**



- **Functional Requirements**
  - **"Global" and line of sight downlink transmission of Instrument, Engineering and Operations data**
  - **"Global" and line of sight uplink transmission of Instrument, Engineering and Operations Commands**

ULDB
3.3 Telemetry

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- **Target Design-to Requirements**
  - **50kbps average downlink Global, >50kbps line of sight**
  - **100 bps average uplink, line of sight**
  - **100 bps, 4 x 10 minute periods/day, Global uplink**
- **ULDB Subsystem Manager - Bruce Smith**
- **Leading Design Concepts**
  - **Line of Sight**
    - » **Existing systems work well, upgrade to S-Band**
  - **Near Global Systems**
    - » **TDRSS with pointed antenna**
    - » **Iridium (2400 bps) and GlobalStar (7200 bps)**

ULDB
3.4 Data Handling & Processing

- **Functional Requirements**
  - **3.4.1 Data Acquisition - provide a distributed system that acquires data from sensors, subsystems, instruments**
  - **3.4.2 Data Processing - format data for transmission and storage**
  - **3.4.3 Data Archive - store instrument and operations data onboard**
  - **3.4.4 Command Handling - decode and execute commands**
  - **3.4.5 Flight Software**

ULDB
3.4 Data Handling & Processing

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- **ULDB Subsystem Managers**
  - 3.4.1, .3, .4 - Linda Thompson
  - 3.4.2 - Henry Hart
  - 3.4.5 - Roger Mason
- **Leading Design Concepts**
  - 3.4.1 Acquisition - 1773 and 232 interface busses, COTS or LDB based acquisition decks
  - 3.4.2 Processing - PC104 bus COTS Single Board Computer
  - 3.4.3 Archive - sealed, ruggedized hard disk drive(s)
  - 3.4.4 Command - flight computer process with hardware based backup command decoder
  - 3.4.5 Software - QNX RTOPS, C or C++ language, LDB based

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3.5 Sensors

- **Functional Requirements**
  - **Altitude, Ground Track, Housekeeping, other operations and engineering driven measurements**
  - **Performance Requirements TBD**
- **ULDB Subsystem Manager - Barton Bull**
- **Leading Design Concepts**
  - **Altitude - Pressure transducers and GPS**
  - **Ground Track - GPS**
  - **Housekeeping - COTS temperature, voltage, current**

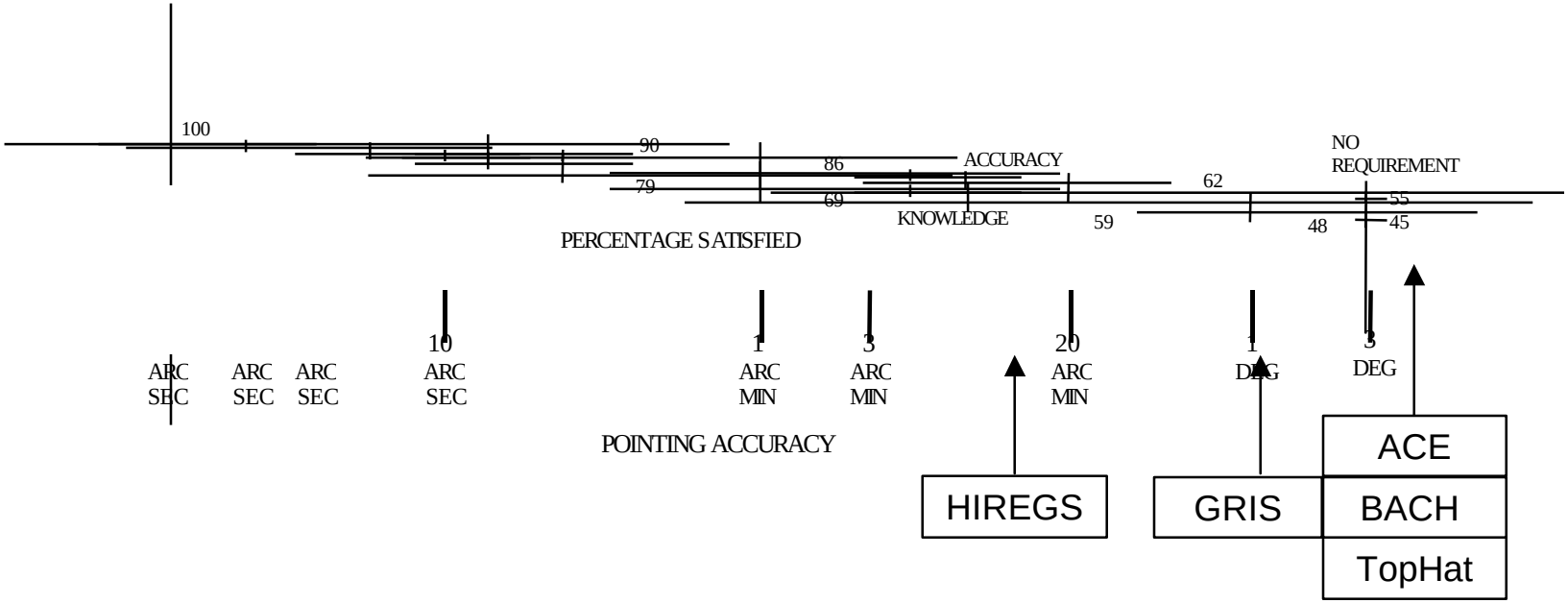
ULDB
3.6 Attitude Control

- **Breakdown Structure**
  - **3.6.1 Gondola Azimuth Pointing control and determination**
  - **3.6.2 Gondola Elevation Pointing control and determination**
    - » **no requirement**
  - **3.6.3 Subsystem Azimuth Pointing control and determination**
  - **3.6.4 Subsystem Elevation Pointing control and determination**
- **Subsystem Manager**
  - **Kenny Hall**

ULDB
3.6 Attitude Control

- **Science User Requirements**

Gondola Azimuth Control



Gondola Azimuth Determination

– **All Demo 2000 gondola azimuth determination requirements one degree or greater except ACE 0.04 degree, HIREGS 0.05 degree**

ULDB
3.6 Attitude Control

- **Functional Requirements**
  - **Provide Gondola Azimuth Control**
    - » **Support four Instrument pointing modes - spin, scan, point relative to sun, point relative to moon**
    - » **Support sun tracking mode for mission power system pointing**
- **Target Design-to Requirements**
  - **Support all modes**
    - » **rate accuracy 20 percent**
    - » **absolute pointing accuracy one degree (solar), ten degree (lunar)**
    - » **Azimuth determination of one degree**
- **Leading Design Concepts**
  - **Enhanced WFF/LDB pointer**
  - **Joint venture with science team with existing pointer**

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3.6 Attitude Control

- **Subsystem Pointing control and determination Functional Requirements**
  - **Instruments that are pointed separately from the gondola have unique requirements that a generic ULDB capability would not satisfy**
  - **Support subsystems such as pointed antennas and non-fixed solar panels will require Az and/or El pointing**
  - **Performance requirements TBD**
- **Leading Design Concepts**
  - **Processor controlled electric motor drives**
  - **Requires new development**

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3.7 Cryogenic Cooling

- **Demo 2000 instruments requirements**
  - **Four of Six have cooled instruments**
    - » **All four are considering Sunpower Cooler**
    - » **Two are providing additional cooling stage**
- **Target Design-to Requirement**
  - **Develop a mechanical cryogenic system capable of cooling more than one Watt of input load to <90K (40° C heat sink)**
- **ULDB Subsystem Manager - Bob Ray**
- **Leading Design Concepts**
  - **Sunpower Stirling Cycle Cryogenic Cooler**
  - **Ball and TRW also being characterized**

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3.8 Thermal

- **Functional Requirements (user)**
  - **Provide thermal control to maintain systems within temperature limits (science, mission)**
- **ULDB Subsystem Manager - Henry Cathey**
- **Leading Design Concepts**
  - **Passive Control Methods - louvers/shutters**
  - **Electronics on central heat exchange core**

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3.9 Mechanical Systems

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- **Functional Requirements (user)**
  - **Provide Gondola Structure (science, mission)**
  - **Deployment, Separation and electromechanical Systems (science, mission)**
  - **Mechanical support to other sub-systems (mission)**
- **ULDB Subsystem Manager - Bob Ray**
- **Leading Design Concepts**
  - **Inflatables, Foam for floatation**
  - **Structures - Graphite Epoxy, Tension, Aluminum/Foam**
  - **Thermal - Heat Pipes**

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- 3.0 Balloncraft
  - 3.1 Power
  - 3.2 Electrical
    - 3.2.1 Power Distribution
    - 3.2.2 Pyrotechnics
  - 3.3 Telemetry
    - 3.3.1 Global Downlink
    - 3.3.2 Global Uplink
    - 3.3.3 Line of sight D/L
    - 3.3.4 Line of sight U/L
  - 3.4 Data Handling
    - 3.4.1 Acquisition
    - 3.4.2 Processing
    - 3.4.3 Archive
    - 3.4.4 Command Handling
    - 3.4.5 Flight Software
  - 3.5 Sensors
    - 3.5.1 Altitude
    - 3.5.2 Ground Track
    - 3.5.3 Housekeeping
    - 3.5.4 Ops and Eng
  - 3.6 Attitude Control
    - 3.6.1 Gondola AZ
    - 3.6.2 Gondola EL
    - 3.6.3 Subsystem AZ
    - 3.6.4 Subsystem EL
  - 3.7 Cryogenics
  - 3.8 Thermal
    - 3.8.1 Analysis
    - 3.8.2 Control
  - 3.9 Mechanical
    - 3.9.1 Analysis
    - 3.9.2 Structures
    - 3.9.3 Mechanisms

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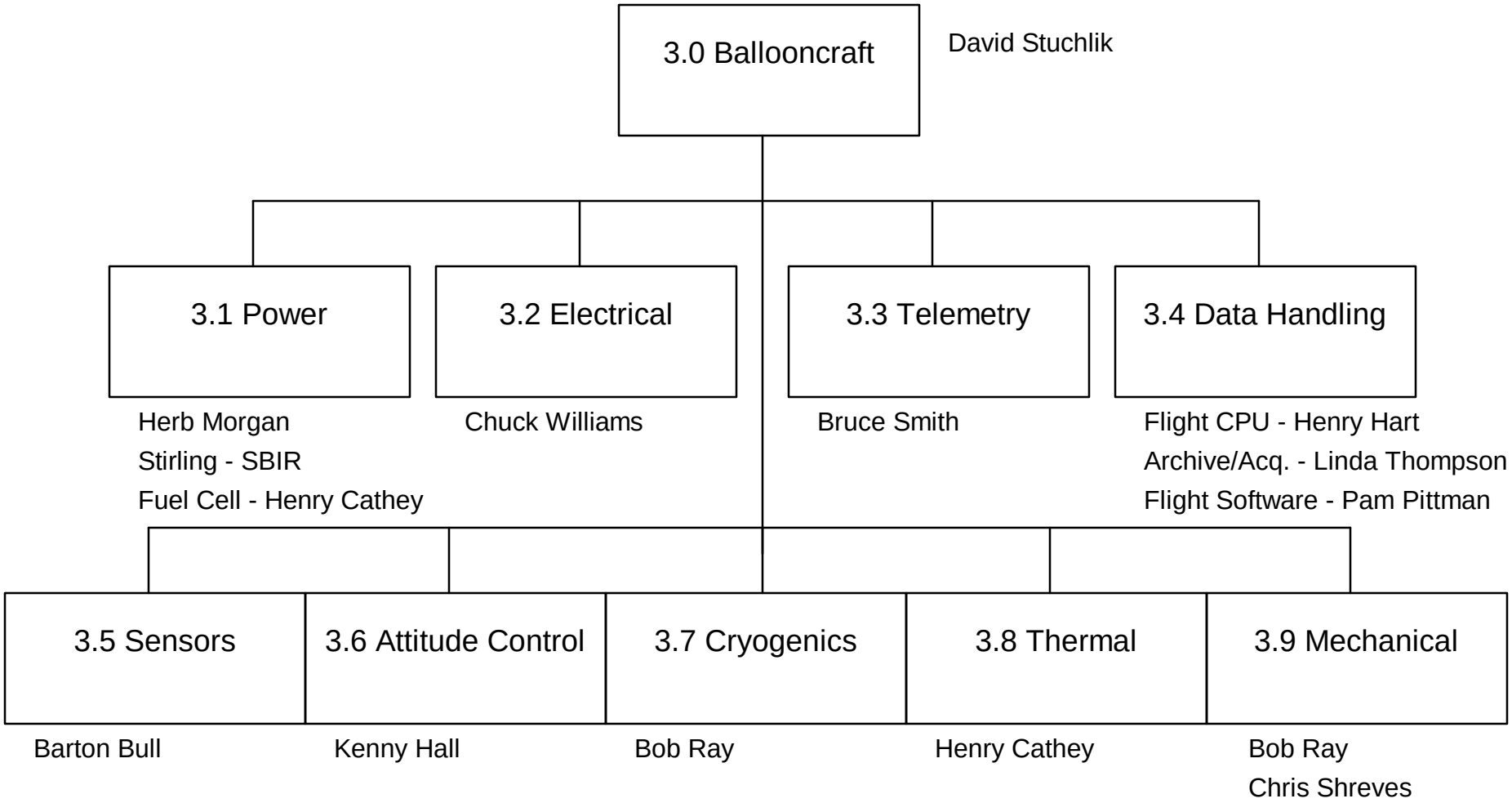
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