1. Vision Narrative:

a. Technology Description

Optimal operation and maintenance of the smart grid require knowledge of everything—external as well as internal—that could impact its reliability and performance. Situational awareness (SA) and health monitoring (HM) technology provides that knowledge using networks, databases, and data processing algorithms.

b. Current State of the Technology(ies)

The knowledge of state of the grid and its environment is spotty and is not fully integrated with all relevant data sources.

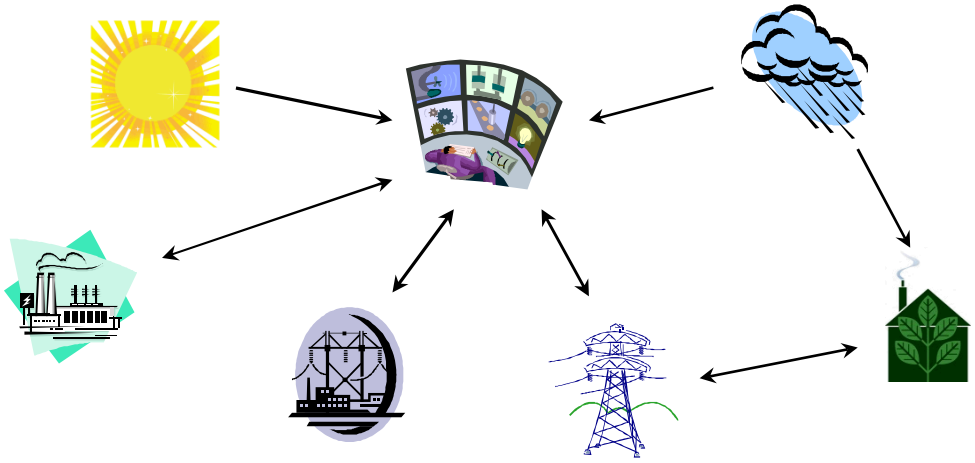
c. Anticipated Future State of the technology(ies)

Voltages, currents, phases, and temperatures will be available for all grid components with up to a 120 Hz sample rate. Certain special sensor data (vibration, electromagnetic fields, pressure, chemical, video, etc.) will also be available for select components. Data latency and history will vary as needed. The provenance and maintenance records of all components will be known. Data will be appropriately reduced and available to various stakeholders on a need-to-know basis. Operators will know normal loads a week to months in advance. Unusual loads can be reported by consumers as little as 1^{s} in advance. Neighborhood weather will be known a week in advance. Locations of weather events (microbursts, hail storms, lighting strikes) will be known 60^{s} to 1^{h} in advance. Intensity of geomagnetic storms will be known 5^{m} in advance while solar activity forecasts will be available hours to months in advance. The location of any faults will be known within half a cycle.

d. Concepts for Innovative applications of the technology(ies) within Smart Grid

Experimentally known state information could be used to improved estimates of current and future states. Strategic operations and business planning could be performed based on better information about external cycles. Tactical maintenance activities could be scheduled to prevent failures. Automatic generation and power flow control could be improved. Likely contingencies could be planned in advance. Parts of the grid could be isolated to shield against extensive damage from external events. Unexpected human activity could be flagged automatically.

e. Model describing the concept – behavioral and architectural



2. Tier 2 use cases that this Technology Vision applied to:

- **a. UC03, Bulk Power/Transmission Dynamic Operations**
- **b. UC04, Emergency Response & System Restoration**
- **c. UC05, Transient operations**
- **d. UC06, Asset Management**
- **e. UC12, Real time simulation based state estimation for normal conditions**
- **f. UC19, Island to island stable power flow control**
- **g. UC31, Congestion detection and isolation in case of overloads**
- **h. UC32, Power Flow Forecasting in Distribution Networks**
- **i. UC34, State Awareness**

3. Revolutionary or disruptive advancements in computer science key words:

- **a. Network communications**
- **b. Sensor networks**
- **c. User interfaces**
- **d. System integration and implementation**
- **e. Algorithms for data and knowledge management**
- **f. Information Storage and Retrieval**
- **g. Vision and Scene Understanding**
- **h. Physical security**

4. **Anticipated technology evolution and barriers to evolution:**

- **a. Assumptions**
  - i. High-bandwidth, low latency networks
  - ii. Large data storage and management systems
  - **iii.**
- **b. Sequence of Events**
  - i. (Just list)
  - **ii.**
  - **iii.**
- **c. Tech Challenges, Issues, and barriers**
  - i. Improved ground and space weather forecasts
  - ii. Stakeholder authentication
  - iii. Hardware costs
- **d. Areas that need research and development**
  - i. Component sensors
  - ii. Sensor data analysis
  - iii. Failure prediction
- **e. Training and education needed**
  - i. (Just list)
  - **ii.**
  - **iii.**
- **f. Standards Needed**

i. (Just list)

ii.

iii.

g. Other Needs

i. (Just list)

ii.